

# The Enterprise of Understanding and the Enterprise of Knowledge

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*For Isaac Levi – in admiration and friendship.*

1. Isaac Levi's work and my own will probably not strike a reader as very much alike. We have dealt with rather different subjects; and our styles, or angles of approach, have also tended to be different. But it was apparent to both of us, from very soon after we became acquainted (in Cleveland, in the fall semester of 1967), that our views of what philosophy should be—of what deserves to be regarded as serious engagement with serious philosophical questions—had a deep kinship. I hope the present paper will serve, in part, as testimony to that fact.

The phrase "the enterprise of knowledge" is used by Isaac as the title of a deeply interesting book, and is intended by him to indicate the keynote of his view of epistemology, expressed pungently also in the opening words of that book, which argue that knowledge should not be considered "a matter of pedigree": "Epistemologists ought to care for the improvement of knowledge rather than its pedigree. They ought to ask" [not what justifies the claims of a subject X to know something, but] "what X (who may be a person or a group) should do, given his knowledge at a time  $t$ , to render that knowledge more efficient in performing its functions"—a process, he immediately goes on to make clear, that may involve improving that state of knowledge itself, by expanding it *or by correcting* it.<sup>1</sup> As to the phrase "the enterprise of understanding," I use "understanding" here to refer to the grasp of ideas, or concepts; the enterprise I mean, then, is that of the *clarification* of ideas. And I want to

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<sup>1</sup> Isaac Levi, *The Enterprise of Knowledge* (Cambridge, Mass.: MIT Press 1980), p.1.

suggest—what may, stated in generality, appear merely banal—that the two enterprises, that of knowledge and that of understanding, are inextricably intertwined: let me say, “Understanding without knowledge is empty; knowledge without understanding is impossible.” As to the matter of pedigree, I think I know what Isaac means, and do not disagree; but I also think that questions about pedigree *do* have a role to play—and I should say even more than one role—in connection with understanding, and hence at least indirectly in connection with knowledge. This isn’t a point about which I want to be contentious; but I mention it—as it were, apologetically—because I shall be concerned here, as I have often been, with historical points, and so *ipso facto* with *some* matters of pedigree.

2. In a number of papers, John McDowell has argued for a view that accords to *values* an ontological status analogous to that of secondary qualities.<sup>2</sup> There is in this a startling echo of G. E. Moore—whose position, I believe, has not been taken seriously for a long time. McDowell, however, gives to his claim a turn quite different from anything in Moore. I believe McDowell’s enterprise is badly misconceived; and to explain why I do so—in what way that enterprise seems to me misconceived—I want to discuss the notion of secondary qualities, and their distinction from primary ones, in a historical context: the context of this distinction as it is developed by Locke, and of some of the subsequent history of the actual investigation of an important class of secondary qualities—namely, *colors*, which serve as McDowell’s own paradigmatic example.

But first, here is how McDowell characterizes secondary qualities:

A secondary quality is a property the ascription of which to an

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<sup>2</sup> See especially, in John McDowell, *Mind, Value, and Reality* (Cambridge, Mass.: Harvard University Press, 1998), Essays 6 through 8: “Aesthetic Value, Objectivity, and the Fabric of the World”—pp. 112–130; “Values and Secondary Qualities”—pp. 131–150; “Projection and Truth in Ethics”—pp. 151–166.

object is not adequately understood except as true, if it is true, in virtue of the object's disposition to present a certain sort of perceptual appearance: specifically, an appearance characterizable by using a word for the property itself to say how the object perceptually appears. Thus an object's being red is understood as something that obtains in virtue of the object's being such as (in certain circumstances) to look, precisely, red.

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I have written of what property-ascriptions are *understood* to be true in virtue of, rather than of what they are true in virtue of. No doubt it is true that a given thing is red in virtue of some microscopic textural properties of its surface; but a predication understood only in such terms – not in terms of how the object would look – would not be an ascription of the secondary quality of redness.<sup>3</sup>

This is not a characterization of such properties that I should choose to make myself; but I am not sure that – or whether – I disagree with it. At any rate, the following incident from my own experience might suggest a measure of agreement: When my brother's children were in either elementary or junior high school, one of their teachers gave an explanation of the blueness of the sky: the teacher said that the sky looks blue because it reflects the color of the ocean, which covers most of the earth. The children, to their credit, found this not very convincing, and asked me about it. The first part of my comment was: "The sky looks blue because it *is* blue: blue is the color of air." Had I stopped there, although I should have had, compared with the teacher, the merit of not saying *the thing that is not*, I think my response would have fallen short. I shall come back to this; but now, as indicated, I want to turn to some points about the

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<sup>3</sup> McDowell, *Mind, Value, and Reality*, pp. 133-4.

discussion of color in the seventeenth century.

3. It is usual to say of Locke that by *quality* of a body he means the body's power to cause in us what he calls a "simple *Idea*"; and that he divides such qualities into two sorts: "primary," distinguished by the fact that the ideas they cause "resemble" the qualities themselves, and "secondary," characterized by the fact that no such resemblance exists. None of this is altogether wrong; nor is the discomfort that has been felt with this distinction based upon "resemblance" and its lack; but that reading of Locke is also not entirely right—I believe that the large volume of philosophical discussion that has been built upon it involves a very serious misunderstanding of what Locke himself was aiming at here. I have touched on this point elsewhere,<sup>4</sup> but I want to take it up again more fully now.

Perhaps the clearest indication that there is something wrong with the standard account of Locke's distinction comes from the form this distinction—or the relevant one corresponding to it—takes at its first appearance in his surviving drafts for the *Essay concerning Human Understanding*: the one titled *An Essay concerning the Understanding, Knowledge, Opinion and Assent* (and now generally referred to as "Draft B" of the *Essay*). In this version, setting aside a few earlier casual references to "sensible qualities," the first more or less *systematic* discussion of the notions of "quality" and "idea" occurs in §61, which treats principally the notion of *substance*. (It must be borne in mind that although he makes a very clear statement of his "official" usage of the terms *quality* and *idea*, Locke also — even in parts of that very statement—*conflates* the two, saying "idea" when he

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<sup>4</sup> See Howard Stein, "On Locke, 'the great Huygenius, and the incomparable Mr. Newton'"; in Phillip Bricker and R. I. G. Hughes, eds., *Philosophical Perspectives on Newtonian Science* (Cambridge, Mass.: MIT Press, 1990), pp. 17-47; and "On Philosophy and Natural Philosophy in the Seventeenth Century," *Midwest Studies in Philosophy*, Vol. XVIII, *Philosophy of Science*, ed. Peter A. French, Theodore E. Uehling, Jr., and Howard K. Wettstein (Notre Dame, Indiana: University of Notre Dame Press, 1993), pp. 177-201 (esp. pp. 186-191 and 194-7).

should say “quality.” This is something he acknowledges explicitly, and he seems proud of it—as if it is more gentlemanly not to be fussy in one’s usage. The point is quite unimportant: in *this* regard, Locke’s meaning is always quite clear.) — Here, then, is the passage:

[H]e knows most and has the perfectest idea of any particular thing (or, if you will, substance), who has grasped and put together most of those simple ideas, or rather qualities, which are causes of those simple ideas[,] which do exist in it; among which are to be reckoned its active powers and passive capacities, i.e., not only those qualities which do actually exist in it, but such as are apt to be altered in it, or that thing is apt to alter in any other subject upon a due application of them together. Thus it is a property of the sun by shining long on a fair face to make it swarthy, on a green apple to make it red, and on yellow wax to make it white. A loadstone has the power of drawing iron, and iron a capacity to be drawn by the loadstone. All which powers being inherent in those subjects, and as ready to produce in other subjects those sensible qualities as they are in us those simple ideas we receive from them, and so do mediately affect our senses.<sup>5</sup> And all these powers terminating only in the alteration of some sensible qualities in those subjects, and so making them exhibit to us new sensible ideas, therefore it is that these powers, though in themselves properly relations, are reckoned up amongst those simple ideas which make the complex idea of any of those things we call substances. And in this sense I would crave leave to call

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<sup>5</sup> This sentence is clearly defective—multiply so. It might be amended to: “All which powers being inherent in those subjects, and as ready to produce sensible qualities in other subjects as these latter are to produce in us the simple ideas we receive from them, the first-named powers do mediately affect our senses.”

these potentialities simple ideas, when I speak of the simple ideas which we recollect in our minds when we think of substances; which are necessarily to be considered, if we will have true notions of them, and distinguish those substances well from one another.

And this in short is the true notion of *substance*, viz., a collection of several simple ideas which are united together; and by *subject*, wherein we think they inhere, we mean nothing else but the unknown cause of their union and coexistence. Also when I speak of simple ideas as existing in things, e.g., heat in the fire, and red in a cherry, I would be understood to mean such a constitution of that thing as produces that idea in our minds. So that by *idea*, when it is spoken of as being in our understandings, [I mean] the very thought and perception we have there, when it is spoken of as existing without us, I mean the cause of that perception, and is vulgarly supposed to be resembled by it. [N.B.: Nothing is said here about the primary/secondary distinction.] And this cause I call also quality, whereby I mean anything which produces or causes any simple idea in us, whether it be the operation of our minds within, which, being perceived by us, causes in us the idea of those operations, or else anything existing without us, which, affecting our senses, causes in us any sensible simple ideas. These all, I say, I call qualities. And because all the powers and capacities which we can conceive in things are conversant only about simple ideas, and are considered as belonging to and making up a part of the complex idea of the thing, I call those also qualities, and distinguish qualities into actual and potential. By actual qualities I mean all those simple ideas, or, to speak righter, those causes of them, that are in anything, e.g., taste, colour, smell, and tangible qualities of all the component parts of a cherry. By potential qualities I mean the fitness it has to change the simple ideas of any

other thing, or to have its own simple ideas changed by any other thing; e.g., it is a potential quality of lead to be melted by fire, and of fire to melt lead, i.e., change its solidity into fluidity . . . . All that I desire is to have understood what I mean by the word quality when I use it. Wherein it is to be used by me something differently from the common acception, I hope I shall be pardoned, being led to it by the consideration of the things, and this being the nearest word in its common use to those notions I have applied it to.<sup>6</sup>

Although it is impossible to acquit this lengthy passage of a certain higgledy-piggledy jumbledness, the basic conception emerges quite clearly: qualities are *powers*, existing in things; they are known to us by “ideas,” and ultimately by “simple” ideas (“all the powers and capacities which we can conceive in things are conversant only about simple ideas”), of which they are—directly or “mediately” —the causes. Qualities—powers—that are the direct causes of simple ideas in us, Locke here calls “actual qualities”; those which “terminate only in the alteration of some sensible qualities in [other] subjects, and so make them exhibit to us new sensible ideas,” he calls “potential qualities.” And he remarks quite casually in passing that the “actual qualities” are “vulgarly supposed to be resembled by” the perceptions they cause. The “actual/potential” terminology is not very well chosen, since both sorts of qualities are, according to Locke, actually present in the subject—but present *as powers*; hence the one sort is actual in the same sense as the other, and potential in the same sense as the other. Presumably for this reason, Locke’s terminology in the published *Essay* is different, signaling rather the “immediateness” or “mediateness” of the perception.

