

CONTENTS

Empedocles on Colour and Colour Vision KATERINA IERODIAKONOU	1
Xenophon at his Most Socratic (<i>Memorabilia</i> 4. 2) DAVID M. JOHNSON	39
Socrates' Deliberative Authoritarianism ANTONY HATZISTAVROU	75
The Unity of Virtue in Plato's <i>Protagoras</i> BERND MANUWALD	115
Shame, Pleasure, and the Divided Soul JESSICA MOSS	137
Animadversions on Burnyeat's <i>Theaetetus</i> : On the Logic of the Exquisite Argument MICHAEL V. WEDIN	171
Authenticating Aristotle's <i>Protrepticus</i> D. S. HUTCHINSON & MONTE RANSOME JOHNSON	193
Aristotle on Why Plants Cannot Perceive DAMIAN MURPHY	295
Aristotelian Teleology LINDSAY JUDSON	341
On the Use of <i>Stoicheion</i> in the Sense of 'Element' TIMOTHY J. CROWLEY	367
<i>Index Locorum</i>	395

EMPEDOCLES ON COLOUR AND COLOUR VISION

KATERINA IERODIAKONOU

EMPEDOCLES is among the first ancient philosophers, if not the very first, not only to use colour terms as adjectives characterizing the way things present themselves to us, such as ‘white’ of white milk (31 B 33 DK: γάλα λευκόν), but also to refer to colours as items whose explanation forms a crucial part of a proper explanation of the world of experience. One basic fact which one cannot overlook about the objects of experience is that they are coloured, and another crucial fact is that they conspicuously differ from each other in particular in the way they are coloured. The surviving textual evidence about earlier philosophers who seem to have concerned themselves with colours is unfortunately so meagre that it proves extremely difficult to get a clear sense of what they think about this topic. But since Empedocles in many instances already seems to have relied on earlier thought about the matter, we shall occasionally have the chance, while trying to reconstruct his colour theory, also to comment on the little information available about the first recorded views on colour.

The main source for Empedocles’ own view is, of course, his poem *On Nature* (*Περὶ φύσεως*), which probably ran to about two thousand lines of hexameter verse, and of which approximately one-sixth has survived in fragmentary form. To begin our enquiry into Empedocles’ account of colour, we should first examine the context in which he talks about colours, and the reasons why he

© Katerina Ierodiakonou 2005

I would like to thank István Bodnár, Myles Burnyeat, Michael Frede, Geoffrey Lloyd, Maria Michela Sassi, and David Sedley for their helpful comments on an earlier version of this paper. I would also like to thank an anonymous referee for advice on art-historical aspects. I wrote this paper during my stay at the Institute for Advanced Study in Princeton (September–December 2003), where I greatly benefited from the warm encouragement of my colleagues and their stimulating conversation.

raises this topic. Like most Presocratic philosophers, he is interested in presenting a theory about the generation of the world as we know it, its constituents and its transformations. That is to say, he wants to identify the elements it is made up of, and to understand it as it presents itself to us, in terms of what happens to these elements in the course of a cosmic process. He thus constructs an elegant cosmological system founded on a small number of uncreated and indestructible basic elements, the four 'roots' (ρίζώματα), namely earth, water, air, and fire (e.g. A 37, B 6), which are united and separated during different stages of the cosmic cycle by two personified motive forces, Love and Strife (e.g. B 17 and 35). It is precisely in terms of these that Empedocles attempts to explain the processes by which the things surrounding us, both animate and inanimate, were at some point created and came to acquire their present form as the result of the combination of some or all of the four basic elements, though in different proportions (e.g. B 21 and 98). And since all objects, animate and inanimate, are characterized by the fact that they are coloured, Empedocles also undertakes to explain what it is that makes them coloured and, moreover, how it happens that they have the different particular colours they have.

To put the matter in another way, it is a crucial part of his overall project of understanding the cosmos and its evolution that Empedocles should also deal in particular with the physical question concerning the nature of colour, in general, and the production of the various colours. Parmenides had claimed that it just appears that there are things which are coloured and which even change colour, and that if people believe that there are things which are coloured, this is another example of how people foolishly confuse appearance with reality (28 B 8. 41 DK). What Parmenides had failed to explain was how objects could appear to be coloured if in reality there is no colour. Against Parmenides, Empedocles took it upon himself to explain both how it comes about that objects in the world actually are coloured and how, in consequence, it is that they appear to us as coloured.

Thus, very much in the same spirit of grasping the apparent workings of the universe in detail, Empedocles also sets out to understand how human beings manage to perceive the coloured things around them. For he considers human beings in their present form to be the result of survival of the fittest, a survival partly due to their being equipped with sense-organs (e.g. A 72, B 61). That is to

say, on Empedocles' view human beings are creatures constructed in a way which enables them to perceive the world, understand it, and thus fit into it. The human sense-organs, when properly used, are supposed to fulfil exactly this task, namely to obtain reliable information about our world that we need for our survival (e.g. B 2 and 3). But Empedocles is more interested in grasping the physiology of perception as a biological function which gives us the ability to be aware of and distinguish the things around us than in asking the epistemological question whether the features we perceive objects to have are those that actually characterize reality. And since sight is essentially concerned with how objects appear to us, he tries in this context to figure out how by means of sight we perceive the colour of objects.

Thus the reason why Empedocles discusses issues related to the nature of colour and to colour perception can be traced to his pre-occupation with the physical question of the constitution of things, as well as with the question of how human beings, in particular, are biologically equipped to function and survive in this world. He pursues these questions against the background of Parmenides' claim that reality is not the way we perceive it to be, that, for instance, things are not coloured and do not change colour in reality. But to present Empedocles as having different interests from those sketched above, and to rephrase his questions in the light of more recent developments as questions about the metaphysical status of colour and about the epistemology of colour perception, would, I think, be grossly anachronistic.

Let us then turn to what Empedocles actually has to say concerning the two distinct questions of why or how things are coloured and how we perceive their colour. The surviving Empedoclean fragments and ancient testimonies relevant to the issue of the nature of colour are frustratingly few in number. Empedocles' central claim on this topic is presented in the following fragment, in which it is clearly stated that things are coloured because they originate from the combination of the four basic elements (B 71):¹

¹ The texts cited here are from H. Diels and W. Kranz, *Die Fragmente der Vorsokratiker*, 6th edn. [DK] (3 vols.; Berlin, 1951), unless otherwise stated. As for the translations, they very much depend on those by B. Inwood (*The Poem of Empedocles: A Text and Translation and Introduction*, rev. edn. (Toronto, 2001)) and by M. R. Wright (*Empedocles: The Extant Fragments, Edited with Introduction, Com-*

And if, concerning these things, your conviction is in any way wanting, as to how from the combining of water, earth, aether, and sun the forms and colours of mortal things might come to be, which have now come to be, fitted together [συναρμοσθέντα]

by Aphrodite . . .

Note the prominent position given to forms and colours here; what need to be explained, in the first instance, are the shapes or forms and the colours of the objects we encounter in the world.

To understand better how the combination of the four elements results in the generation of all the colours of this world, another much-quoted Empedoclean fragment should be taken into consideration (B 23):

As when painters adorn votive offerings,
men well taught [εὖ δεδαῶτε] by wisdom in their art,
and so when they take in their hands pigments of various colours

[πολύχροα φάρμακα],

mixing them in harmony [ἀρμονίῃ μείζαντε], more of some, less of others,
from them they prepare forms resembling all things,
making [κτίζοντε] trees and men and women
and beasts and birds and water-nourished fish
and long-lived gods, first in their prerogatives.

In this way let not deception overcome your mind
that there is any other source for the countless mortal things that are seen,
but know these things clearly, having heard the story from a god.

The comparison here is between what painters actually do when they mix their pigments of various colours in order to paint all the different things in the world, and what happens when the struggle between Love and Strife results in the generation of everything simply out of the combination of the four basic elements. Just as the painters manage to represent everything in the world by using pigments of various colours, Love and Strife bring it about that everything in this world arises out of these four elements.² This fragment, however, does not, and is not meant to, give us

mentary, Concordance [Extant Fragments] (New Haven, 1981; repr. 1995), with a few changes.

² Note here the use of the duals εὖ δεδαῶτε, μείζαντε, and κτίζοντε; in order for the comparison to work better, Empedocles introduces two painters whose art can be compared to the workings of Love and Strife. However, it is unclear how far the parallelism extends; if Love and Strife, each in its own way, make things arise out of the combination of the four elements, in what sense do two painters, each in his own way, bring about a representation of the world by using various colours? Cf. S.

direct information about how all the colours originated from the combination of the four elements; it does not, for instance, say that the mixture of a few colours produces all the colours in the world. It rather points out that just by using pigments of various colours, painters can represent all the diverse objects encountered in the world. Nevertheless, we shall see that the comparison proves to be instructive in clarifying how all the things in this world came to be from the combination of the four elements, and in this way also instructive in clarifying how all the colours originated.

For the comparison to work, this fragment must refer to the way painters mix their pigments (*φάρμακα*);³ 'mix' not in the sense of completely blending pigments of various colours in order to produce new hues, but in the sense of arranging pigments of various colours side by side in order to portray the world realistically.⁴ For it seems that this was exactly the practice followed by the painters of the fifth century BC. They drew an outline, filled it in with colour, and then on top of that colour juxtaposed washes of different colours; and if they wanted to produce a different shade of colour, what they did was to superpose a layer of colour on top of another, rather than blending two colours in advance.⁵ Hence, *πολύχροα φάρμακα* in the Empedoclean fragment does not mean 'many-coloured pigments', i.e. pigments produced by mixing many colours; they are simply pigments of various colours.⁶ The use of the adjective *πολύχροα* here leaves it completely open how many colours of pigments Empedocles has in mind, though the comparison strongly suggests that he must be talking of a rather limited

Trépanier, 'Empedocles on the Ultimate Symmetry of the World', *Oxford Studies in Ancient Philosophy*, 24 (2003), 1–57 at 35–6.

³ The term *φάρμακα* refers in this context to the pigments used for painting; cf. also Hdt. 1. 98; Ar. *Ecl.* 735; Plato, *Rep.* 420 c; *Crat.* 434 B 1; *Pol.* 277 c.

⁴ Wright, *Extant Fragments*, 38 and 180; A. P. D. Mourelatos, 'Quality, Structure, and Emergence in Later Pre-Socratic Philosophy' ['Quality'], in J. J. Cleary (ed.), *Proceedings of the Boston Area Colloquium in Ancient Philosophy*, 2 (Lanham, Md., 1987), 127–94 at 141 n. 15.