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<sup>6</sup> John Locke, *An Essay concerning the Understanding, Knowledge, Opinion, and Assent*, ed. Benjamin Rand (Cambridge, Mass.: Harvard University Press, 1931), pp. 122-5. (Subsequently referred to as *Essay*, Draft B.)

As to the more famous distinction of qualities into primary and secondary, it appears considerably later in this draft, namely in §94, in connection with a comparison of what we know of material substances—*bodies*—on the one hand, and spiritual substances—*minds*—on the other. Of minds, he says,

by putting together ideas of thinking, perceiving, and power of moving, themselves and other things, we have as clear a perception and notion of their essence as we have of the essence of body, by the complex idea of colored, extended, hard and all other sensible qualities, which is all that we know of it.

Nor after all the acquaintance and familiarity which we imagine we have with matter, and the many qualities men assure themselves they perceive and know in bodies, will it perhaps upon examination be found that they have any more or clearer primary ideas belonging *originally* to body, than they have belonging to spirit.

For setting aside extension and cohesion of parts, all the other qualities we observe in, or ideas we receive from, body as distinguished from spirit (for we have some ideas common to both[,] as number), are probably but the results and modifications of these. For impenetrability, or a power of receiving and communicating motion by impulse or protrusion, is a necessary consequence of extension and cohering of parts: and figure, also, is but the termination or modification of extension in the several masses of such cohering parts; and all the other sensible qualities in bodies, as heat, cold, colors, smells, tastes, and all the objects of sense, and the ideas thereof produced in us, are probably in the bodies wherein we imagine they reside nothing but different bulk and figure; and in us those appearances and sensations of them are nothing but the effect of various impulses made upon our organs by particles or little masses of

bodies of different size, figure, and motion.

(In this version, one sees, the “primary ideas” are not identified with “simple ideas of sensation” – for *cohesion of parts* can certainly not be so regarded.)

After a brief discussion of the question “what and how many simple primary ideas we have belonging to spirit,” his comparison of body and spirit is summed up by Locke in these words:

[I]n short, the knowledge we have of spirit compared with the knowledge we have of body, stands thus: The essence of spirit is unknown to us; and so is that essence of body equally unknown to us. Two primary qualities or properties of body, viz., *extension* and *cohesion of parts*, we perfectly know and have distinct, clear ideas of. So likewise we know, and have distinct, clear ideas of two primary qualities or properties of spirit, viz., *knowledge* [this, Locke has just indicated, he essentially equates with “perception” and with “thinking”; one may suggest as an alternative: *awareness*], and a power of moving, i.e., beginning of *determinate* motion. We have also the knowledge of several qualities inherent in bodies, and have the clear distinct ideas of them, which qualities are but the various modifications of the extension of cohering parts and their motion. We have, likewise, the idea of the several modes of knowledge or perception, viz., believing, doubting, willing, intending, fearing, hoping, all which are but the several modes of thinking, etc. We have also the idea of willing, and motion or change of place, which to me seems equally to belong to spirit as to body . . . .<sup>7</sup>

The term “secondary qualities” does not, I believe, occur in Draft B; but it is

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<sup>7</sup> Locke, *Essay*, Draft B, §94, pp. 197-200.

the natural contrast to “primary.” In the published *Essay*, qualities are, of course, classified into primary and secondary; and secondary qualities are, in effect, *further* classified into what in Draft B Locke had called “actual” and “potential” qualities, but in the final version he calls *secondary qualities* IMMEDIATELY *perceived*, and *secondary qualities* MEDIATELY *perceived*. And there is one rather important change in his list of primary qualities: he now includes impenetrability (or “solidity”) among the primary qualities of bodies, and omits cohesion of parts (but for a qualification, see §12 and n. 59 below). His summary of the situation now reads:

And thus I have, in a short draught, given a view of our *original Ideas*, from whence all the rest are derived, and of which they are made up; which if I would consider, as a Philosopher, and examine on what Causes they depend, and of what they are made, I believe they all might be reduced to these very few primary, and original ones, *viz.*

*Extension,*  
*Solidity,*  
*Mobility, or the Power of being moved;*

which by our Senses we receive from Body:

*Perceptivity, or the Power of perception, or thinking;*  
*Motivity, or the Power of moving;*

which by reflection we receive from our Minds. . . . To which if we add

*Existence,*  
*Duration,*  
*Number;*

which belong both to the one, and the other, we have, perhaps, all the Original *Ideas* on which the rest depend.<sup>8</sup>

4. I have cited these passages at such length in order to provide evidence for a claim about Locke's chief interest in making the distinctions he does make among qualities: namely, that he is concerned *primarily* with what deserves to be regarded—to use a quasi-Aristotelian phrase—as “first in the order of nature”: that is to say, so far as “body” in particular is concerned, with what, among the properties we know of bodies, are to be regarded as *fundamental*, and therefore as providing the basis for any possible “scientific” knowledge of bodies. That is the reason why, in the chapter in which he introduces the distinctions in the finished *Essay*, he is constrained to admit that he has deviated from his declared program of employing exclusively a “Historical, plain Method,” and that he has “been engaged in Physical Enquiries a little further than, perhaps, I intended.”<sup>9</sup> In fact—in striking fact—Locke's view of this matter bears a close relationship to that of Descartes. Locke's “primary” qualities of bodies include more than the one essential attribute, *extension*, of Descartes; and accordingly Locke's metaphysics allows for the possible existence of space void of body, as Descartes's does not; but Locke's view of what a science of body would have to be like is very nearly the same as Descartes's view. — More on this subject presently.

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<sup>8</sup> John Locke, *An Essay concerning Human Understanding*, ed. Peter H. Nidditch (Oxford: Clarendon Press, corrected edition 1979)—henceforth, simply *Essay* — Bk. II, ch. xxi, §73; pp. 286-7. (Note that all page references are to Nidditch's edition; but of course references by Book, chapter, and section are not limited in that way.)

<sup>9</sup> Locke, *Essay*, Bk. II, ch. viii, §22, p. 140; for the statement that he intends to limit himself to a “Historical, plain, Method”—in effect, to offer, not a *natural philosophy*, but a *natural history* of the mind—see Bk. I, ch. 1, §2; the quoted phrase occurs on p. 44.

5. A color, such as redness, according to Locke as well as McDowell, is “a property the ascription of which to an object is not adequately understood except as true, if it is true, in virtue of the object’s disposition to present a certain sort of perceptual appearance” (recall Locke’s sarcasm about the blind man who thought he had at last formed an idea of *scarlet*: that “It was like the Sound of a Trumpet”<sup>10</sup> [myself, I have always thought that rather good!]). And in Locke’s developed terminology, this is an example of a *secondary quality, immediately perceived*.

A few years before the composition by Locke of Draft B of the *Essay* Newton carried out his first investigations of light and colors. And a part of what he discovered can be expressed, in Locke’s terminology, by saying that colors— as properties of bodies— are *not* secondary qualities immediately perceived. For we see through the intermediation of light (*this* was not news!); and there are various *kinds* of light (*this was* news); and the color we see in a body is the result of the kind of light that reaches our eyes from that body; which in turn is the result of a *selection* the body effects among the kinds of light that happen to fall upon it. Therefore the “quality”— in Locke’s sense— *of a body*, that is relevant to the color we perceive in it, is a power of that body to act in a certain way, *not* upon our senses, but *upon light*. It is therefore—in Locke’s terms—a secondary quality *mediately* perceived.

This may seem a merely scholastic point. Its significance rests on what Newton discovered *about* the kinds of light, including their role in the very complex transaction involved in our perception of color. He was led to introduce, as a conceptual analytical tool, the notion of a *ray*, or elementary part of light: whatever it is that is propagated *along a line* when “light” is propagated there. His discovery that there are various kinds of light took the more specific form of the discovery that there are various kinds of rays, *each with a number of properties*

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<sup>10</sup> *Ibid.*, Bk. III, ch. iv, §11.