⁵ According to Plutarch (*De glor. Ath.* 2), Apollodorus was the first painter to use mixed colours (*φθορά*) at the end of the 5th cent. On the painters' use of the term *φθορά* as equivalent to *μείξεις*, i.e. as meaning 'corruption' in the sense of a colour losing its distinctive character by being mixed with other colours, cf. Porph. *De abstin.* 4. 20. 28; Plut. *Mor.* 393 c and 436 b. On the subsequent widespread use of mixed colours by ancient painters, cf. D.H. *De Isaeo* 4.

⁶ Similarly, when Aristotle uses the adjective *πολύχροα* for the eyes of human beings (*HA* 492^a5; *GA* 779^b9), he is simply referring to the fact that the eyes of human beings are of different colours.

number of kinds of pigments. It could be four, like the number of the basic elements, but it could also be more or fewer. It cannot be a large number, however, for the reference to the colours used by ancient painters is supposed to help us understand how just four elements can explain the seemingly endless variety of objects in this world.

Therefore, if we take seriously the comparison thus understood against the background of the actual practice of painting in Empedocles' time, it suggests that, when some or all of the four elements combine and produce something new, they do not fuse together in some kind of complete, genuine mixture in which the different elements can no longer be distinguished. Rather, it seems that the different elements are arranged side by side, as a result not losing their identity, just as the colours in an ancient painting are placed side by side or on top of each other. That this, most likely, is the way Empedocles also understands the combination of elements is confirmed by the fact that in other fragments he uses for the same purpose the verbs *συναρμόζεσθαι* (B 71. 4) and *ἀρμόζεσθαι* (B 107. 1), both of which standardly mean to 'fit' and 'join things together', rather than to blend different things in, as it were, a chemical mixture. These verbs, for instance, are used to refer to the construction of a boat or a wall, while in medicine they are used to describe how the different parts of the human body are joined together.⁷ And elsewhere, Empedocles talks of gluing the elements in harmony (B 96. 4: *ἀρμονίης κόλλησιν ἀρηρότα*; cf. B 34), a metaphor which again refers to the juxtaposition of elements, rather than to their complete mixture. Besides, such an account of Empedocles' theory of the combination of elements is strongly supported by the way the ancient philosophers comment on the subject. For instance, Aristotle says that, according to Empedocles, when the elements are combined, they are set beside one another, just as bricks and stones are placed when building a wall (*GC* 334^a26–31 = A 43). And Galen compares Empedocles' understanding of the combination of elements to a powder composed of different metals, finely ground and not completely mixed with each other (*In Hipp. De nat. hom.* xv. 32 Kühn = *CMG* 5. 9. 1. 19. 7–12 = A 34). Hence, since the four elements are said to be made up of minute discrete, but in principle

⁷ e.g. Hom. *Od.* 5. 248 and 361; Hdt. 2. 96; Eur. *Hel.* 233; *Tro.* 111; D.S. 2. 8. 2; Hipp. *Off.* 25; *Oss.* 12.

divisible, particles,⁸ Empedocles seems to hold that everything in this world is a result of the aggregation of imperceptibly minute ingredients which are set side by side without thereby changing their nature.

Furthermore, in the surviving fragments and testimonies there are certain examples of combinations which suggest that, when Empedocles uses the verbs *ἀρμόζεσθαι* and *συναρμόζεσθαι*, or when he uses the phrase *ἀρμονίης κόλλησιν ἀρηρότα*, the 'harmony' (literally 'fitting') he talks about is not simply the fitting together of the elements; it refers rather to a combination in accordance with an appropriate mathematical ratio, so that the thing generated is stable and can survive. For instance, blood and flesh are said to have all the elements in equal proportions (B 98; Aëtius 5. 22. 1=A 78; Theophr. *De sens.* 10=A 86), bones seem to consist of four parts of fire, two of earth, and two of water (B 96), while sinews originate from fire and earth mixed with double the amount of water (Aëtius 5. 22. 1=A 78); even our ability to perceive and to think and our special talents crucially depend on the proportion of the elements from whose combination each person is created (Theophr. *De sens.* 11=A 86). In this regard Empedocles seems to be influenced by Pythagorean views on mathematical ratios and harmony as the principle of the order both in particular things and in the whole universe.⁹ Still, it is not clear whether on his view the principle of specific ratios can be generalized to all cases of combinations of elements. That is to say, there are doubts whether Empedocles really thinks that all combinations of elements can be expressed in such ratios, or whether this principle should be confined either to organic compounds or even just to the specific examples mentioned above.¹⁰ Besides, in the comparison with painting in B 23, the harmonious juxtaposition (*ἀρμονίη μείξαντε*) of colours does not necessarily imply a combination of colours in specific mathematical ratios. And it is interesting to note here that the noun *ἀρμογή*, when used as a technical term of Greek painting, simply means the

⁸ e.g. Galen, *In Hipp. De nat. hom.* xv. 49 Kühn=CMG 5. 9. 1. 27. 22-7=A 34; xv. 49 Kühn=CGM 5. 9. 1. 27. 24=A 43; Aëtius 1. 13. 1 and 1. 17. 3=A 43.

⁹ On the Pythagorean influence on Empedocles in connection with mathematical ratios and harmony, cf. Porph. *V. Pyth.* 30; Simpl. *In DA* 68. 5-8 Hayduck; Philop. *In DA* 176. 32-177. 4 Hayduck; Sophon. *In DA* 32. 18-32 Hayduck.

¹⁰ E. Bignone, *Empedocle: studio critico* (Turin, 1916), 417 and 469; F. Solmsen, 'Tissues and the Soul: Philosophical Contributions to Physiology', *Philosophical Review*, 59 (1950), 435-68 at 436-41; Mourelatos, 'Quality', 167-71.

juxtaposition of, or transition from, one colour to another (cf. Pliny, *Nat.* 35. 29).

But however this may be, what still remains to be explained is how the combination of the four elements, as this is presented in the comparison with painting as well as in the other relevant texts, throws light on the way in which all the colours in this world are produced. We still need to explain what exactly happens, according to Empedocles, when the elements are harmoniously fitted together so as to generate not just something, but something with a specific colour. The Empedoclean fragment about the mathematical ratio which explains how bones are generated is particularly illuminating; for in this case the mathematical ratio seems also to explain why bones have the colour they have, namely why bones are white (B 96):¹¹

And the kindly earth into her broad hollows
received two parts of gleaming Nestis out of the eight
and four of Hephaistos; and they came to be white bones
marvellously fitted together with the glues of harmony

[ἀρμονίης κόλλησιν ἀρηρότα].

Empedocles claims in this fragment that bones are generated from the harmonious combination of earth, fire and water, more specifically from the combination of four parts of fire, two of earth, and two of water.¹² And presumably the underlying assumption is that fire is white, and that it is the excess of fire here that gives

¹¹ For discussion of the alternative readings of this fragment, cf. D. Sider, 'Empedocles B 96 (462 Bollack) and the Poetry of Adhesion', *Mnemosyne*, 37 (1984), 14–24. G. E. R. Lloyd, *Polarity and Analogy [Polarity]* (Cambridge, 1966), 274 n. 3, suggests that the second sentence may refer to the harmonious arrangement of bones in the body, rather than to the generation of bones from the harmonious combination of elements.

¹² These proportions are found in Aëtius (5. 22. 1=A 78). The ancient commentators (Simpl. *In DA* 68. 10–14 Hayduck; Philop. *In DA* 176. 30–2 Hayduck; Sophon. *In DA* 32. 18–23 Hayduck), on the other hand, interpret the phrase *Νήστιδος αἰγλης* as referring both to water and air, presumably following Theophrastus, who says that bones and hair are composed of all elements (*De sens.* 23=A 86); and thus they all talk of four parts of fire, two of earth, one of water, and one of air. I agree with C. E. Miller (*On the Interpretation of Empedocles [Interpretation]* (Chicago, 1908), 41) and J. Longrigg ('The "Roots of All Things"' ['Roots'], *Isis*, 67 (1976), 420–38 at 433) that there is no reason to suppose that all four elements need be constituents of everything. For the concept of everything in everything seems to be distinctive of Anaxagoras; and moreover, Empedocles himself does not mention air in the composition of sinews (Aëtius 5. 22. 1=A 78), while he seems to believe that fruit is composed of only water and fire (Aëtius 5. 26. 4=A 70).

bones their white colour; this is, at least, what the ancient commentators report (Simpl. *In DA* 68. 10–12 Hayduck; Philop. *In DA* 178. 6–8 Hayduck; Sophon. *In DA* 32. 19–20 Hayduck). Could we infer, though, just on the basis of the particular case, that this is Empedocles' account of how everything acquires its colour? Does Empedocles really want to claim that something has the colour it has only because elements have a colour and one of its constituent elements exceeds the others in quantity, thus accounting for the colour of the object?

Since everything, according to Empedocles, is generated from the harmonious combination of some or all of the elements, which are juxtaposed without losing their features, it is reasonable to suggest that the colour of something also depends on the combination of elements, and in particular on the combination of the colours of its constituent elements; and this combination should again be understood not as a complete mixture of the colours of the elements, but as a juxtaposition of those colours. However, if we suppose that the colour of an object depends only on the colour of the element which predominates, Empedocles would not be able to explain the colour of all things, but only of those which have exactly the same colour as one of the four elements, provided that the four elements all have different colours. Besides, what happens when no element prevails, but they are all combined in equal proportion, as for instance in the case of blood and flesh, which obviously do have a colour?

First, though, we have to examine the assumption that all four elements have a colour. And if they do, are they different in colour? And if they are different, precisely which are their colours? The fragment about the creation of bones (B 96) suggests that according to Empedocles the colour of fire is white. This is also confirmed by another Empedoclean fragment in which the sun, i.e. fire, is presented as white (or bright) and hot, while rain, i.e. water, is presented as dark and cold (B 21. 1–6):

But come! Gaze on this witness to my previous words,
if anything was in my previous [remarks] left wanting in form:
sun, white [*λευκόν*]¹³ to look on and hot in every respect,

¹³ *λευκόν* might be better translated 'bright' rather than 'white'. On the general issue about whether the Greek colour terms should be understood as denoting the qualitative or the quantitative difference between colours, i.e. whether the Greek colour terms have hues or luminosities as their primary connotation, cf. M. Platnauer, 'Greek Colour-Perception', *Classical Quarterly*, 15 (1921), 153–62; H. Os-

heavenly bodies [ἄμβροτα]¹⁴ bathed in heat and shining light,
rain everywhere dark and cold;
and from earth issue firmly rooted solids.

It is important to note that in this fragment, although presumably all four elements are presented, only fire and water are characterized by their colours.

Theophrastus, too, reports that on Empedocles' view the colour of fire is by nature white (λευκόν) and the colour of water is by nature black (μέλαν), without saying anything about the colour of the other elements, namely earth and air (*De sens.* 59=A 69a; cf. *De sens.* 7=A 86). Moreover, when Theophrastus discusses Democritus' theory of four primary colours, he explicitly contrasts it with the dominant view of the other philosophers of the period, who treated white and black as the only simple colours (*De sens.* 79=68 A 135 DK):

First of all, his [i.e. Democritus'] increase of the number of primaries [ἀρχάς] is puzzling; for the other philosophers propose white and black as the only simple [ἀπλῶν] colours.

But this remark would make no sense if Empedocles, with whose views Theophrastus is familiar, had already assumed four primary colours or even the very four primary colours Democritus came to postulate. So, even if the terms used here for primary and simple colours (ἀρχάς/ἀπλῶν) are not Empedocles' own, Theophrastus' testimony, together with the surviving fragments, suggests that Empedocles talked only of the colour of fire and the colour of water, namely the colours white and black, as the basic colours.

On the other hand, there is a text in Aëtius which ascribes to Empedocles four colours corresponding to the four elements, namely white, black, red (ἐρυθρόν), and yellow (ὄχρόν), but it does not specify the exact correspondence between these colours and the four elements (1. 15. 3=A 92). On the basis mainly of this text scholars in the past have often assumed that Empedocles associated the four elements with four specific colours.¹⁵ It has rightly been

borne, 'Colour Concepts of the Ancient Greeks', *British Journal of Aesthetics*, 8 (1968), 269–83; V. J. Bruno, *Form and Color in Greek Painting [Form and Color]* (New York, 1977), 47–51; J. J. Pollitt, 'Περί χρωμάτων: What Ancient Greek Painters Thought about Colors', in M. A. Tiberios and D. S. Tsifakis (eds.), *Color in Ancient Greece* (Thessaloniki, 2002), 1–8. On Empedocles' view, see below.

¹⁴ ἄμβροτα probably refers here to the moon and the stars, which are understood as combinations of fire and air; cf. Wright, *Extant Fragments*, 178.

¹⁵ K. Prantl, *Aristoteles: Über die Farben* (Munich, 1849), 41–2; W. Kranz, 'Die

suggested, though, that the doxographical tradition is most probably misleading, in that it ascribes to Empedocles the four colours of Democritus. For we learn from Theophrastus (*De sens.* 73–5=68 A 135 DK) that Democritus postulated four simple colours, namely white, black, red, and green (χλωρόν). Aëtius, however, presumably misreports this and presents the four Democritean colours as white, black, red, and yellow (1. 15. 8); and this is the list which the doxographical tradition then erroneously ascribes to Empedocles too, as well as to the Pythagoreans (1. 15. 7).¹⁶ But even assuming that this explanation of how part of the later tradition came to ascribe these four colours to Empedocles is correct, we can only speculate about the reason why Aëtius or his source introduces yellow instead of green in all four-colour lists which he attributes to the ancient philosophers in question. For instance, it is tempting to connect Aëtius' mistake with the fact that from quite early on in classical antiquity both medical doctors and painters, each group for its own reasons, showed a particular interest in this same list of four colours, namely white, black, red, and yellow.

In particular, the four humours which ancient doctors postulate and whose imbalance they consider to be the basic reason for lack of health, i.e. blood, phlegm, and black and yellow bile, are intrinsically characterized by the same four colours, red, white, black, and yellow, respectively. And it is interesting that a younger contemporary of Empedocles, Diogenes of Apollonia, claimed that all disease can be diagnosed on the basis of whether the patient's outward appearance displays one of these four colours; for it is the patient's colour, according to Diogenes, which unmistakably reveals the predominant humour in the patient's body ([Galen], *De humor.* xix. 495 Kühn=64 A 29a DK; Theophr. *De sens.* 43=64 A 19 DK). Could this mean that Empedocles, who also thought of himself as a healer (e.g. B 112), was influenced by the four-humour theory when he introduced the four elements and their colours, or could

ältesten Farbenlehren der Griechen' ['Farbenlehren'], *Hermes*, 47 (1917), 126–40 at 127–8; H. Cherniss, *Aristotle's Criticism of Presocratic Philosophy* [*Criticism*] (Baltimore, 1935), 217 n. 280; E. Siegel, 'Theories of Vision and Colour Perception of Empedocles and Democritus; Some Similarities to the Modern Approach' ['Theories of Vision'], *Bulletin of the History of Medicine*, 33 (1959), 145–59 at 152–3.

¹⁶ For the erroneous attribution to Empedocles of a four-colour list, cf. H. Diels *Doxographi Graeci* (Berlin, 1879), 50 and 222; J. I. Beare, *Greek Theories of Elementary Cognition* [*Greek Theories*] (Oxford, 1906), 21 n. 6; Millerd, *Interpretation*, 83; Longrigg, 'Roots', 432–3.

it be the other way round, namely that the ancient doctors who accepted the four-humour theory were influenced by Empedocles' four elements and their colours?

To assume that the doctors influenced Empedocles, at least as far as this issue is concerned, is implausible. For the four-humour theory seems to have become a standard doctrine, if at all, only after Empedocles' time. On the contrary, there is enough evidence to suggest that it is the Empedoclean theory of four elements that exercised considerable influence upon those doctors who postulated the four humours.¹⁷ For example, Empedocles' influence can be traced in the Hippocratic treatise *De natura hominis* (chs. 4–7), in which the author closely links the four humours to the four opposites, namely hot and cold, dry and wet, which are said to characterize the four elements; that is to say, phlegm is cold and wet, blood is wet and hot, yellow bile is hot and dry, and black bile is dry and cold. And in the fourth century BC Diocles of Carystus (fr. 8 Wellmann) directly connects the four humours with the four elements and the four opposites; that is to say, phlegm with air and cold, blood with water and wet, yellow bile with fire and hot, and black bile with earth and dry. However, the fact that medical doctors after Empedocles are influenced by his theory of the four elements does not necessarily imply that they are also influenced, in their choice of humours, by the colours of Empedocles' four elements. In other words, we cannot infer that Empedocles attributed to his elements the colours white, black, red and yellow, just because the ancient doctors after Empedocles talk about four humours with the very same four colours. Besides, fire is for Empedocles white, whereas the doctors associate it with yellow bile, and hence with yellow; furthermore, water for Empedocles is black, whereas the doctors associate it with blood, and hence with red.

To sum up, it is not reasonable to suggest that Empedocles' basic elements must have four different colours, namely white, black, red, and yellow, and hence that Aëtius was right, solely on the basis that in the ancient medical tradition there is the doctrine of the four humours with these particular colours. Nevertheless, nothing prevents us from thinking that this tradition may have been on

¹⁷ On the relationship between Empedocles' four elements and the theory of four humours, cf. Kranz, 'Farbenlehren', 130; J. Longrigg, 'Philosophy and Medicine: Some Early Interactions' ['Philosophy and Medicine'], *Harvard Studies in Classical Philology*, 67 (1963), 147–75 at 153.

Aëtius' mind, or on that of a careless source, when he ascribed the four-colour list to the philosophers, including Empedocles.

Turning next to ancient painting, there is enough evidence, both archaeological and textual, that at a certain time in the classical period ancient painters used just four colours, namely white, black, red, and yellow; or as Pliny says (*Nat.* 35. 50), white from Melos, Attic yellow, red from Sinope, and lamp-black (*atramentum*).¹⁸ Plutarch confirms this (*De def. or.* 436 B–C), as does the pseudo-Aristotelian treatise *De mundo* (396^b13), while Pliny, again, mentions Apelles' painting *Alexander Holding the Thunderbolt* as an example of a painting in which only these four colours were used (*Nat.* 35. 92). Unfortunately, no original example of Greek pictorial art of the classical period survives. Historians of art manage to reconstruct the development of Greek painting largely depending, for instance, on the painted decorations of Greek pottery and on Roman copies of Greek murals and mosaics. Among such copies, the magnificent Alexander mosaic of the late second century BC from the House of the Faun in Pompeii, presumed to be a copy of a late fourth-century original by Philoxenus of Eretria, provides us with a typical example of a work executed in shades derived from white, black, red, and yellow.¹⁹

It has therefore been suggested that there must be a close connection between the ancient painters' four colours and Empedocles' colours of the four elements. And since there is no evidence that ancient painters were interested in Empedocles' theory of the four elements, B 23 has often been used to support the claim that Empedocles was probably influenced by the painters' practice, especially

¹⁸ On the production of these pigments in antiquity, cf. Pliny, *Nat.* 35. 30–49; *Vitr.* 7. 7–14.

¹⁹ The Alexander mosaic, known as *The Battle of Issus*, is now at the National Museum in Naples. A. Cohen (*The Alexander Mosaic: Stories of Victory and Defeat* (Cambridge, 1997), 167–9) remarks that green is occasionally used for some details, but it is insufficient to affect the general four-colour character of the mosaic. Sellers (K. Jex-Blake and E. Sellers, *The Elder Pliny's Chapters on the History of Art [Elder Pliny]* (London, 1896), 97) mentions a modern example of the four-colour technique, *The Crowning with Thorns* by Titian in the Munich Pinakothek (c.1570–6). G. Morelli (*Italian Masters in German Galleries*, trans. L. M. Richter (London, 1883), 43), who initially made the comparison between the Alexander mosaic and Titian's painting, says that the aged Titian's example was afterwards often followed by Rubens and Van Dyck, but most brilliantly by Frans Hals in the last years of his life; for instance, in his two celebrated paintings *Regents of the Old Men's Almhouse* and *Regentesses of the Old Women's Almhouse*, which are both dated 1664 and now belong to the Frans Halsmuseum in Haarlem.

in his supposed choice of the colours white, black, red, and yellow.²⁰ But B 23 cannot really help us to settle this issue, for the comparison with painting in this fragment says nothing about the colour of the four elements. Rather, the comparison is supposed to work between the four elements used by Love and Strife for the creation of the world and the few colours painters used to paint the world; not between the four colours of the four elements and the four colours used by painters. In other words, the comparison would work perfectly even if some elements were not intrinsically coloured, or even if fewer than four colours characterized the four elements.