*indissolubly associated with it.* He calls these “*Original and connate properties*” of the rays;<sup>11</sup> and the role of these properties in the scientific understanding of light and vision that Newton develops is entirely analogous to the role that *should* be played, according to Locke, by *primary* qualities. For Newton, however, there is simply no question of “resemblance” between such qualities and our perceptions. Indeed, the sensation, for instance, of *red* is normally stimulated—in a normal eye—by the impinging on the retina of rays of a particular kind, and the ability to produce that sensation Newton says is an “*Original and connate*” property of such rays; so the redness of a body is its power—one way or another—under normal circumstances to send rays of that kind to the eye; which power obviously cannot be said to be “resembled” by the sensation. But Newton is very clear that there is nothing in the rays, either, that the perceived color resembles. “[T]he Rays,” he says, “to speak properly are not coloured. In them there is nothing else than a certain Power and Disposition to stir up a Sensation of this or that Colour.” And he amplifies:

For as Sound in a Bell or musical String, or other sounding Body, is nothing but a trembling Motion, and in the Air nothing but that Motion propagated from the Object, and in the Sensorium ‘tis a Sense of that Motion under the Form of Sound; so Colours in the Object are nothing but a Disposition to reflect this or that sort of Rays more

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<sup>11</sup> See *The Correspondence of Isaac Newton*, vol. I, ed. H. W. Turnbull (Cambridge University Press, 1959), p. 97 (in Newton’s letter to Oldenburg of February 6, 1672). The quoted phrase is here applied specifically to what Newton calls the “disposition [of the rays] to exhibit this or that particular colour”; but that is not the only property he finds to be immutably associated with the individual kinds of rays (in the paper—or letter—in question, one other such, namely [degree of] refrangibility, comes into the discussion; but a still deeper property of this sort was known to Newton at this time [see below]; and it is quite clear that the terms “original” and “connate” are equally applicable to them all).

copiously than the rest; in the Rays they are nothing but their Dispositions to propagate this or that Motion into the Sensorium, and in the Sensorium they are Sensations of those Motions under the Forms of Colours.<sup>12</sup>

Note that, on this analysis, not only is the relevant “power” of the body one of affecting, not our senses, but a beam of light: the relevant “power” of the light-rays themselves is one, not of affecting our senses, but of *communicating motion* of a certain kind into the “sensorium” (Newton conjectures that the motion in question is a kind of *oscillation* aroused in the retina and propagated along the optic nerve).<sup>13</sup> That there then arise “Sensations of those Motions under the

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<sup>12</sup> Isaac Newton, *Opticks* (reprint, based on the fourth edition; New York: Dover Publications, 1952), pp. 124-5. — In his book *Color and Color Perception: a Study in Anthropocentric Realism* (Stanford, CA: Center for the Study of Language and Information, 1987), David R. Hilbert misquotes this passage (p. 7), giving one of its clauses — without even ellipsis dots — as: “Colours in the Object are nothing but their dispositions to propagate this or that Motion into the Sensorium.” Hilbert himself argues for the view that colors *are* properties of objects — and *only* of objects — and identifies the color of an object with its “spectral reflectance”; i.e., its “disposition . . . to reflect varying percentages of the incident light” (*ibid.*, p. 119). This is so nearly identical with what Newton says “Colours in the Object are,” that one is astounded at Hilbert’s taking Newton to have a “flawed theory” (cf., e.g., p. 134. (To be sure, Newton distinguishes *various senses* of “color” — “what colors are in the object, in the rays, in the sensorium.” These distinctions are — I should say *obviously* — clarifying; and it seems to me a strange view of philosophy that holds that there is a single canonically “right” use of the word “color.” — As to the identification of color in an object with its spectral reflectance, although this is a useful association, and Newton has surely done service by introducing it, there are some linguistic difficulties: e.g., it prevents us from saying correctly that a red hot piece of iron is red.)

<sup>13</sup> The suggestion was first made by Newton in his reply to Hooke’s criticisms of Newton’s “New Theory of Light and Colors,” as a natural conjecture in the context of Hooke’s conception of light as a wave motion (see Newton, *Correspondence*, I, pp. 174-5 — in his letter to Oldenburg of June 11, 1672). It is repeated — in the context of Newton’s own view of the probable nature of light — in his *Opticks*, Bk. III, Queries 12 and 13 (Dover edition, pp. 345-6).

Forms of Colours” implies the exercise of yet another power: that of the matter of the sensorium, by its motions, to excite in the mind “Sensations . . . under the Forms of Colours”; and, correspondingly, the power of the mind itself to perceive in that way.

I trust it will be sufficiently clear that, on any reasonable understanding of the word “philosophy,” this is a subtler, more nuanced, and altogether more adequate parsing of the structure of the situation in perception than that of Locke. But, again, what I am especially interested in is the role that this more elaborate *conceptual* analysis played in the furtherance of our *knowledge*—our knowledge about light, about bodies, and about the perception of color.

That Newton’s optical investigations furthered our knowledge of light is in itself, of course, a historical truism—if they had not done so, they would not be celebrated as they are. But there is a particular aspect of Newton’s discoveries that I think deserves a kind of recognition, especially by philosophers, that it has not received. I shall just briefly characterize it at this point, and return later to the reason I think it deserves that recognition. What I am referring to is Newton’s discovery that one of the original and connate properties of the light-rays of any given homogeneous kind is a certain *submicroscopic length*: a length that is always the same, in a given medium, for rays of any one kind—that is, for rays of a specified “original,” “simple,” or “primary” color, or (equivalently) of a specified degree of refrangibility; and which varies from medium to medium in a way Newton also determined (namely, it is inversely proportional—for a given kind of ray—to the index of refraction, *for* that kind, of the medium in which it is being propagated). The length in question, for instance, for what Newton describes as “the Rays which paint the Colour in the Confine of yellow and orange” (we may take these to be, approximately, the rays of sodium light), is, he tells us, “the 89000<sup>th</sup> part of an Inch.”<sup>14</sup>—Perhaps it is already clear at least that this was

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<sup>14</sup> Newton, *Opticks*, Book II, Part III, Proposition XVIII (Dover edition, p. 285).

an astonishing discovery. It must at any rate be clear that such a proposition could not even have been formulated without the new conception of light as comprising fundamentally distinct physical kinds.

6. On the subject of color-perception, another result, apparently first reported by Newton in his *Opticks*,<sup>15</sup> has proved to have a very much deeper importance than he himself attached to it. He was concerned with the problem of *calculating* what perceived color would result from any given combination of “primary” colors—that is, of monochromatic lights. The problem of doing this was already adumbrated by him in 1672, when he maintained that he had done something no natural philosopher would have anticipated to be possible—namely, rendered the science of colors *mathematical*.<sup>16</sup> In his explanation of what he meant by that claim he might even seem to imply that he had already *solved* the indicated problem; for he wrote as follows (in his reply to the criticisms made upon his first paper by Hooke):

[I]f those Principles [namely, his own propositions about colors] be such that on them a Mathematician may determin all the Phænomena of colours that can be caused by refractions, and that by computing or demonstrating after what manner & how much those refractions doe separate or mingle the rays in wch severall colours are originally inherent; I suppose the *Science of Colours* will be granted *Mathematicall*

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<sup>15</sup> That is to say, rather late in his career: the first edition of the *Opticks* was published in 1704. It had apparently been completed at least ten years earlier—see Richard S. Westfall, *Never at Rest: a Biography of Isaac Newton* (Cambridge University Press, 1980), p. 523—and many things in the *Opticks* (including, e.g., the lengths associated with the kinds of rays) had been expounded in papers published previously in the London *Philosophical Transactions*; but the proposition in question here had not, so far as I know, been announced before.

<sup>16</sup> Newton, *Correspondence*, I, p. 96.

. . . . And that this may be done I have good reason to beleive, because ever since I first became acquainted with these Principles, I have with constant successe in the event made use of them for this purpose.<sup>17</sup>

It seems likely, however, that the success Newton here refers to is his ability to “compute or demonstrate” the spectral composition of the light resulting from such a process; and that the visual color produced thereby was determined only with the help of prior experimental determination of the visual appearance of lights of various spectral compositions. But Proposition VI of Book I, Part II of the *Opticks* poses the problem, “In a mixture of Primary Colours, the Quantity and Quality of each being given, to know the Colour of the Compound”;<sup>18</sup> and offers the following solution: Let the “primary”—i.e., the spectral—colors, from red through orange, yellow, green, blue, and violet (in their continuous gradations)<sup>19</sup> be represented, according to a prescription Newton gives, along the circumference of a circle; the region abutting the extremes of red and violet being filled by the gradations of *purple*, which do not occur in the spectrum.<sup>20</sup> Let the interior points of this circle represent colors in the following way: each *radius* represents colors of a single “quality,”<sup>21</sup> and the distance of any point of the radius from the center of the circle is “proportional to the Fulness or Intenseness of the Colour,

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<sup>17</sup> *Ibid.*, pp. 187-8.

<sup>18</sup> Newton, *Opticks* (Dover edition), p. 154.

<sup>19</sup> Newton says: “all the Colours of uncompounded Light gradually passing into one another”; and, again, refers to “all degrees of red” (etc.) (*ibid.*, pp. 154-5).

<sup>20</sup> *Ibid.*, p. 156.

<sup>21</sup> Here I use the term employed by Newton in his statement of the problem quoted above; in his formulation of the solution, he simply says that the point at which the radius meets the circumference “shall shew the Colour arising from the Composition [in question].”

that is, to its distance from Whiteness.”<sup>22</sup>—So far, then, we have (merely) a geometrical representation of (some) colors by the points of a certain plane area; and the *conceptual distinction*, in relation to this representation, of two aspects or parameters of the color, represented geometrically by (in effect) the *polar coordinates* of its representing point: what Newton calls the “quality” (or simply the “color”) and the “fullness or intensity,” and what we usually call the *hue* and the *saturation*.—Now comes the solution to the problem itself: Suppose we have a mixture of (let us first say—it is the only case Newton treats explicitly) a finite number of monochromatic colors, each in a given “quantity.” Then if we determine the *center of gravity* of a system of *weights*, placed at the positions of the circumference representing the colors in the mixture, with the weights themselves proportional to the “quantities” of the several colors, the position of that center of gravity will represent the resulting color—both in quality (hue) and in fullness (saturation).—An obvious generalization of this rule, which Newton surely would have taken for granted, is that if the composite is thought of as containing a *continuum* of spectral components, the resultant color should be represented by the center of gravity of an appropriate *continuous distribution* of weights. (On the other hand, Newton’s atomism—as well as the usual somewhat loose way of thinking of such matters in the mathematics, or at least in the mathematical physics, of the time—would probably have led him to be entirely content with the assumption of a finite, even if very large, number of “primary” constituents.)