Further, to assume that the four-colour technique of the ancient painters influenced Empedocles' choice of colours for his four elements presupposes that this technique was standard at least during Empedocles' life, if not beforehand. There is an ongoing discussion, however, as to when exactly the four-colour palette was introduced in ancient painting; historians of Greek art have interpreted ancient sources on this matter quite differently. The two relevant texts are Pliny, *Nat.* 35. 50, and Cicero, *Brut.* 18. 70: Pliny claims that the artists who used four colours were Apelles, Aetion, Melanthius, and Nicomachus, who all lived during the late fourth century BC. On the other hand, Cicero's list of four-colour painters begins with Polygnotus, who was a very near contemporary of Empedocles, and continues with Zeuxis and Timanthes, who belong to the late fifth and early fourth centuries. Some art historians have suggested that Pliny's and Cicero's remarks do not have to be treated as contradictory. For it makes perfect sense to suppose that painters of the fifth century, e.g. Polygnotus, were the first to paint with just four colours, whereas the painters of the fourth century further developed this technique.²¹ More recently, though, others have insisted that Pliny's remarks are more authoritative and that Cicero is plainly mistaken. They claim that ancient painters started using only four colours not earlier than the fourth century.²² Therefore, it would certainly be hazardous to assume that the painters of Empedocles' time used the four colours white, black, red, and yellow, and

²⁰ I. Scheibler, 'Die "vier Farben" der griechischen Malerei' ['Farben'], *Antike Kunst*, 17 (1974), 92–102 at 101; Bruno, *Form and Color*, 56–7.

²¹ Jex-Blake and Sellers, *Elder Pliny*, 96–7.

²² J. J. Pollitt, *The Ancient View of Greek Art [Ancient View]* (New Haven, 1974), 110–11.

that Empedocles was influenced by them. But even if Polygnotus did restrict his colours to four, which in itself is extremely questionable, it seems clear that this was not the standard practice of the fifth-century painters, let alone in Empedocles' day.

However, even if it is an unfounded claim that Empedocles postulated for the four elements the same four colours which the painters of his time used, perhaps the painters' practice does help us better to understand what the issue at stake was concerning colours at that particular period. Historians of Greek art have argued that, whenever ancient painters decided to limit the number of colours they used (and archaeological evidence suggests that they did not use four colours in all of their works), it was always a deliberate choice on their part. For even the earlier painters must have had a greater range of colours open to them, as becomes clear, for instance, from traces of blue and green paint which are found on buildings and sculptures; in fact, blue and green seem to have been available to ancient painters as early as the archaic period.²³ But can we explain this deliberate restriction of colours?

In the case of the fourth-century painters, who undoubtedly had achieved a high level of sophistication in producing new colours, their decision to use fewer colours, definitely including white and black, was motivated by their interest in naturalistic representation.²⁴ For in order to simplify experiments with three-dimensional forms, ancient painters must have found it helpful, if not necessary, to restrict their colours. This trend may well go back to the fifth century, or even to Polygnotus, which would explain Cicero's remarks. Thus, the palette with fewer colours seems to have been the invention of those ancient painters who were the major participants in the discovery of the technique known in European art as *chiaroscuro*, the method which, by using highlights and cast shadows, tries to simulate our normal optical experience of how light falls on objects. This is, in fact, the method the ancients called *σκιαγραφία*, which literally means drawing or painting with shading.²⁵

²³ M. Robertson, *Greek Painting [Painting]* (Geneva, 1959), 13; *A History of Greek Art [Art]* (Cambridge, Mass., 1975), 260 and 500; Scheibler, 'Farben', 98–9.

²⁴ Bruno, *Form and Color*, 66.

²⁵ E. Pfuhl, 'Apollodoros ὁ Σκιαγράφος', *Jahrbuch des Archäologischen Instituts*, 25 (1910), 12–28; 'Skiagrafia', *ibid.* 27 (1912), 227–31; Pollitt, *Ancient View*, 247–54. For a different interpretation of *σκιαγραφία* as an impressionistic technique which relies on the phenomenon of optical colour fusion, cf. E. Keuls, 'Skiagraphia Once Again', *American Journal of Archaeology*, 79 (1975), 1–16; E. G. Pemberton, 'A Note

Hence, since painters of the fifth and fourth century were mainly interested in producing an atmosphere of *chiaroscuro*, they used the colour white as the equivalent of light, and the colour black as the equivalent of darkness, neither of which we would nowadays include among primary colours.²⁶

But, again, there are two different statements by ancient authors describing the invention of *σκιαγραφία*. In Plutarch (*De glor. Ath.* 2) Apollodorus is supposed to be the inventor of this technique, an account also supported by Pliny's discussion of Apollodorus' contribution to art towards the end of the fifth century (*Nat.* 35. 60–1). On the other hand, Quintilian (*Inst.* 12. 10. 4) states that it is Apollodorus' student Zeuxis who 'invented the law of lights and shades' (*luminum umbrarumque invenisse rationem*). Some art historians have suggested that Quintilian must be mistaken.²⁷ Others have tried to reconcile the two apparently contradictory statements, by proposing that the two ancient sources may very well be speaking of two different moments in the development of *σκιαγραφία*: Apollodorus was probably the first to perfect the shading methods and impart to his paintings a more convincing three-dimensional appearance, whereas Zeuxis may have introduced a kind of *chiaroscuro* in which shading assumed a more dominant role and the nuances of colouring became more and more complex.²⁸ Finally, in the fourth century Apelles, Protogenes, Pausias, and Nicias fully achieved in their works the naturalistic ideal, both by successful foreshortening and shading and by the use of mixed colours (Pliny, *Nat.* 35. 79 ff.). It seems, therefore, that it took the ancient painters some time to develop the technique of *σκιαγραφία*. In fact, its history must have started even before Apollodorus and Zeuxis. For although it is true, generally speaking, that there is no depth in archaic Greek painting

on *Skiagraphia*', *American Journal of Archaeology*, 80 (1976), 82–4. In addition, A. Rouveret, *Histoire et imaginaire de la peinture ancienne* (Rome, 1989), 13–63, interprets it as a technique used in the classical period especially at the theatre, i.e. as painting *en trompe-l'œil*.

²⁶ Since the pigment which ancient painters actually used for black was really dark blue, they were able to produce a high degree of nuance both in *chiaroscuro* and in the variety of reds and yellows, browns and ochres obtainable. So, although blue was omitted as an active colour in ancient paintings of this period, this darkening agent together with white, red, and yellow made the four-colour palette a reasonable choice for painters of the classical period. Cf. E. Bertrand, *Études sur la peinture et la critique d'art dans l'antiquité* (Paris, 1893), 132–44; Siegel, 'Theories of Vision', 153–4; Bruno, *Form and Color*, 58–9 and 79–87.

²⁷ Pollitt, *Ancient View*, 252.

²⁸ Bruno, *Form and Color*, 28–9.

up to the early fifth century, some kind of primitive shading does appear on late archaic works and in the early classical period. And certainly before the middle of the fifth century painters like Polygnotus seem to have deliberately restricted their colours, precisely because their main concern was to develop the *chiaroscuro* effect by using the colour white for highlights and the colour black for shades.²⁹ That is to say, it may be perfectly true that both Apollodorus and Zeuxis played a crucial role in the development of *σκιαγραφία*, but they presumably depended on previous generations of painters, systematizing and further developing their experiments.

Thus it may well be that when Empedocles undertook to construct a cosmological theory in order to explain the constitution of the world, he was also interested in explaining light and darkness and thus associated the colour white with the brightness of the element fire and the colour black with the darkness of the element water. I do not, however, want to claim that there is a direct influence of painters' practice in the fifth century on Empedocles' discussion of the colours white and black. Instead, I want to suggest that it seems to have been a preoccupation of the time to understand how light falls on objects and how the contrast between light and darkness is produced. I therefore do not believe that, just because Empedocles did not provide colours for all elements and did not associate all four elements with other opposites, such as the hot and the cold, the dense and rare, or the bitter and the sweet, his theory was not fully worked out.³⁰ Rather, one reason why he focused on only two colours, white and black, may have been that it is on the basis of these that light and darkness, which play such a crucial role in the way things present themselves to us, including the way they appear coloured, can adequately be accounted for.

To sum up, scholars and historians of Greek art have usually stressed the connection between Empedocles and ancient painting with reference to the use of only four colours in a type or style of ancient painting. Nevertheless, the part of the doxographical tradition which claims that Empedocles associated four colours with the four elements is not reliable. The painters' practice, just like the medical doctrine of the four humours, may have been in Aëtius'

²⁹ On the main stages of the history of *σκιαγραφία*, cf. Robertson, *Painting*, 14–15 and 153; *Art*, 489.

³⁰ Cf. G. E. R. Lloyd, 'The Hot and the Cold, the Dry and the Wet in Greek Philosophy', *Journal of Hellenic Studies*, 84 (1964), 92–106 at 93 n. 4.

mind when he attributed to Empedocles a four-colour theory. But our other and more authoritative ancient sources all talk of Empedocles' two colours, namely white and black, the colours of fire and water respectively. And there is no evidence to suggest that he provided different colours for the other two elements, namely air and earth, or that he believed that air and earth themselves are intrinsically coloured.