There is an immediate, rather remarkable, corollary of this rule: Suppose we are concerned to determine the hue and saturation of a mixture of colors that are themselves *not* “primary,” but *composite*. Each of these will then be represented by a point inside the circle—which point is the center of gravity of a system of weights representing the actual spectral composition of the color in question (or

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<sup>22</sup> *Ibid.*, pp. 155-6.

more properly speaking, of the light that produces it). Clearly, for any interior point, there will be many—indeed, *infinitely* many—spectral compositions that will give the *same* resulting quality-cum-intensity (infinitely many systems of weights with the same center of gravity).<sup>23</sup> But from the properties of the center of gravity it follows that this ambiguity is of no consequence in the problem: namely, the result of the mixture of composite colors is itself the center of gravity of a system of weights placed at the points representing those *composite* colors—each proportional to the “quantity” of the composite color at whose representing point it is placed.

I want to emphasize just how surprising a result this is: Newton has already taught us that—as we may say—our visual system informs us incompletely about the light that falls on the retina.<sup>24</sup> That is not very surprising. But why should one have expected there to be, then, a mathematics of these “reduced forms” themselves, according to which they combine with one another, to determine effects as it were “causally,” in a fashion to which the lost information is no longer relevant? Why, that is, should the perceptual effect of a mixture of lights—which may be qualitatively quite different from the perceptual effects of its components separately—be nevertheless *determined* by the perceptual effects of those components, independently of their own actual physical constitution?

Newton did not point out this consequence of his rule—much less pursue it further. In fact, he stated the rule only as a convenient rough device for predicting the effect of color-combinations; he says: “This Rule I conceive accurate

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<sup>23</sup> To be extremely precise, a qualification would be required, because of the somewhat special character of the purples; but let this be passed over here.

<sup>24</sup> The word “informs” here is exactly appropriate: Newton has said that our perceptions are aroused by certain motions, but that we perceive these motions “under the Forms of Colours”; the motions thus “inform” our minds, in the etymological sense of that word; and those “forms,” the colors, have in another—almost a punning—sense lost “information” that was present in the stimulus.

enough for practice, though not mathematically accurate.”<sup>25</sup> In particular, one special consequence of the rule he *does* signalize, and expresses *doubt* that it is correct; he says:

[I]f only two of the primary Colours which in the circle are opposite to one another be mixed in an equal proportion, the point [that results] shall fall upon the center O, and yet the Colour compounded of those two shall not be perfectly white, but some faint anonymous Colour. For I could never yet by mixing only two primary Colours produce a perfect white. Whether it may be compounded of a mixture of three taken at equal distances in the circumference I do not know, but of four or five I do not much question but it may. But these are Curiosities of little or no moment to the understanding of the Phænomena of Nature. For in all whites produced by Nature, there uses to be a mixture of all sorts of Rays, and by consequence a composition of all Colours.<sup>26</sup>

7. There the state of that question—the special one of the possibility of producing the sensation of white by means of two spectral colors—rested until the 1850’s. Then a rapid and dramatic sequence of events occurred. First, Helmholtz published, in 1852, a report of a careful experimental study—executed with the help of a new technique expressly designed for this purpose—of *all possible combinations* of pairs of spectral colors (that is: *all* pairs, in *all* quantitative proportions; since there are infinitely many pairs, and infinitely many propor-

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<sup>25</sup> *Ibid.*, p. 158. — To the best of my knowledge, nothing has appeared in Newton’s papers that might clarify either the evidence on which his rule is based, or the methods by which he employed it in practice. These are matters that are not at all evident; evidence—or even plausible conjecture—bearing on them would, in my opinion, be of considerable interest.

<sup>26</sup> *Ibid.*, pp. 156-7.

tions for each pair, this is by no means a trivial accomplishment!). What he found was that the sensation of white could indeed be produced by such a pair, contrary to Newton's belief; but that only two narrow bands of the spectrum could be so matched as to yield white—namely, a band of yellow lights, each matched appropriately with an indigo blue; so that after all Newton was *right* in thinking that his rule was merely approximate (since that rule implies that each color whose diametric opposite is also a spectral color—not a purple—can enter in such a pair of “complementary colors”).<sup>27</sup> Very promptly—namely, in the following year—Hermann Graßmann published an article<sup>28</sup> in which he discussed Helmholtz's results from a purely theoretical point of view, and urged that these theoretical considerations made a reconsideration of Helmholtz's experiments desirable. I believe that this work of Graßmann's is not very well known

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<sup>27</sup> Hermann Helmholtz, “Ueber die Theorie der zusammengesetzten Farben,” *Annalen der Physik und Chemie*, 2nd series, **87** (1852), pp. 45-66.—To give an idea of the care with which Helmholtz reported his findings, I quote the passage—*ibid.*, p. 55—in which he states this part of his result: “Die auffallendste und von den bisherigen Ansichten abweichendste Thatsache ist die, daß unter den Farben des Spectrums nur zwei vorkommen, welche zusammen reines Weiß geben, also Complementarfarben sind, und daß dieß Gelb und Indigblau sind, zwei Farben, aus deren Verbindung man bisher fast immer Grün entspringen ließ. Das Gelb, was man zu dieser Mischung gebraucht, ist ein sehr schmaler Strich im Spectrum, zwischen den Linien *D* und *E* gelegen, und etwa dreimal so weit von *E* als von *D* entfernt, ein Gelb, welches weder in das Orange, noch in das Grünliche zieht und unter den Pigmenten am besten durch das chromsaure Bleioxyd (Chromgelb) wiedergegeben wird. Das dazu gehörige Blau hat eine grössere Breite und umfaßt die Abstufungen dieser Farbe, welche *Newton* und *Fraunhofer* als Indigo bezeichnen, etwa von der Mitte zwischen den Linien *F* und *G* bis gegen *G* hin. Unter den Farbstoffen giebt dunkles Ultramarin diese Farbe aber besser wieder, als das mehr violette Indigo.”

<sup>28</sup> Hermann Grassmann, “Zur Theorie der Farbenmischung,” *Annalen der Physik und Chemie*, 2nd ser., **89** (1853), pp. 69-84.

—certainly not to philosophers;<sup>29</sup> it seems worth taking a little time to describe his analysis.

Graßmann's argument is a somewhat sophisticated mathematical one—it rests on a *topological* consideration. But topology was still in its infancy at the time, and Graßmann's formulation, accordingly, is in a crucial place rather obscure. I shall take the liberty of giving a revised version of his assumptions and of the form of his reasoning (but shall not depart from the main principles of his account).—As to the principles, then, one may state them as follows: (1) Abstracting from the quantity—the dimness or brightness—of a color sensation, points representing the perceptual qualities of these sensations can be so arranged within a plane area that *continuous transitions* of perceptual quality correspond to continuous transitions—i.e., to connected (curved or straight) *lines*—in the plane, and conversely: that is, a transition among points is continuous if and only if the corresponding transition among sensory qualities is so.<sup>30</sup> (2) In this planar arrangement, every color of *maximal saturation* is a *boundary point* of the set of points corresponding to sensory qualities. These include the spectral colors.

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<sup>29</sup> For instance, in his well-informed, careful, and instructive book on color, C. L. Hardin cites Graßmann for the laws of color-perception formulated in the cited paper; but he does not even mention the argument I am speaking of—see C. L. Hardin, *Color for Philosophers: Unweaving the Rainbow* (Indianapolis: Hackett Publishing Co., 1988), pp. 29 and 195-6 (n. 8).—This is not said in criticism of Hardin, who discusses what he *intends* to discuss, but only to indicate that philosophers who turn to this work for information about the scientific understanding of color will in fact not learn about Graßmann's argument from it.

<sup>30</sup> To say that a transition among sensory qualities is “continuous” is here to be understood as meaning that it is effected by a series of *imperceptible* gradations. (Of course, this implies that the principle of assigning sensory qualities to points really requires a subtler analysis; for if the transitions are “imperceptible,” it cannot be the case that distinct points always represent *immediately distinguishable* qualities. How this matter is to be dealt with is a question in the theory of perception that is certainly beyond the scope of this paper; the fact that it is, accordingly, here simply “bracketed” may be taken to illustrate a philosophical point that will be made more generally later in the discussion.)

Since, moreover, the transitions within the spectrum are continuous, the points corresponding to the spectral colors constitute a *line*, or *arc*, on the boundary of that set; this arc is not a closed curve—it is, however, completed to a simple closed curve by the *maximally saturated purples*, and these, together with the spectral colors, (a) exhaust the maximally saturated colors, and (b) correspond to the complete boundary of the system of points that represent color-sensations at all: i.e., that region is the *interior*—all of it—of that closed curve.<sup>31</sup> (3) If we now choose any two maximally saturated colors—say, *a* and *b*—and consider their mixture in all possible quantitative proportions, then as these proportions vary continuously from “all *a* and no *b*” to “no *a* and all *b*,” the sensory qualities will vary continuously, and therefore (by principle (1)) the representative point will describe a continuous path within the plane region, starting at the point representing *a* and ending at that representing *b*. (4) (Here I depart from what Graßmann explicitly lays down): If, more generally, we allow the sensory qualities *a* and *b* and the ratio  $(1-\lambda) : \lambda$  in which these are mixed to vary independently (*a* and *b* around the bounding curve,<sup>32</sup>  $\lambda$  from 0 to 1), the function  $f(a,b,\lambda)$  whose value is the result of the indicated mixture is continuous simultaneously in its three arguments.

Now let any spectral color *a* be given. The bounding curve *C*, as a simple closed curve, admits two senses of traversal; choose one of them, and let it be called the “positive” sense. Then consider the following process: First take a path, along the bounding curve *C*, starting from *a* and following *C* in the positive sense all the way back to *a*: thus, a *closed* path. Then *deform* that path in this way:

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<sup>31</sup> Graßmann believed that the spectral colors themselves form a closed curve—i.e., that the extremes of red and violet are sensorily adjacent. Helmholtz, in the paper cited below (n. 34), corrected this error, pointing out what Newton had rightly said on this point.

<sup>32</sup> To reduce prolixity, I shall no longer distinguish explicitly between the sensory qualities on the one hand and their representative points on the other.