But if it really is the case that Empedocles postulated only the colours of fire and water, his claim that from the combination of elements all colours are generated remains a puzzle. For how are we to explain the production of all colours from the mixture of black and white alone?³¹ Interestingly enough, Empedocles is not the only ancient philosopher to defend such a counter-intuitive position. Aristotle, too, puts forward the very same view in *De sensu* (439^b18 ff.), in which he claims that it is from the complete mingling in different ratios of just black and white that we derive the rest of the colours. Moreover, before presenting his own explanation of how this is possible, Aristotle discusses another view on the production of colours, according to which all colours are produced by the juxtaposition (*παρ' ἄλληλα θέσις*) of very small white and black particles which are the constituents of all objects; although the white and black particles are not themselves apparent, because of their minute size, objects acquire certain colours as a result of the specific ratio in which the white and black particles are found in each object. It seems reasonable to attribute this view to Empedocles, since it fits in well with what we know from our other ancient sources about Empedocles' account of the generation of things in this world. For, as we have said, everything is generated on Empedocles' view from

³¹ No Empedoclean fragment talks about mixing other colours apart from white and black. The only fragment which has been interpreted in this way is B 93 βύσσω δὲ γλαύκοιο κρόκου καταμίσγεται ἀκτίς (Bennet's text). It is not clear, though, what the term βύσσω means here: it has been understood as referring to linen, so that saffron mixes with linen in the sense of dyeing linen (Wright, *Extant Fragments*, 232–3); it has also been understood as referring to a purple colour (cf. *Suda*; Hesychius), so that saffron mixes with purple to make a better dye (J. Barnes, review of M. R. Wright, *Empedocles: The Extant Fragments, Edited with Introduction, Commentary, Concordance* (New Haven, 1981), in *Classical Review*, NS 32 (1982), 191–6 at 194). The context in which Plutarch quotes this fragment (*De def. or.* 433 B) seems to favour the latter interpretation, since the other two examples used by Plutarch in this text are both examples of mixing different things in order to produce a better dye. But even if it is the case that Empedocles talks here of the mixture of two colours, i.e. purple and saffron, we still get no information about the production of a new hue.

the combination of the four elements, which are placed side by side and made up of minute discrete particles. So, if the elements of fire and water are respectively white and black, an object has a specific colour depending on the amount of the minute particles of these elements which constitute the particular object; or more specifically, depending on the mathematical ratio in which these elements are to be found in the particular object. But there is still the question of why Empedocles would think that the mere juxtaposition of white and black particles generates in some cases an object with a colour other than white or black, e.g. red, yellow, or blue.

To deal with this problem, I think we first need to settle a more basic question, what Empedocles actually means when he says that fire is white and water is black. It would not make much sense to think of these colours the way we think of them today, when we say that milk is white or a crow is black; for placing side by side any amounts of these colours in whatever ratio would never give us the impression of colours like red, yellow, or blue. To be more precise, it would not make sense to think of these colours only in this way, for after all Empedocles does characterize milk as white and there is no reason to believe that he would not characterize a crow as black. At the same time, however, when Empedocles characterizes men as black (B 67) and bones as white (B 96), he must have something different in mind; for he is certainly not referring only to Ethiopians when he talks of black men, and bones are not exactly white in the way milk is. Most importantly, when Empedocles talks of the sun as representative of the element of fire (B 21. 3) and characterizes it as 'white' (*λευκόν*), it becomes clear that his notion of white is not limited to the white of the milk.

Does this mean that the standard Greek terms for 'white' (*λευκόν*) and 'black' (*μέλαν*) cover a wide range of colours, that *λευκόν*, for instance, refers not only to white but also to yellow, orange, and even red, although there are other terms in Greek to distinguish these colours, which Empedocles undoubtedly knows and uses? In following such a practice, it could be argued, Empedocles proves not to be very different from ourselves, when we talk of white wine, or black grapes, or black and white men, in a sense which is not that found in 'white' milk and the 'black' crow. Nevertheless, this suggestion does not settle the issue. For, if that is the whole story, what exactly is the sense of 'white' and 'black' that Empedocles has in mind when he suggests that the combination of these colours

may produce all other colours? On this account all other colours would just be forms of white or black, rather than the result of a mixture of them.

Another way to approach this issue is to think of the two main cases which Empedocles himself discusses, but which are also used as standard examples throughout antiquity: namely, the case of the sun, or fire, as being white, and the case of rain, or the sea, or water, as being black. There is a fragment quoted in one of Plutarch's *Quaestiones naturales* (39) in which Empedocles claims that, when water is not illuminated by the sun's rays, as in the depths of a river or in cavernous grottoes, it is black (B 94):

And in the depths of the river a black [*niger*] colour is produced
by the shade,
and in the same way it is observed in cavernous grottoes.

This fragment, which is preserved only in a Renaissance Latin translation by Gilbert Longueil, is presented by Plutarch as an appropriate answer to the question 'Why does the surface of the water look white and the depths black?' It seems, therefore, that according to Empedocles' account the colour of water, though black by nature, changes depending on whether it is illuminated, e.g. at the surface of the sea, where it looks light blue and sometimes even white, or is not illuminated, e.g. in the depths of the sea, where it really looks dark blue and black. The production of all the different colours in this case is thus due to the penetration of water by light, which on Empedocles' view is fire emitted by a luminous body, i.e. the sun (e.g. Arist. *DA* 418^b20–6; Philop. *In DA* 344. 33–7 Hayduck; Cod. Ath. 1249=A 57). In other words, all the different colours in this case are the result of the combination of watery with fiery particles in different proportions. And what about the colour of the sun? In what sense is it white, and does it always remain white? Though at noon the sun looks white, at sunrise and around sunset it may look yellow, orange, pink, and red. The colours yellow, orange, pink, and red are thus all produced by the fact that the fiery particles of the white sun are combined in different proportions with the watery particles of the moisture which exists in the atmosphere (cf. Arist. *De sensu* 440^a10–12; *Meteor.* 374^a7–8). And if the amount of water were to increase, according to Empedocles, we would get all kinds of colour, until little or no fire is left, and then we would get dark blue or black.

Hence, when Empedocles talks of the colour of the sun, or the light of the sun, and of that of the sea, he refers to the two extreme colours white and black, but he also has in mind a whole range of colours, indeed all other colours, which are said to be produced by the combination of black and white. For the colour of the sea, being by nature black, gradually changes to the other extreme, depending on how much it is illuminated by the sun, i.e. penetrated by fire; and the colour of the light of the sun, being by nature white, changes to a whole range of colours, depending on how much moisture, i.e. water, there is in the atmosphere. That is to say, it seems that Empedocles understands the production of all the colours which characterize the things in this world as resulting from the combination of fiery and watery particles. For this is what he observes in nature, this is how the sun and the sea seem to him to acquire and constantly change their colours. And although the only Empedoclean fragment which mentions the rainbow does not say anything about how its colours arise (B 50), it was surely clear to Empedocles, as to the ancients in general, that the colours of the rainbow somehow must be due to the light of the sun and the water of the rain; for they will have noticed that we see rainbows only in places on which the sun shines and where water, e.g. in the form of rain, is dispersed.

According to Empedocles, therefore, the colours white and black should be regarded as two extremes in a continuum, like hot and cold, or day and night. There is something that in absolute terms can be said to be the white and the black, i.e. the elements of fire and water, and everything else is characterized by colours which are understood as shades of black and white. For instance, something's being yellow is understood as being more white than black, in the sense that it consists of more fire than water; and something's being blue is understood as being more black than white, in the sense that it consists of more water than fire. Let us take two of Empedocles' own examples. Blood and flesh, which are both red, are said by Empedocles to contain an equal proportion of all the elements (B 98; Aëtius 5. 22. 1 = A 78; Theophr. *De sens.* 10 = A 86); thus, the colour red seems to occupy the middle point of the continuum, in the sense that it is no more white than black, since it is produced by the same amount of white fiery and black watery particles. Furthermore, Empedocles is reported to have said (Arist. *GA* 779^b15–20 = A 91; [Arist.] *Probl.* 910^a12–15) that eyes with more water than fire are black (*μέλαινα*), whereas eyes with less water than fire are grey-

blue (*γλαυκά*); so he clearly thinks that the difference between the colours grey-blue and black depends on the amount of fiery and watery particles contained in the objects which are characterized by these colours.

To conclude, Empedocles claims that the colour of an object depends on the constituent elements of the particular object, and more specifically on the proportion of the black watery particles and the white fiery particles which the object contains; more watery particles produce a darker colour, while more fiery particles produce a brighter colour. Hence, it seems that Empedocles' continuum between the white and the black should rather be understood as a continuum between the bright and the dark. This means, however, that Empedocles puts forward two views that sound counter-intuitive to us: namely, that the other two elements, i.e. not only air but even earth, are colourless, and that all colours are produced by the combination of the white and the black, or the bright and the dark. Counter-intuitive though they may be, these are the views, it seems, which Empedocles puts forward, and I hope to have shown the rationale behind them. Instead of starting from our modern views about the nature of colour and the production of different colours, we need to remember that Empedocles lives in a culture strongly inclined to think in terms of opposites, in this case the opposites white and black or bright and dark. It is not the case that Empedocles' 'imaginary vividness took hold of him with more persuasiveness than logical consistency', so that 'the important thing in understanding him is to stop thinking at the right moment';³² the task rather is to try to think like him and his contemporaries, and to uncover the assumptions underlying this way of thinking.

Let us now turn to Empedocles' theory of colour perception. There are, fortunately, enough texts to provide us with a fairly clear picture of his views on perception, and in particular the perception of colour. To start with, there is the famous passage from Plato's *Meno* (76 C 4–D 5 = A 92):

'Do you want me to answer after the manner of Gorgias,³³ which would enable you most easily to follow?'

³² Millerd, *Interpretation*, 21.

³³ On the relationship between Gorgias and Empedocles, cf. H. Diels, 'Gorgias und Empedokles' ['Gorgias'], *Sitzungsberichte der Preußischen Akademie der Wissenschaften*, 49 (1884), 343–68.

‘Of course I want to.’

‘You say, then, following Empedocles, that there are certain effluences [*ἀπορροάς*] from things?’

‘Certainly.’

‘And pores [*πόρους*] into which and through which the effluences move?’

‘Definitely.’

‘And that some of the effluences fit into some of the pores, and others are too small or too large?’

‘That is so.’

‘You also say, then, that there is such a thing as the organ of vision?’

‘I do indeed.’

‘“Grasp what I tell you”, as Pindar said, on the basis of these points. For colour is an effluence from things which is commensurate with the organ of vision [*ὄψει σύμμετρος*] and is perceptible.’

So, according to Plato, Empedocles claims that whatever human beings perceive in the world, they perceive it because of different kinds of ‘effluences’ which are emitted by every object and enter into the ‘pores’ of our sense-organs, in particular into those pores which are commensurate with them. In the case of visual perception, more specifically, we see colours because certain effluences emitted by objects reach our eyes and, since they are commensurate with the pores of the eyes, they enter into our eyes and give us information about the colour of these objects.