Think of a second point,  $b$ , as “moving” along  $C$ , *also* starting from a position that coincides with  $a$ , and *also* in the positive sense. For any position of  $b$  “after it has left  $a$ ,” let the “deformed” path go first from  $a$  to  $b$  through the “mixing” locus ( $a$  and  $b$  mixed in the ratio  $(1-\lambda) : \lambda$ , as  $\lambda$  varies from 0 to 1), and then back to  $a$  through the remaining positive arc of  $C$  (so that the positive arc from  $a$  to  $b$  has been, as it were, “erased,” and replaced by the “mixing path”). By virtue of our continuity assumption (4) above, this process is a *continuous* deformation (a “homotopy”) of the closed path. It begins with the path “ $C$  followed in the positive sense.” Where does it *end*, as  $b$  completes a traversal of the entire curve  $C$ ?—Clearly, at the end of the process  $C$  has been entirely “erased”—except for the single point  $a$ , which has been held fixed throughout (at *both* ends of the path). As  $b$  returns around the curve  $C$  to  $a$  (having left it “on the positive side,” but returning so as to have  $a$  “on the positive side” of  $b$ —thus  $b$  “on the *negative* side” of  $a$ ), the “mixing path” that takes us first from  $a$  to  $b$  will—again by the continuity assumption (4)—become *in its entirety* closer and closer to the point  $a$  itself; so that at the final stage the whole closed curve will have been deformed to the single point  $a$ .

Geometrically, this is all quite in order; but Graßmann’s conclusion now follows. For it is a fundamental theorem of the topology of the plane that in the course of any continuous deformation, within a plane, of a simple closed plane curve, that concludes by reducing the curve to a single point, *every point in the interior of the curve must be crossed, at some stage of the process, by the deformed curve at that stage*. But the color-quality *white* is represented by a point in the interior. Therefore, for every spectral color  $a$ , there is some  $b$ —which may itself be a spectral color or a purple—such that  $a$  and  $b$ , mixed in a suitable proportion, yield white.<sup>33</sup>

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<sup>33</sup> It should be noted that in this argument Graßmann does not make use of Newton’s full construction, but only of weaker principles implied by that construction.

Helmholtz found this reasoning sufficiently impressive that he reconsidered the circumstances of his own experiments (an issue that Graßmann had not addressed)—and recognized that, in spite of the ingenuity of the technique by which he had contrived to produce simultaneously *all possible* mixtures of spectral colors, there was a possible flaw (or, rather, there were *two* possible flaws) in the experimental design. Accordingly, he arranged for the construction of a new instrument, with whose help he was able to produce, again, all possible mixtures in all possible proportions, but in this case to view them, successively, each *in isolation*.<sup>34</sup> This more painstaking method substantially confirmed Graßmann's contention; more precisely, it showed that the colors of two spectral intervals—from extreme red through what Helmholtz describes as greenish yellow, and from greenish blue through violet—can be placed in one-to-one

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<sup>34</sup> Helmholtz, "Ueber die Zusammensetzung von Spectralfarben," *ibid.*, 94 (1855), pp. 1-28.—Although this paper appears in the volume of the *Annalen* dated 1855, it is cited in Helmholtz's *Handbuch der physiologischen Optik*—see the translation, from the third edition, under the title *Treatise on Physiological Optics*, tr. James P. C. Southall (reprinted New York: Dover Publications, 1962), vol. 2, p. 164—under the year 1853. (A qualification is perhaps in order for the sake of accuracy: it is indeed true that Helmholtz's new instrument allows arbitrary pairs of colors to be mixed in arbitrary ratios; and it also allows *continuous* transitions to be made, (a) from one to another color—paired with a given one, and (b) from one to another ratio of these colors. But since the transition from one color to another will be with the ratio fixed, and the transition from one ratio to another will be with the pair of colors fixed, it is easy to see that the experimenter cannot actually view all possible *combinations* of pairs and ratios. This is the price paid for the ability to view the resulting mixtures *in isolation*—which Helmholtz's critique of his first attempt showed to be a strong desideratum. In practice, this means that a lengthier set of observations is required, with the gaps between successive combinations tried made very small; but that Helmholtz was able to achieve—with small enough gaps to lead to a successful outcome.)—It is perhaps worth noting, as a historical curiosity, that the article "Colour" in the eleventh edition of the *Encyclopædia Britannica* (1911) still asserts, on the authority of Helmholtz's paper of 1852, that "H. Helmholtz has shown that the only pair of simple spectral colours capable of compounding to white are a greenish-yellow and blue."

correspondence as complementary colors, each such complementary pair—combined in a suitable ratio—producing white. (The remaining interval, comprising the gradations from yellowish green through green to bluish green, have as their complements, not spectral colors, but purples; this Helmholtz’s instrument, specifically designed to mix *pairs* of spectral lights, did not demonstrate.)

The cited argument of Graßmann does not use, and the principles that are used in it do not imply, the corollary of Newton’s construction to which I have called attention previously; but in the latter part of his paper, Graßmann introduces that principle, along with another (which he describes as less compelling), as a basis from which to infer the correctness of Newton’s full construction. In point of fact, this part of Graßmann’s reasoning contains a defect: as Helmholtz rightly points out, the full set of assumptions of Graßmann indeed imply the correctness of Newton’s center-of-gravity rule for locating the result of a mixture of colors (when the “quantities” of those colors are suitably defined), but do not imply that, under this rule, the spectral colors will be located on the circumference of a geometrical circle.<sup>35</sup> The matter was made the subject of

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<sup>35</sup> (1) I say “geometrical circle,” because the maximally saturated colors *do*—according to these principles—comprise a simple closed curve: that is, a “topological circle.” (2) Since Newton’s description of the construction *begins* with the placement of the spectral colors on the circumference of a circle, a word is in order about the modified procedure that does not involve any assumption about their location. This consists in first choosing *any* three color-sensations, no one of which can be produced by mixing lights that themselves yield the other two, and assigning to them three arbitrary non-collinear points (one will do well here to choose three quite saturated colors whose hues are widely separated in the spectrum; but this is inessential); and then proceeding as follows: To any mixture of the three initial colors, assign as representative point the one determined by Newton’s center-of-gravity rule, using as weights the relative quantities of the three colors in the mixture. (If the three “initial” colors are those of *pigments*, the relative quantities can be both *defined* and *achieved* by the technique of the “color-top”—a device both simple and ingenious, whose description I here forgo.) This procedure fills up the interior and perimeter, in the plane, of the triangle whose vertices are the three “initial” points. That the center-

a series of wonderful experimental investigations by the young James Clerk Maxwell.<sup>36</sup> His main results were as follows: (a) The center-of-gravity rule is

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of-gravity construction is correct for further mixtures of colors within and on the perimeter of this triangle now follows from Graßmann's principles. To reach colors not attainable as such mixtures is now, in principle, straightforward (although for spectral colors, not strictly reproducible by pigments, a more sophisticated device than the color-top is required to control the quantities in a mixture). Let us suppose, for simplicity, that *white* is already contained within our triangle; and let the new color whose location is to be determined be designated *c*. Then *some* mixture of the color *c* with white will fall within the triangle. The location of the point representing that mixture can be found, by producing the same color by a mixture of our initial three (e.g., by trial and error—successively approximating the result we want—with the color top); and if we determine the ratio  $(1-\lambda) : \lambda$  of white to the color *c* in that mixture, we shall be able to locate the point at which a weight equal to  $\lambda$  must be placed in order to have, together with a weight equal to  $1-\lambda$  at the point representing white, its center of gravity at the *known* point representing that mixture. — The essential fact here is that the geometrical distribution of the spectral colors becomes, once the initial triad has been selected, an *empirically determinable fact*.

<sup>36</sup> See "On the Theory of Colours in relation to Colour-Blindness," in *The Scientific Papers of James Clerk Maxwell*, ed. W. D. Niven (Cambridge University Press, 1890; reprinted, two volumes bound as one, New York: Dover Publications, 1965), vol. I, pp. 119-25; "Experiments on Colour as perceived by the Eye, with remarks on Colour-Blindness," *ibid.*, pp. 126-54; "On the Theory of Compound Colours with reference to mixtures of Blue and Yellow Light," *ibid.*, pp. 243-5; "On the Theory of Compound Colours and the Relations of the Colours of the Spectrum," *ibid.*, pp. 410-44; cf. also the summary of a lecture at the Royal Institution, "On the Theory of Three Primary Colours," *ibid.*, pp. 445-50, and a second such lecture, reported in full, "On Colour Vision," *ibid.*, vol. II, pp. 267-79. (These papers were published, respectively, in 1855, 1856, 1857, and 1860; the Royal Institution lectures were delivered in 1861 and 1871). In the first three papers, Maxwell reports results obtained by means of his color-top; the fourth, which treats of mixtures of *spectral* colors, required (cf. *ibid.*) a more sophisticated instrument, the "color box" invented for the purpose by Maxwell; and he tells us (*Scientific Papers*, I, 415) that an apparatus of this kind had already been made and used by him in 1852—when Maxwell was 23 years old, and before Graßmann's discussion had appeared (almost surely, also, before Maxwell knew of Helmholtz's first investigation; for he refers—*ibid.*, p. 414, n.—to the English version of the latter as published in the *Philosophical Magazine* for December, 1852).

correct to a high degree of precision. (b) The boundary curve on which the spectral colors lie is quite far from a circle: two large portions of that curve (for colors extending from a scarlet-red to a green, and from a bluish green to a blue) are *nearly straight*, so that the spectral colors can be described more accurately as distributed on the boundary of a figure that is approximately a triangle, but with slightly curved sides in the spectral regions named, and a more pronouncedly rounded-off vertex in the green. (c) He initiated the investigation of the perceptions of so-called “color-blind” observers, with a view to obtaining certain fundamental pieces of information concerning the visual process. But this last matter deserves a new (though brief) section.

8. As I have remarked before, the corollary of Newton’s rule—indeed, what in view of the investigations I have described deserves to be called the *fact*—that one can predict the sensation to be produced by a mixture of lights if one knows the sensations produced by each separately, irrespective of further information about the physical constitution of those lights—and this, let me add, despite the fact that in the sensation produced by the mixture there may be no trace whatever of the sensory qualities of the components (e.g., blue and yellow, or red and blue-green, or greenish yellow and violet, can produce white; orange and green can produce yellow)—and further, that these sensations are determined by a very simple mathematical construction, is quite surprising. It is *not* surprising, therefore, that an explanation was sought; nor, further, that such a striking fact about perception was seen as a possible clue to the perceptual process itself.