There are two points worth making concerning the way Plato in this passage presents Empedocles’ theory of colour perception. First, it seems that on Empedocles’ view what we obtain through our sense of sight are perceptions not of objects, but of colours. Since colour is the effluence from objects which is commensurate with the pores of the visual organ, what we are really able to perceive with our eyes are colours; and we say that we see things, just because we see their colours. Second, the way the effluences enter into and move through the pores of the eyes is described here by the verb ‘fit’, *ἀρμόττειν*. This reminds us of the fitting together of the four elements on the basis of which everything is generated; but in this case the fitting of the effluences into the pores is said to be harmonious in the sense that the effluences and the pores are commensurate (*σύμμετρος*), i.e. neither smaller nor larger, but of the same size.³⁴

³⁴ Examples of commensurability and of lack of commensurability are given in a fragment in which Empedocles talks of water being mixed with wine and of the

Theophrastus helps us to add some further details to our account of Empedocles' theory of colour perception (*De sens.* 7 = A 86):

Empedocles gives a similar account for all the senses and says that sense perception occurs by means of [things] fitting into [ἐναρμόττειν] the pores of each [sense-organ]. That is why they cannot discern each other's objects, because some senses happen to have pores which somehow are too wide for the object of perception [i.e. of another sense], while others have pores which are too narrow, so that the objects which do not touch [οὐχ ἀπτόμενα] are able to pass through steadily and the others are completely unable even to get in. And he also tries to give an account of what the organ of vision is like. He says that the inside of it is fire and around this are water,³⁵ earth, and air, through which fire passes, being fine like the light in lanterns. And the pores [of the organ of vision] are alternately of fire and water; we recognize white things with the pores of fire and black things with those of water (for each sort fits into the respective pores). And the colours are brought to the organ of vision by the effluence.

Theophrastus thus confirms the two points made in Plato's *Meno*, namely that (1) each sense has different objects, because the pores of our different sense-organs have different sizes, and thus each sense-organ can obtain effluences only of a certain size; and (2) the object of vision is colour, since we see when certain effluences from the objects around us which correspond to their colour fit into (ἐναρμόττειν) the pores of our eyes.

Furthermore, Theophrastus' description of how on Empedocles' view our senses successfully perceive objects helps to clarify why it is essential for the effluences from the objects and the pores of our sense-organs to be of the same size. For, although it is clear why perception is impossible when the effluences are larger than the pores, as in this case they cannot even enter them, it is at first puzzling why we cannot perceive when the pores of our sense-organs are larger than certain effluences; one might expect that,

inability of water to be mixed with oil (B 91). More generally, on the commensurability between the effluences from objects and the pores of our sense-organs, cf. Arist. *GC* 324^b26–35 = A 87; Theophr. *De sens.* 12 = A 86; Aëtius 4. 9. 6 = A 90.

³⁵ Some scholars have been reluctant to emend the text, as Diels does, by adding water to earth and air. They have claimed either that Theophrastus must have taken the presence of water for granted (Millerd, *Interpretation*, 83), or that at this particular point he is simply describing the composition, according to Empedocles, of the part inside the eye which consists only of the internal fire and the membranes separating it from the internal water (G. M. Stratton, *Theophrastus and the Greek Physiological Psychology before Aristotle* (London, 1917), 163–4 n. 25; Wright, *Extant Fragments*, 242).

since the effluences are smaller than the pores, they could enter into the pores and move through them with no problem. But if we assume that certain effluences from objects, e.g. those which correspond to how an object smells or tastes, are smaller than, for instance, the pores of our eyes, we could then see smells and tastes; and this is certainly counter-intuitive. So, Theophrastus makes it clear that on Empedocles' view the important prerequisite for any kind of sense perception to take place is that the effluences from objects exactly fit into the pores of our sense-organs, in the sense that they actually touch the pores of our sense-organs; and it is for this reason that Theophrastus uses in this passage the verb 'touch'. That is to say, Empedocles seems to think, according to Theophrastus' report, that any sense perception involves some kind of touching.

Theophrastus in this passage also provides us with two further pieces of information about Empedocles, namely (1) his description of the structure of the human eye; and (2) his explanation of what happens when we see white or black. Concerning the anatomy of the eye, Theophrastus says that, according to Empedocles, it mainly consists of fire which is surrounded by water, earth, and air, and has pores which are alternately pores of fire and of water. In addition, he compares the way our eyes see to the way a lantern works; this simile, in fact, is also found in a much-discussed fragment in which Empedocles himself compares the way our eyes are built and function to the way a lantern is made and works (B 84):³⁶

As when someone planning a journey prepared a lantern,
 A flame of burning fire through a wintry night,
 and fastened linen screens against all kinds of breezes,
 which scatter the wind of the blowing breezes,
 but the light leapt outwards, to the extent that it was finer,
 and shone across the threshold with unfailling beams;
 in this way [Aphrodite] gave birth to the rounded eye,³⁷
 primeval fire wrapped in membranes and in delicate tissues;

³⁶ I do not follow Diels's text, in which an extra line is inserted after line 8, (α¹) *χράνησι δίαντα τετρήατο θεσπεσίησιν*. This line, which has been pieced together from garbled words found in a single manuscript, has been discarded by many scholars for sound philological reasons; cf. J. Bollack, *Empédocle*, vol. iii (Paris, 1969; repr. 1992), 327; Wright, *Extant Fragments*, 241.

³⁷ I here translate the text as emended by Föster and Ross; cf. Wright, *Extant Fragments*, 241.

these kept back the surrounding deep water
but let through fire, as much of it as was finer.

The structure of the human eye, as presented here, is relatively clear:³⁸ the standard account offered is that the fiery part of the eye is the lens, surrounded by water and protected by membranes and tissues.³⁹ It has also been argued, though, that in this fragment we are given a description of the externally visible features of the eye, rather than a description of the eye's hidden internal structure; in this case, then, the fiery part of the eye is most likely the iris, the membranes and tissues protecting it are identified with the cornea, and the water which the membranes are said to keep out is the moisture on the surface of the cornea, i.e. the lachrymal fluid.⁴⁰ As to the simile of the lantern, it has also been interpreted in many different ways among both ancient and modern readers of Empedocles' verses. Aristotle (*De sens.* 437^b23–438^a5), for instance, who cites this fragment, accuses Empedocles of being inconsistent; for if the simile of the lantern is taken seriously in all its details, and especially if the fact that the lantern emits light means that the eyes emit fire, then it seems that Empedocles explains vision both on the basis of incoming effluences and on the basis of light issuing from the eyes. Modern interpreters, too, have been unable to agree on this matter, though many ingenious attempts have been made to find an appropriate solution.⁴¹ I am inclined to think that we

³⁸ Perhaps it was Alcmaeon (24 A 5 and 10 DK), before Empedocles, who gave for the first time an account of the anatomy of the eye and its function. However, it is still disputed to what degree Empedocles was really influenced by Alcmaeon's views on the structure of the eye; cf. Diels, 'Gorgias', 353–4; Beare, *Greek Theories*, 15; Longrigg, 'Philosophy and Medicine', 156–7; 'Roots', 437; Wright, *Extant Fragments*, 230 and 243.

³⁹ There is a difference of opinion among scholars as to whether the membranes are membranes separating the internal fire from the internal water (Beare, *Greek Theories*, 16; Wright, *Extant Fragments*, 241–2) or, as I am inclined to assume, membranes separating the inside of the eye, namely the fire and the water, from the outside (Lloyd, *Polarity*, 326).

⁴⁰ D. Sedley, 'Empedocles' Theory of Vision and Theophrastus' *De sensibus* ['Vision'], in W. W. Fortenbaugh and D. Gutas (eds.), *Theophrastus: His Psychological, Doxographical and Scientific Writings* (New Brunswick, 1992) 20–31 at 20–6; cf. also V. Caston, 'Empedocles' Theory of Vision' (diss., University of Texas; Austin, 1985), 17–23. This interpretation is partly based on the assumption that dissection was not practised at the time of Empedocles, and thus he need not have had knowledge of the internal features of the eye; cf. G. E. R. Lloyd, 'Alcmaeon and the Early History of Dissection', *Sudhoffs Archiv*, 59 (1975), 113–47, repr. in *Methods and Problems in Greek Science* (Cambridge, 1991), 164–93.

⁴¹ Beare (*Greek Theories*, 17), Millerd (*Interpretation*, 84–5), and Cherniss (*Criti-*

should not try to press the analogy between the way the lantern is made and works and the way the eye is built and functions in all its details. Rather, we should limit ourselves to understanding the simile the way Theophrastus does: namely, as an analogy between the function of the membranes which surround the internal fire of the eye and that of the linen screens which surround the lantern. For just as the linen screens of the lantern let the light pass through without allowing the wind to extinguish the light of the lantern, the membranes of the eye let the fire pass through without allowing the water to disperse.

But whatever we think about the details of the simile of the lantern as well as about those of the structure of the eye, there is no doubt that Empedocles understands colours as effluences from objects which are commensurate with the pores of the visual organ, and thereby capable of being seen. Moreover, according to Theophrastus' account, Empedocles claims that human beings see colours because they are able to perceive the colour white with the pores of fire and the colour black with the pores of water. So, how are we able to perceive the colour white and the colour black? The fact that white objects are white means, according to Empedocles, that they

cism, 317–18 n. 106) argue that the two accounts of vision presented by Empedocles cannot be reconciled, and the simile of the lantern should be carried no further than the adoption of a simple analogy between the interior of the eye and a lantern. G. R. T. Ross (*Aristotle: De Sensu and De Memoria* (Cambridge, 1906), 137–8) claims that both accounts are needed, since the images of things entering by means of the pores have to be illuminated by the fire issuing from the pupil. W. J. Verdenius ('Empedocles' Doctrine of Sight' ['Doctrine'], in *Studia Varia Carolo Gulielmo Vollgraff Oblata* (Amsterdam, 1948), 55–64) assigns different functions to both the incoming effluences and the outgoing ocular fire: seeing is imagined to be at once something passive, i.e. receiving impressions, and something active, in the form of a projection by which we return our impressions to the object. A. A. Long ('Thinking and Sense-Perception in Empedocles: Mysticism or Materialism?' ['Thinking'], *Classical Quarterly*, NS 16 (1966), 256–76) argues that on Empedocles' view fire does not issue forth from the eye, although an intraocular fire is required for visual perception, since vision occurs only when there is the right correspondence between internal and external fire. D. O'Brien ('The Effects of a Simile: Empedocles' Theories of Seeing and Breathing' ['Simile'], *Journal of Hellenic Studies*, 90 (1970), 140–79 at 159) says that if we were to synthesize the two accounts, then the simplest method would be to suppose that fire leaves the eye in order to make room for equivalent effluences to enter the eye from the outside. Finally, Sedley ('Vision', 25–6) suggests that, since on Empedocles' view it is the reflective surface of the eye which is responsible for vision, fire must come out of the eye to mix with the water on its outer surface and to receive in its pores the effluences of things. For a more detailed list of earlier interpretations of Empedocles' theory of vision, cf. O'Brien, 'Simile', 157–60.

emit an overwhelming proportion of minute particles of fire, which reach our organ of vision and enter into the pores commensurate with them. These are the pores which Theophrastus refers to when he talks of the pores 'of fire' (*τοῦ πυρός*). They are not pores in something which is fiery, since they are at the surface of our eyes, where there is no fire; rather, they are the pores of the membranes which surround the eye, and into which the fine particles of fire fit, but not the coarser particles of water, nor for that matter the particles of earth or air. That is to say, these pores are of fire in the sense that they are pores for fire, i.e. for receiving particles of fire which are commensurate with them and emitted by the objects around us. Thus, the fiery particles of the white objects pass through the membranes of the eyes and move inside the eye; when there is a high proportion of fiery particles, we see the colour white. Similarly in the case of black objects, the fact that they are black means, according to Empedocles, that they emit an overwhelming proportion of minute particles of water, which reach our organ of vision and enter into the pores commensurate with them. These are the pores which Theophrastus refers to when he talks of the pores 'of water' (*τοῦ ὕδατος*). They are the pores of the membranes which surround the eye, and into which the water particles fit, but not the finer particles of fire, nor for that matter the particles of earth or air. That is to say, these pores are of water in the sense that they are pores for water, i.e. for receiving particles of water which are commensurate with them and emitted by the objects around us. Thus, the watery particles of the black objects pass through the membranes of the eyes and move inside the eye; when there is a high proportion of watery particles, we see the colour black.

In this way, Empedocles believes, human beings can see the colours white and black. The fiery and watery particles emitted from objects reach our eyes and enter into their pores, being attracted by the fire and the water of which human eyes are composed.⁴² But do we see only black and white? Of course not, unless we are completely colour-blind. So is Theophrastus right when he accuses Empedocles of suggesting a theory on which we cannot explain our perception of other colours apart from black and white?

⁴² It should be clarified here that the pores of our eyes receive fiery and watery particles of a certain size which is different from that of the fiery and watery particles which another sense-organ may receive into its pores; for instance, the watery particles which fit into the pores of our tongue are not of the same size as those watery particles which fit into the pores of our eyes.

Let us look more closely at Theophrastus' objection (*De sens.* 17 = A 86):

Moreover, [there are problems] in his treatment of the individual senses. For it turns out that recognition occurs by what is like [$\tau\omega\acute{\nu}$ $\acute{\omicron}\mu\acute{\omega}\iota\omega$]. For as to the organ of vision, if it is composed of fire and its opposite, it might be able to recognize the white and the black by their likes, but how will it recognize grey and the other colours, namely the mixed ones? For he explains it neither with the pores of fire nor with the pores of water nor with other pores combined from both. Yet we see these no less than the simple colours.

To defend Empedocles' theory of colour perception from such an objection, it has been suggested that we should perhaps assume that, apart from the pores of fire and of water, there must also be pores of earth and air which are crucially involved in our visual perception.⁴³ This is, in fact, how some scholars have understood the following Empedoclean fragment (B 109):

With earth we see [$\acute{\omicron}\pi\acute{\omega}\pi\alpha\mu\epsilon\nu$] earth, with water water,
with aether divine aether, with fire destructive fire,
love with love, and strife with baneful strife.

The verb 'see' ($\acute{\omicron}\pi\acute{\omega}\pi\alpha\mu\epsilon\nu$), however, need not refer literally to vision; for it can refer, as has rightly been pointed out, more generally to perception, grasping, and understanding.⁴⁴ Moreover, it would not make sense to talk about literal seeing in the case of Love and Strife (cf. B 17. 21). That is probably why Aristotle (*DA* 404^b8–15), in paraphrasing this fragment, substitutes the verbs 'perceive' ($\alpha\iota\sigma\theta\acute{\alpha}\nu\epsilon\sigma\theta\alpha\iota$) and 'know' ($\gamma\nu\omega\sigma\kappa\epsilon\nu$).⁴⁵ We therefore do not have to assume that B 109 deals specifically with vision, rather than perception, quite generally, or some kind of awareness; and it thus cannot be used as evidence in support of the view that pores of earth and air also play a role in Empedocles' theory of vision.⁴⁶

⁴³ Verdenius, 'Doctrine', 155. Long ('Thinking', 261 and 264) claims that it is possible, perhaps even probable, that there are pores of earth and air involved in the operation of sight, but he also recognizes that there is no evidence to support this view.

⁴⁴ O'Brien, 'Simile', 164; Sedley, 'Vision', 28.

⁴⁵ This also explains why Theophrastus claims (*De sens.* 10 = A 86) that what we have as fragment B 109 continued with the following two lines (= B 107):

For all are constructed and fitted together out of these,
and it is with these that they think and feel pleasure and pain.

⁴⁶ Galen (*De plac. Hipp. et Plat.* v. 627 Kühn = *CMG* 5. 4. 1. 2. 462. 1–19) refers to

But do we need to assume that pores of earth and air are crucially involved in vision if we want to explain how, according to Empedocles, human beings are able to see all the different colours? The introduction of the pores of earth and air has been considered necessary because Theophrastus stresses that Empedocles' theory of vision is based on the principle that perception is of like by like. Theophrastus says this in the passage quoted above (*De sens.* 17 = A 86). He also makes the same claim at the beginning of his treatise, at which point he tries to classify into different groups the views on perception expressed by the ancient philosophers before his time (*De sens.* 1-2 = A 86):

Parmenides, Empedocles, and Plato [make sense-perception] a result of the like ($\tau\acute{\omega}$ ὁμοίῳ), and the Anaxagoreans and Heracliteans of the opposite . . . The others more or less omit [any account] of each of the individual senses; but Empedocles tries to reduce these too to [a process involving] likeness.

The idea, therefore, is that on Empedocles' view seeing is a particular case of the general principle that perception is of like by like. That is to say, we can see white objects because their fiery effluences fit into the pores of fire, and we can see black objects because their watery effluences fit into the pores of water. If there are also pores of earth and air involved in the process of seeing, then the particles of earth and air emitted from objects around us can also be perceived by our eyes; and if the elements of earth and air are characterized by colours other than black and white, then our eyes can perceive all four basic colours, and hence all mixed colours. In other words, this interpretation of Empedocles' theory of vision assumes that (1) Empedocles' views on colour perception are based on the principle that perception is of like by like; and (2) the elements earth and air are coloured, and their colours together with the colours of fire and water constitute the basic colours from which all other colours can be derived.

Both of these assumptions have been seriously contested. Scholars have long remarked that Empedocles' theory about the commensurability of pores and effluences does not have to be understood as involving some kind of likeness; for it may be the case that

the first two lines of B 109 in order to justify the view that each of the four elements can be associated with a particular sense: namely, fire with sight, air with hearing, water with taste, earth with touch, and 'vapour' ($\acute{\alpha}\tau\mu\omicron\epsilon\iota\delta\acute{\epsilon}\varsigma$) with smell. But this interpretation is not plausible, for it does not take into consideration that, according to Empedocles, sight involves both the element of fire and the element of water.

something is commensurate with something else but not similar to it. However, the initial reaction of scholars was to conclude that Empedocles was not aware of this distinction and that that is why in his theory of vision he applies the principle that perception is of like by like in this way. It is only recently that some scholars have been more critical of Theophrastus' historiographical methods, and in particular of his way of classifying and schematizing earlier theories of perception. Thus, it has been argued that it is Theophrastus, rather than Empedocles himself, who correlates the commensurability between the effluences and the pores in perception with the principle that perception is of like by like.⁴⁷ It might be suggested, therefore, that effluences of particles of earth and air are emitted from the objects and are perceived by the pores of fire and water of our organ of vision, where 'pores of fire' is now understood in the sense of 'fiery pores', and the same for water; for even if these effluences are not like the pores of fire and water, they may be said to be somehow commensurate with them. But there is no evidence to support the view that the perception of particles of earth and air plays any role in our visual perception, and for that matter in our colour perception. Most importantly, though, if we understand the pores of fire and water as pores for exclusively receiving fiery and watery particles respectively, and not as pores in something fiery and in something watery, as suggested, this view does not make much sense. One would rather think that, according to Empedocles, the effluences of particles of earth and air emitted from the objects around us do not fit into the pores of our eyes; in other words, they are not perceived by our eyes.

The suggestion that the effluences of particles of earth and air are not visible is after all in agreement with what we have previously claimed concerning the colours of the elements earth and air, even though this claim has been made mainly on the basis of an argument *ex silentio*. For our ancient sources, at least those we can rely on, do not talk of the colours of the elements earth and air. And to say that earth and air are colourless precisely means that the effluences of particles of earth and air emitted from objects are not commensurate with the pores of our eyes, and thus invisible. But the fact that earth and air have no colour does not cause a problem, as we have already seen, in our understanding of the production of

⁴⁷ Sedley, 'Vision', 26–31.

all other colours; for according to Empedocles, just by combining the white of fire and the black of water we may derive all colours.

Have we thus managed to rebut Theophrastus' objection? Even if we do not have to correlate Empedocles' theory of vision with the principle that perception is of like by like, and even if we do not have to assume that the elements of earth and air are coloured, there is still a problem: how does it happen that the fitting together of the white effluences to the pores of fire and the black effluences to the pores of water gives us the impression of different colours? Empedocles does not provide us with any information on this matter. And Theophrastus may be understood as complaining exactly about this, namely that Empedocles has no account of how we perceive mixed colours. Nevertheless, the following can be said and is in tune with Empedocles' views on visual perception: the fiery and watery particles which are emitted in a certain proportion from an object, e.g. a blue object, pass through the pores of fire and water in the membranes of our eyes, and enter into the internal fire and water of our eyes; thus, our visual organ as a whole registers the proportion of fiery and watery particles in it and, depending on the kind of proportion, it has the impression of, for instance, a blue object.

This account may need some refinement to accommodate testimony according to which, on Empedocles' view, eyes differ in their constitution and, correspondingly, in their perceptual powers. Interestingly enough in the present context, the difference in constitution is correlated with their difference in colour. Aristotle says that, according to Empedocles, dark eyes have more water than fire, and thus see better in the daytime, whereas bright eyes have more fire than water, and thus see better at night (*GA* 779^b15–20=A 91; cf. Philop. *In DA* 217. 10–25 Hayduck):

To suppose, then, that grey-blue [eyes] are fiery, as Empedocles says, and that dark eyes have more water than fire, and that this is why the former do not see sharply in the daytime [namely the grey-blue ones], because of their lack of water, and that the latter do not see sharply at night because of their lack of fire, this is not a good theory, if indeed one must assign vision in all animals to water, not to fire.