The first suggestion on this score was made, near the beginning of the nineteenth century, by Thomas Young.<sup>37</sup> The nub of it is that there are three fundamental neural processes, respectively stimulated by the absorption of light by pigmented retinal cells of three different kinds; that each process separately

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<sup>37</sup> Cf. Maxwell, *Scientific Papers*, I, 412-13.

can be conceived to initiate a sensation corresponding to a single point in the plane of color-qualities; that a light-beam of given spectral composition, falling on the color-sensitive cells of the retina,<sup>38</sup> stimulates these three processes with particular respective intensities; and that—within the limits of “moderate” stimulation—a beam obtained by *mixing* two others produces each of the three fundamental processes with intensities that are the *sums* of those produced by the component beams separately. The “center-of-gravity” construction then simply represents the appropriate weighted combination of the fundamental processes.

Now, since all *actual* color-sensations must, on this hypothesis, be located at points within what we may call the “fundamental triangle”—the one whose vertices represent the fundamental processes (since that is where all possible centers of gravity of non-negative weights placed at those three points lie)—it follows that this triangle must contain the entire curve of the spectral colors. The fact that the spectral curve, according to Maxwell’s results, is itself close to two sides of a triangle, suggests that this is itself close to the fundamental triangle. It was in order to obtain more definite information on the geometrical location of the fundamental processes that Maxwell undertook the investigation of the visual responses of color-blind observers mentioned above. His basic working assumption here was that the visual system of a typical color-blind person lacks one of the three fundamental processes, but is otherwise “the same as”<sup>39</sup> that of a

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<sup>38</sup> That is, as we know but Young did not, the “cones” of the retina.

<sup>39</sup> I put “the same as” in quotes, because although there is a high degree of agreement in the geometry of perceived colors among ordinary observers, there are small individual differences, as Maxwell’s original experiments with just two observers (whom, by the way, he refers to [*Scientific Papers*, I, 433 ff.] as “J.”—for “James”—himself—and “K.”—for “Katherine”—his wife) already showed. The degree of agreement implied by “the same,” therefore, is roughly the degree of *approximate* agreement that holds among “normal” persons themselves. And I speak of a “typical” color-blind person, to indicate that there is in fact a diversity

visually normal person. On this assumption, a comparison of the geometry of the “normal” and the “color-blind” person allows one to determine what *hue* corresponds to the process the latter lacks. This of course is far from locating the actual *point* corresponding to the missing process; it is, however, a beginning in that direction.

I shall not pursue this question in further detail, but only add that evidence of the kind Maxwell collected has made it plausible that the three fundamental processes belong to particular red (or purplish-red), green, and blue (or violet-blue) hues:<sup>40</sup> i.e., that these are the *physiologically* “primary” colors; and, further, that the long-sought anatomical evidence for the existence of three classes of pigmented cone-cells in the retina has at least in part been obtained, in the second half of the century now drawing to a close.<sup>41</sup>

It is perhaps worth noting – although a small point – that this now well-established

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of such types, but among them two – “red-blindness” (or “Daltonism”) and “green-blindness” – that do satisfy Maxwell’s assumption (with different “missing” processes, as the terms themselves imply).

<sup>40</sup> So naming them, it should be understood, does not imply that these are (the hues of) the spectral lights for which the three pigments have, respectively, *maximum absorptiveness*; they are, rather, the respective hues that would be seen by a (visually normal) person if *only that one* of the systems of absorptive cells were stimulated; or, since that ideally conceived circumstance may be impossible to attain, the respective hues that would be seen if all three systems were stimulated, but the two others in such proportions that the net effect is one of “white, plus an excess of the response of the one system in question.” In this last case – which *can* be attained in practice – what the observer will see is a color of the *hue* corresponding to the one preponderant system, but of a *lower saturation* than that “ideally” produced by that system in isolation. (Further, it should go without saying that these are not even nearly the “colors of the pigments”: indeed, the colors *of* the pigments are complementary to – now speaking roughly – the colors *absorbed by* the pigments.)

<sup>41</sup> I here take a stand on a recently burning issue. (Let me add, however, that in my view a century – a millennium too – is *always* drawing to a close: it is always a hundred years since *something* or other – and a thousand, likewise.)

lished result has an implication concerning the existence of *sensory colors that have never been actually sensed*; in other words, an implication at least distantly related to the celebrated issue raised by Hume of the possibility of inferring, as an “idea” without an antecedent “impression,” a “particular shade of blue” which the subject has never perceived. For according to the theory I have described, the three fundamental neural processes cannot all correspond to sense-qualities evoked by actual light. In particular, the process corresponding to a green hue—the green region of the spectrum being notably curved in Maxwell’s diagram—must correspond to a *more highly saturated* green than is producible optically. Nor is it out of the question that such a “supersaturated” green might actually be produced, some day, as a sensation; it would only be necessary to find a way of stimulating the “green” process without stimulating either of the other two (e.g., by very nicely discriminated electrical stimulation of nerve-fibers; or, on the other hand, optically, by the use of pharmacological agents to paralyze, temporarily, the other two processes).<sup>42</sup>

#### 9. What does all this imply about the colors of things?

A first point about this requires still further *knowledge*: knowledge, namely, of the fundamental difference between the effects of the mixing of colored *pigments* and the mixing of colored *lights*. This matter seems not to have been understood before the appearance of Helmholtz’s paper of 1852, cited above. Newton, in his

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<sup>42</sup> For Hume’s posing of the issue, see David Hume, *A Treatise of Human Nature*, ed. L. A. Selby-Bigge (2<sup>nd</sup> ed., with scholarly revisions by P. H. Nidditch; Oxford: Clarendon Press, 1978), Book I, Part I, §I; pp. 4-5. There is, to be sure, a difference of more than detail between Hume’s hypothetical case and the real one I have mentioned: for Hume asks, not simply whether the *existence* of a not yet perceived “idea” can be inferred, but whether the “idea” itself—i.e., the mental image of the color—can be formed. I have some doubt that ordinary people (such as myself)—in contrast to people with the gift of eidetic imagery—can form “ideas” of colors in Hume’s sense *at all*.

discussions of color-mixing, freely appeals to the appearances of mixtures of colored *powders*; and this presumably is the reason for his uncritical use, in his first paper, as the first instance of his claim that colors of the same appearance as those of the spectrum can be produced by mixing, of the proposition that “a mixture of *Yellow* and *Blue* makes *Green*.” It is, in fact, *false* that anything close to the appearance of monochromatic green can be produced by mixing yellow and blue lights.<sup>43</sup>

Helmholtz’s explanation of the difference rests essentially upon the observation that the colors of ordinary opaque bodies are *not* the result of

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<sup>43</sup> Newton’s initial failure to notice this fact, and his failure ever to point out the difference between mixtures of lights and mixtures of pigments, makes the question of his actual procedure in arriving at his center-of-gravity rule (cf. n. 25 above) a still more tantalizing one. For his statements about the combining of blue and yellow to make green, cf. the *Correspondence*, I, 98, paragraph numbered “6.”, and *Opticks*, Bk. I, Part II, Prop. IV and its discussion (especially, in the Dover edition, p. 133).—There is, I think, some evidence here that Newton eventually noticed that something isn’t quite as one would have expected in the mixture of blue and yellow lights. For whereas in the earlier passage he says quite flatly, and as his first instance of the claim that colors *indistinguishable from spectral ones* can be produced by composition: “For, a mixture of *Yellow* and *Blew* makes *Green*,” in the (much) later-written passage, his first instance is that of “a Mixture of homogeneal red and yellow” — which, he rightly says, “compounds an Orange, like in appearance of Colour to that orange which in the series of unmixed prismatick Colours lies between them”; he passes from this to yellow and green, which make “the Colour between them both” (right again); and — quite strikingly — he proceeds as follows: “[A]nd afterwards, if blue be added” — that is, added to the mixture of yellow and green — “there will be made a green the middle Colour of the three which enter the Composition. For the yellow and blue on either hand, if they are equal in quantity they draw the intermediate green equally towards themselves in Composition, and so keep it as it were in *Æquilibrium*, that it verge not more to the yellow on the one hand, and to the blue on the other, but by their mix’d Actions remain still a middle Colour.” — This is true; and the fact that Newton has substituted this elaborate correct statement for the simple but incorrect one that yellow and blue make green, is hard to explain otherwise than as the result of his having found it impossible to make green from spectral yellow and blue. Yet he does not say so — much less does he discuss the implied discrepancy between mixing lights and mixing pigments.

selective reflection of light by their surfaces; rather, the light that falls on such a body penetrates a short distance into the body (as Newton had already remarked);<sup>44</sup> and as it successively traverses particles of the body, experiences—successively—in each of them selective absorption. Almost all the light that is ultimately scattered back from the body, then, has had some of its spectral constituents removed by that selective absorption in the *assorted* particles of the body's surface layers. Now, a yellow pigment will absorb, in the layers near its surface, most of the light of the spectrum in the blue and violet regions; and a blue pigment will similarly absorb most of the light from red through yellow. Therefore, if blue and yellow powders are mixed (which is what happens when blue and yellow paints, or dyes, or crayon, are mixed), the result will be the scattering back, not of blue and yellow lights, but of light from which all the spectral components except the greens have been largely eliminated.<sup>45</sup>

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<sup>44</sup> *Opticks*, Book II, Part III, Prop. II (Dover ed., p. 248): “*The least parts of almost all natural Bodies are in some measure transparent: And the Opacity of those Bodies ariseth from the multitude of Reflexions caused in their internal Parts.*” (He adds, “Only white metalline Bodies must be excepted, which by reason of their excessive density seem to reflect almost all the Light incident on their first Superficies.” The exception is as sagacious as the general proposition.)

<sup>45</sup> One would think that this, by the middle of the twentieth century, was widely known. As a sign that it was not (perhaps still is not) so, and also as an object lesson in the care that has to be taken in intellectual history, let me cite a curious circumstance: Browsing in H. W. Fowler's *Modern English Usage*—a book that I have long found to provide both nourishing and toothsome intellectual food—I came across an article on “primary colours,” to the following effect: “As the phrase is used in different senses, the OED definition is here given: ‘Formerly, the seven colours of the spectrum . . . ; now, the three colours red, green, and violet (or, with painters, red, yellow, and blue), out of which all the others are said to be produced.’ That the painters have the better of the argument will be admitted by anyone who has tried to produce a pure yellow out of red, green, and blue.” Since I very much admire Fowler's general good sense and scholarship, as well as his wit, I was surprised—nay, troubled—to find that he had indulged in this piece of ignorant raillery. It then occurred to me that the volume I had before me was the *second edition* of the work (Oxford University Press, 1965), and that this had been revised by Sir Ernest Gowers—with no

I emphasize the main point: The color that we *see* as characteristic of the *outermost surface* of an ordinary (not metallic) body is in fact a characteristic, *not*, strictly, of *any surface*, but of (the interaction with “ordinary” light of) particles extending to a physically measurable depth within the body: namely, of a process, both of absorption and of scattering, that takes place, successively, in the interiors of those particles.

10. It is almost time to return to Locke and to McDowell; but before doing so, I want to add something to my earlier brief remarks about the color of the sky.

I said that the sky looks blue because it *is* blue; because blue is the color of *air*. But why, then, does the sky look like a blue *surface*, *above* us, and not like a blue ambience that surrounds us?—Perhaps I should, for the purposes of a lecture, just let this question hang, omitting any detailed explanation (but *not* omitting to remark that a full understanding of this fact is available, on the basis of the optics of vision).<sup>46</sup>

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indication of the alterations made. I therefore checked the first edition (Oxford University Press, 1926); and sure enough, the article appears there just as quoted, *except* for the final sentence—which, therefore, is Gowers’s, not Fowler’s at all.

<sup>46</sup> For the purposes of a *paper*, such omission is undesirable; here is the explanation: The blue light we receive from an ordinary blue surface, according to the account given just above, arises from selective scattering—the selectivity, in this case, as stated, is the result of selective *absorption*—from particles located to a measurable depth in the body, but a very *small* depth. The corresponding light waves reach the eye, and are focused on the retina, as light waves emanating, for a given direction, from a microscopically small range of distances, and distances that are to the accuracy of visual discrimination “the” distances of parts of the body’s surface from the observer’s eye(s). It is under these circumstances that we “see a blue surface at a certain distance.” Now, in the case of the light selectively scattered by the air—incidentally, the selectivity in this case is *not* due to absorption: almost all the remainder of the light is *transmitted* without scattering—the scattering that occurs in the course of a thickness even of many miles of air is minute; it is only the cumulative scattering over *very* many miles that is appreciable. In consequence of this fact, essentially all the blue light that reaches the eye from a direction tending toward the sky is in the form of

A second point: Everyone has observed that the *sun*, when high in the sky, looks *yellow*. But how is it, then, that daylight—which of course is the light we receive from the sun—is *white*: why do ordinary white objects—which do in fact scatter to our eyes the light that falls on them with its spectral composition nearly unchanged—*look* white and not yellow?—I suppose the answer will be fairly obvious: The light by which we see ordinary objects “ordinarily”—in daylight, without artificial illumination—is indeed light that we receive from the sun, but it is not (ordinarily) the direct light of a sunbeam; it includes light that has been scattered (“skylight”). Correspondingly: viewed from outside the earth’s atmosphere, the sun itself would look white; *we* see the sun as yellow because yellow is the color complementary to the blue of the sky: the resultant color of the directly transmitted light *out* of which sky-blue light has been scattered.

The moon presents a rather interesting case—a point I have never seen discussed, and that it only occurred to me to think about when I was meditating upon this paper: The light we receive from the moon is, of course, (principally) light that has reached the moon from the sun and then has been diffusely reflected from the moon. This moonlight undergoes the same scattering by the air that sunlight does. So if we assume that the light reflected from the moon is itself white, the moon (when high in the sky) will appear to us to be yellowish; and so it does—at night. But the moon, when it is in a gibbous phase—far enough from the sun in the sky, but not too far to be high above the horizon at the same time the sun is so—is also visible to us by day; and the daytime moon

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waves of corresponding wave-length emanating from a *very great* distance: in effect, then, *plane* waves. But the eye simply cannot discriminate the true distance to the center of curvature of a nearly plane wave—the corresponding point of emanation is simply seen as “very distant”—whether that distance is, say, 20 yards or many light-years. (That is why the moon, the sun, and all the stars, do not appear to our vision as at different distances.) So the blue that the eye receives from scattering by the air does just induce the impression of “blue at a great distance”: hence, a remote blue surface.

does not look yellow at all. Why?—The answer is perhaps less obvious, but not very difficult. When we turn our eyes towards the moon in daylight, the light we receive, from the direction of (each point) of the moon's surface, is *not* simply the light reflected towards us by the moon's surface, *out* of which blue light has been scattered by the intervening air; it includes also light that has been scattered *towards* us by the intervening air, *out* of the light traversing the air from the sun. In other words, *all the blue "skylight" we should ordinarily receive from that direction we still receive*—the presence of the moon, and the light from it, does not *diminish* that blue, but is simply added to it. The resulting total light has no trace of a yellow hue—in so far as it departs from an "ideal" white, it is, perhaps, slightly bluish (because the light scattered "in," from the intense illumination of the sun, exceeds that scattered "out," from the moon's weaker light).

11. One who has found McDowell's view persuasive may react with some impatience to all that I have so far said—may consider it essentially irrelevant to McDowell's philosophical aims. For McDowell explicitly fences off from his purpose the issue of providing an *explanatory* account of secondary qualities. He writes:

A "*virtus dormitiva*" objection would tell against the idea that one might mount a satisfying explanation of an object's looking red on its being such as to look red. . . . Still, however optimistic we are about the prospects for explaining colour experience on the basis of surface textures, it would be obviously wrong to suppose that someone who gave such an explanation could in consistency deny that the object was such as to look red. The right explanatory test is not whether something pulls its own weight in the favoured explanation . . . , but whether the explainer can consistently deny its reality.<sup>47</sup>

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<sup>47</sup> McDowell, *Mind, Value, and Reality*, p. 142.

“However optimistic we are about the prospects for explaining colour experience on the basis of surface textures” seems to me to display an astonishing ignorance of the state of the question *in physics* today—it harks back, rather, to the rudimentary conceptions of Locke himself. It is not “surface textures” (unless this phrase is construed, generously and metaphorically, to stand for what here follows), but available energy-intervals for quantum state-transitions of the electrons in the body’s particles (or, in the case of a metal, the characteristics of its system of conduction-electrons) that determine its interaction with incident light; and for this, “we”—if that means the best-informed contemporary community of scholars—are not in a condition of “optimism” or the reverse, but of rather firmly established *knowledge*.—Of course, this knowledge does *not* amount to an explanation of “color experience”; but *no* such explanation is conceivable on the basis of “surface textures,” or of *any* intrinsic physical properties of ordinary bodies. Rather, Newton’s implied correction to Locke shows that if there is to be an explanation of color experience, it will have to take the form of (a) an account of the effect of bodies upon the light incident on them—an account which we *do now have*; (b) an account of the effect of light that reaches the retina upon the central nervous system—and this account we have *in part*;<sup>48</sup> and (c) an account—a *theory* of some sort—of how neural processes produce “experience.” The last part, (c), we do not have at all today.

Waiving that point temporarily, I am *almost* again inclined to say that if this, so far as secondary qualities are concerned, is all McDowell means: namely, that

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<sup>48</sup> The discussion I have given in §§6-8 above omits any reference to neural processing higher in the nervous system than the retina itself—which is the terminus of the optic nerve, and is the locus of the three-component process posited in the Young-Helmholtz-Maxwell theory. A good introductory account of those higher levels of processing is to be found in the book of Hardin already cited (n. 29 above).

when one sees an object as red, it is then “such as to look red” –then I do not disagree. So far as this is concerned, what makes me uneasy is a feeling that can be expressed in a phrase I once heard attributed to Wolfgang Pauli, who was responding to a suggested theory in physics: Pauli is reported to have said, “*That theory isn’t even wrong!*”

But this is *not* all McDowell means. He certainly intends to distinguish between objects that merely look red (for instance, a portion of a motion-picture screen on which there appears an image of a red carpet) and objects that *really are* red (say, a red carpet). –I allow him this distinction, as a perfectly intelligible one in ordinary speech. But for him, it is important –it is crucial to the argument he makes about *values* on the basis of an analogy to secondary qualities – that this is a distinction fundamental to the philosophical understanding of the matter. And he makes this claim in a way that implies the irrelevance to it of such facts about perception as the ones I have described. Here he is, for instance, discussing – with respectful criticism – some views expressed by Bernard Williams (in the latter’s book on Descartes):

Williams considers an account of colour properties as dispositions to look red, green, etc., in certain circumstances; but he expresses scepticism about it, on the ground that “it leaves us with the discouraging task of explaining ‘. . . looks green’ in some way which does not presuppose any prior understanding of ‘. . . is green’” . . . . This pessimism seems well placed . . . .