And Theophrastus, too, reports that on Empedocles' view the eyes of animals which have less fire, because of their structure, see better

in the daytime, whereas those with less water see better at night (*De sens.* 8 = A 86):⁴⁸

[Eyes] are not [all] constructed in like fashion, (but some are constructed from like [elements]) and others from the opposite things, and some have the fire in the middle, some on the outside. That is why animals have sharper vision in the daytime, others at night—the ones with less fire by day (for their internal light is equalized by the external light), the ones [with less] of the opposite [see better] at night (for they too have their deficiency supplemented). And each kind has the opposite [characteristic] in the opposite conditions. For those who have too much fire have dim vision (for being further increased in the daytime it covers over and blocks up the pores of water), while for those [with too much] water this same [problem] occurs at night (for the fire is blocked by the water). (And this goes on) for the one group until the water is dissipated by the external fire, while for the other group until the fire is dissipated by the air. For the opposite is the cure for each group. The [organ of vision] which is constructed with an equal amount of both [fire and water] is optimally blended and best.

That is to say, Empedocles is here presented as saying that animals with too much fire in their eyes need some water from the outside, i.e. from the darkness of the night, in order to produce the balance of fire and water which helps them to see better at night; on the other hand, animals with too much water in their eyes need some fire from the outside, i.e. from the daylight, in order to make up the balance of water and fire which helps them to see better in the daytime.

As soon as we start talking about differences in the construction of the eyes of different animals, or of different human beings, and a corresponding difference in perception, the problem of subjectivity in perception might seem to be raised. But we should note that Empedocles is discussing a more limited issue, namely the conditions under which different kinds of animal, or even different human beings, see better than others, i.e. see the same colours, but more clearly or more reliably. There is no evidence that he is interested in more general problems, such as whether different

⁴⁸ It is interesting to note that Anaxagoras, too, is reported to have claimed, for different reasons, that some animals, in fact most animals, see better in the daytime and some animals see better at night (Theophr. *De sens.* 27). On the relationship between Empedocles' and Anaxagoras' theories of vision, cf. Beare, *Greek Theories*, 38; D. O'Brien, 'The Relation of Anaxagoras and Empedocles', *Journal of Hellenic Studies*, 88 (1968), 93–113 at 109–13.

animals or different human beings see the same colours or different colours, or whether the colours they see are the colours the objects actually have, or whether objects in reality have any colours at all.

To conclude, Empedocles holds that, when human beings perceive the world with their eyes, they primarily see colours, because colours are effluences from the objects commensurate with the pores of the eyes. And we see the colour white because an overwhelming proportion of fiery particles are emitted from a white object and are commensurate with the pores of fire in our eyes; and we see the colour black because an overwhelming proportion of watery particles are emitted from a black object and are commensurate with the pores of water in our eyes. Finally, the way we see all other colours depends on the proportion of watery and fiery particles emitted from the objects around us. It is therefore the elements of fire and water that play a crucial role both in the fact that objects have the colours they have and in the fact that human beings perceive the colours of objects in this world; for it is their different combinations that are responsible for the generation of the visual characteristics of the world as well as for the way it appears to us. Earth and air, on the other hand, are colourless; we need our other senses to become aware, for instance, of the density of the particles of earth or the rarity of the particles of air emitted by everything around us. And the information we get through all our senses about the various combinations of the four elements helps us, according to Empedocles, to perceive every single characteristic of the objects in this world, and through them the objects themselves.

National Technical University of Athens

BIBLIOGRAPHY

- Barnes, J., review of M. R. Wright, *Empedocles: The Extant Fragments, Edited with Introduction, Commentary, Concordance* (New Haven, 1981), in *Classical Review*, NS 32 (1982), 191–6.
- Beare, J. I., *Greek Theories of Elementary Cognition [Greek Theories]* (Oxford, 1906).
- Bertrand, E., *Études sur la peinture et la critique d'art dans l'antiquité* (Paris, 1893).
- Bignone, E., *Empedocle: studio critico* (Turin, 1916).
- Bollack, J., *Empédocle*, vol. iii [*Empédocle*] (Paris, 1969; repr. 1992).

- Bruno, V. J., *Form and Color in Greek Painting [Form and Color]* (New York, 1977).
- Caston, V., 'Empedocles' Theory of Vision' (diss., University of Texas; Austin 1985).
- Cherniss, H., *Aristotle's Criticism of Presocratic Philosophy [Criticism]* (Baltimore, 1935).
- Cohen, A., *The Alexander Mosaic: Stories of Victory and Defeat* (Cambridge, 1997).
- Diels, H., *Doxographi Graeci* (Berlin, 1879).
- 'Gorgias und Empedokles' ['Gorgias'], *Sitzungsberichte der Preussischen Akademie der Wissenschaften*, 49 (1884), 343–68.
- and Kranz, W., *Die Fragmente der Vorsokratiker*, 6th edn. [DK] (3 vols.; Berlin, 1951).
- Inwood, B., *The Poem of Empedocles: A Text and Translation and Introduction*, rev. edn. (Toronto, 2001).
- Jex-Blake, K., and Sellers, E., *The Elder Pliny's Chapters on the History of Art [Elder Pliny]* (London, 1896).
- Keuls, E., 'Skiagraphia Once Again', *American Journal of Archaeology*, 79 (1975), 1–16.
- Kirk, G. S., Raven, J. E., and Schofield, M., *The Presocratic Philosophers*, rev. edn. (Cambridge, 1983) [1957 edn. by Kirk and Raven].
- Kranz, W., 'Die ältesten Farbenlehren der Griechen' ['Farbenlehren'], *Hermes*, 47 (1917), 126–40.
- Lloyd, G. E. R., 'The Hot and the Cold, the Dry and the Wet in Greek Philosophy', *Journal of Hellenic Studies*, 84 (1964), 92–106.
- *Polarity and Analogy [Polarity]* (Cambridge, 1966).
- 'Alcmaeon and the Early History of Dissection', *Sudhoffs Archiv*, 59 (1975), 113–47; repr. in *Methods and Problems in Greek Science* (Cambridge, 1991), 164–93.
- Long, A. A., 'Thinking and Sense-Perception in Empedocles: Mysticism or Materialism?' ['Thinking'], *Classical Quarterly*, NS 16 (1966), 256–76.
- Longrigg, J., 'Philosophy and Medicine: Some Early Interactions' ['Philosophy and Medicine'], *Harvard Studies in Classical Philology*, 67 (1963), 147–75.
- 'The "Roots of All Things"' ['Roots'], *Isis*, 67 (1976), 420–38.
- Millerd, C. E., *On the Interpretation of Empedocles [Interpretation]* (Chicago, 1908).
- Morelli, G., *Italian Masters in German Galleries*, trans. L. M. Richter (London, 1883).
- Mourelatos, A. P. D., 'Quality, Structure, and Emergence in Later Pre-Socratic Philosophy' ['Quality'], in J. J. Cleary (ed.), *Proceedings of the Boston Area Colloquium in Ancient Philosophy*, 2 (Lanham, Md., 1987), 127–94.

- O'Brien, D., 'The Relation of Anaxagoras and Empedocles', *Journal of Hellenic Studies*, 88 (1968), 93–113.
- 'The Effects of a Simile: Empedocles' Theories of Seeing and Breathing' ['Simile'], *Journal of Hellenic Studies*, 90 (1970), 140–79.
- Osborne, H., 'Colour Concepts of the Ancient Greeks', *British Journal of Aesthetics*, 8 (1968), 269–83.
- Pemberton, E. G., 'A Note on *Skiagraphia*', *American Journal of Archaeology*, 80 (1976), 82–4.
- Pfuhl, E., 'Apollodoros ὁ Σκιαγράφος', *Jahrbuch des Archäologischen Instituts*, 25 (1910), 12–28.
- 'Skiagrafia', *Jahrbuch des Archäologischen Instituts*, 27 (1912), 227–31.
- Platnauer, M., 'Greek Colour-Perception', *Classical Quarterly*, 15 (1921), 153–62.
- Pollitt, J. J., *The Ancient View of Greek Art [Ancient View]* (New Haven, 1974).
- 'Περὶ χρωμάτων: What Ancient Greek Painters Thought about Colors', in M. A. Tiberios and D. S. Tsifakis (eds.), *Color in Ancient Greece* (Thessaloniki, 2002), 1–8.
- Prantl, K., *Aristoteles: Über die Farben* (Munich, 1849).
- Robertson, M., *Greek Painting [Painting]* (Geneva, 1959).
- *A History of Greek Art [Art]* (Cambridge, Mass., 1975).
- Ross, G. R. T., *Aristotle: De Sensu and De Memoria* (Cambridge, 1906).
- Rouveret, A., *Histoire et imaginaire de la peinture ancienne* (Rome, 1989).
- Scheibler, I., 'Die "vier Farben" der griechischen Malerei' ['Farben'], *Antike Kunst*, 17 (1974), 92–102.
- Sedley, D., 'Empedocles' Theory of Vision and Theophrastus' *De sensibus* ['Vision'], in W. W. Fortenbaugh and D. Gutas (eds.), *Theophrastus: His Psychological, Doxographical and Scientific Writings* (New Brunswick, 1992) 20–31.
- Sider, D., 'Empedocles B 96 (462 Bollack) and the Poetry of Adhesion', *Mnemosyne*, 37 (1984), 14–24.
- Siegel, E., 'Theories of Vision and Colour Perception of Empedocles and Democritus: Some Similarities to the Modern Approach' ['Theories of Vision'], *Bulletin of the History of Medicine*, 33 (1959), 145–59.
- Solmsen, F., 'Tissues and the Soul: Philosophical Contributions to Physiology', *Philosophical Review*, 59 (1950), 435–68.
- Stratton, G. M., *Theophrastus and the Greek Physiological Psychology before Aristotle* (London, 1917).
- Trépanier, S., 'Empedocles on the Ultimate Symmetry of the World', *Oxford Studies in Ancient Philosophy*, 24 (2003), 1–57.
- Verdenius, W. J., 'Empedocles' Doctrine of Sight' ['Doctrine'], in *Studia Varia Carolo Gulielmo Vollgraff Oblata* (Amsterdam, 1948), 55–64.

Wellmann, M., *Die Fragmente der sikelischen Ärzte* (Berlin, 1901).

Wright, M. R., *Empedocles: The Extant Fragments, Edited with Introduction, Commentary, Concordance [Extant Fragments]* (New Haven, 1981; repr. 1995).