Williams writes of “understanding, . . . , at a general and reflective level, why things *appear variously coloured* to various observers” [emphasis added by McDowell]. Of course there is no disputing the possibility of such an understanding, on the basis of information about the behaviour of light and the construction of visual equipment. But it seems to be an illusion to suppose that such understanding could still

be forthcoming after we had definitively left behind a view of the world that represents colours as properties things have (it would be a mere pleonasm to say “really have”): in such a position, we would no longer understand what it was that we were supposed to be explaining.<sup>49</sup>

McDowell’s response is to endorse Williams’s “pessimism” over the prospect of explaining “*x* looks green” in some way that does not presuppose a prior understanding of “*x* is green”; but to save the dispositional account by maintaining that the disposition itself is (a) a veritable property of the body,<sup>50</sup> but (b) a property whose possession by a body is *intelligible in no other way* than in terms of the perceptual appearance it is disposed to present.<sup>51</sup>

It is perhaps difficult to see how, if the meaning of the statement “*x* looks green” cannot be explained without a *prior* understanding of “*x* is green,” and if the statement that *x* is green can only be understood in terms of its disposition to present the appearance recorded by “*x* looks green,” it can be at all possible to learn to understand either of these statements. I find it striking that McDowell’s carefully formulated characterization of secondary qualities makes use of the convoluted—and in my view rather slippery—phrase, “not adequately understood except as true, if it is true, in virtue of . . .”; and that this phrase itself and

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<sup>49</sup> *Ibid.*, pp. 122-3. (This occurs in the paper “Aesthetic Value, Objectivity, and the Fabric of the World,” in which McDowell intends only to explore the ground for what he regards as a better view both of secondary qualities and of the objectivity of values—see §6 of that paper, *ibid.*, p. 129. His positive solution to the problem is offered in “Values and Secondary Qualities.”)

<sup>50</sup> Cf. “colours as properties things have (it would be a mere pleonasm to say ‘really have’).”

<sup>51</sup> Cf. the passage already quoted from “Values and Secondary Qualities”: “A secondary quality is a property the ascription of which to an object is not adequately understood except as true, if it is true, in virtue of the object’s disposition to present a certain sort of perceptual appearance.”

the discussion around it implies that the view—or way of speaking—being offered is not only an illuminating one, but one to which there is no intelligible (or “adequate”) alternative. As against that, it seems to me that a modest rejoinder, in three parts, is warranted and is telling: (1) Any attempt to make the distinction between “just looking red” and “being red” a sharp one—and not simply a usable working distinction in ordinary circumstances—faces quite serious problems (for discussion of these I refer to the excellent treatment of the matter by C. L. Hardin in *Color for Philosophers* [see n. 29 above; cf. also my remark at the end of n. 12]). (2) On the other hand, the view that “*x* looks red” is intelligible without a philosophical commitment to a sharp distinction of that kind seems perfectly tenable in ordinary life. Could one not, after all, teach a child to recognize colors strictly by the use of an illuminated screen—one that “is” itself white? The child would learn to say, “Now it looks red; now it looks green; etc.—without “presupposing,” or *having*, a prior notion of red and green as “properties that things *have*”: this notion would naturally follow afterwards, simply from observation of chromatic stability.) (3) The questions that arise about colors—about, in ordinary parlance, “the colors of things” (of the sky; of the sun; of the nocturnal and the diurnal moon; . . .)—can be discussed, in the way I have tried to exemplify in my earlier remarks, without *any* doctrine about the ontology of color; and such discussion—I hope I have convinced you by those examples—can genuinely satisfy the curiosity expressed by such questions—again, without any need to take a stand, *one way or the other*, on the issue of whether colors are in some fundamental sense “really in things.” (I call this a “moderate” rejoinder because it does not claim to refute a theory of the ontology of color. It does claim to refute the view that one such theory is *clearly prerequisite* to the understanding either of ordinary discourse or of our best current knowledge about color.)

**12.** I spoke at the outset of the “enterprise of understanding” —in the sense of *the*

*development of concepts*—as best taken to march along with the “enterprise of knowledge”; and I have suggested that that is in accordance with Locke’s deeper conception of his own enterprise. To me it is clear—although this is certainly a matter of one’s historical-philosophical *judgment*—that Locke himself would have been very glad to modify his doctrine of the classification of ideas and qualities in the light of the investigations I have here described; and would have been quite delighted to find that, through those investigations, his pessimistic assessment of the prospects for *both* knowledge *and* understanding had been proved wrong.<sup>52</sup> To appreciate the gap between Locke’s view of this whole matter and that which most later commentary has taken him to have, and which plays an important role in McDowell’s analysis, it is worth examining the reason for the *epistemological* emphasis Locke introduces into the primary/secondary distinction in the late form of the *Essay* (in contrast with the absence of that emphasis, which I have already pointed out, in his draft), and the connection of this with the grounds of Locke’s pessimism about scientific knowledge.

The nub of the matter is that Locke’s empiricism contains a strangely undigested residue of the principles of Descartes. The latter thought that genuine science must be systematic—in something like the way mathematics is systematic; *and* that it must be grounded in the clear cognizance of simple and indubitable “ideas.” He thought, too, that we possess a sufficiency of such ideas—indubitable in the inner light of reason—to serve as a foundation of natural philosophy. Locke had a quite similar view of what genuine science must be, if we can have it at all; and he believed that our ideas of natural things—of bodies—are all derived from (or “terminate in,” as he likes to say) our “simple

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<sup>52</sup> As partial, but weighty, evidence on this point, there stands the fact that Locke *was* delighted to find that his pessimistic assessment of the prospects for knowledge in physics had been proved wrong by Newton’s discovery of the law of universal gravitation. See, on this point, the discussion in Stein, “On Locke, [etc.],” pp. 30-33.

ideas of sensation.” The analogue, for Locke, of Descartes’s “clearly and distinctly conceived natures,” are the primary qualities. These are not, for Locke, known *a priori* (to use that term anachronistically); but they *are* known in some sense “directly”: they (the strictly corporeal ones) are the qualities corresponding to *certain* “simple ideas of sensation.” And Locke concludes—in the *Essay*—that the only way we could have scientific knowledge of nature is by tracing natural phenomena back to these primary qualities; i.e., by comprehending such phenomena entirely through certain ones of our simple ideas of sensation. In this process, the secondary qualities (which are of course enormously important in helping us deal with the exigencies of life) can in principle play no role; for we know them *only* as “powers to produce the corresponding ideas in us.” The ideas of primary qualities tell us fundamental things about bodies; the ideas of secondary qualities do not.<sup>53</sup> But Locke also considers that what we know of the primary qualities is clearly insufficient to serve as a basis for systematic knowledge; and he is led to say: “[I]t seems probable to me, that the simple *Ideas* we receive from Sensation and Reflection, are the Boundaries of our Thoughts: beyond which, the Mind, whatever efforts it would make, is not able to advance one jot; nor can it make any discoveries, when it would prye into the Nature and hidden Causes of those *Ideas*.”<sup>54</sup> This is an estimate of the scope of what I am calling “the enterprise of understanding”; and here is Locke’s correlative estimate of the outlook for the enterprise of knowledge:

I am apt to doubt that, how far soever humane industry may advance useful and *experimental* Philosophy in *physical Things*, *scientific* will still be out of our reach . . . . By the Colour, Figure, Taste, and Smell,

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<sup>53</sup> Locke expresses this by his unfortunate formula, that the ideas of primary qualities are “resemblances” of those qualities as they are in the bodies, those of secondary qualities not so. (The formulation is perhaps derived from Descartes.)

<sup>54</sup> Locke, *Essay*, II, xxiii, 29; p. 312.

and other sensible qualities, we have as clear and distinct *Ideas* of Sage and Hemlock, as we have of a Circle and a Triangle: But having no *Ideas* of the particular primary Qualities of the minute parts of either of those Plants, nor of other Bodies which we would apply them to, we cannot tell what effects they will produce; Nor when we see those Effects, can we so much as guess, much less know, their manner of production. Thus having no *Ideas* of the particular mechanical Affections of the minute parts of Bodies, that are within our view and reach, we are ignorant of their Constitutions, Powers, and Operations: and of Bodies more remote, we are yet more ignorant not knowing so much as their very outward Shapes or the sensible and grosser parts of their Constitutions.<sup>55</sup>

Locke, in my opinion, was not only a serious and honest thinker (I suppose no one questions this), but a far more interesting one than many people believe—and above all, a far *deeper* one. On the system of general principles I am now discussing, Locke offers, in the *Essay*, remarks that amount to a profound critique of the cogency of those principles. At his first introduction of the primary/secondary distinction in the finished *Essay*, Locke also makes a statement about what sorts of interaction among bodies could form the basis of scientific knowledge; he had written, in the first edition:

The next thing to be consider'd, is how *Bodies operate* one upon another, and that is manifestly *by impulse*, and nothing else. It being impossible to conceive, that Body should operate on what it does not touch, . . . or when it does touch, operate any other way than by Motion.<sup>56</sup>

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<sup>55</sup> *Ibid.*, IV, iii, 26; pp. 556-7.

<sup>56</sup> *Ibid.*, II, viii, 11; p. 135, with the help of the *apparatus criticus* for p. 135, l. 31-p. 136, l. 2. In the fourth edition, this is revised so as to eliminate the statement

That statement could perfectly well have been made by Descartes.<sup>57</sup> But farther on, in a passage that is perhaps less well known, Locke makes these more deeply skeptical reflections upon the “intelligibility” he has alleged, not only for the communication of motion by impulse, but for the primary qualities of bodies themselves; I quote first the passage bearing upon impulse, although it occurs a little after the other:

[I]n the communication of Motion by impulse, wherein as much Motion is lost to one Body, as is got to the other, which is the ordinaryest case, we can have no other conception, but of the passing of Motion out of one Body into another; which, I think, is as obscure and unconceivable, as how our Minds move or stop our Bodies by Thought; which we every moment find they do.<sup>58</sup>

As to the primary qualities:

§23. If anyone says . . . he knows not how he thinks; I answer, Neither knows he how he is extended; how the solid parts of Body are united, or cohere together to make Extension. . . .

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that bodies operate *upon one another* “by impulse” (and in no other way). The revised passage—very strangely, it seems to me—says instead that the way bodies “produce *Ideas* in us” is “manifestly *by impulse*, the only way which we can conceive Bodies operate in.” Cf. my discussion of this in “On Locke, [etc.],” pp. 31-2.

<sup>57</sup> See Descartes, *Principles of Philosophy*, tr. Valentine Rodger Miller and Reese P. Miller (Dordrecht: D. Reidel Publishing Company, 1983), Part II, §40; pp. 61-2. In particular, note the statement (p. 62): “All the individual causes of the changes which occur in bodies are included under this . . . law” — a law that concerns the collision of bodies—“or at least those causes which are physical” (that is: excluding any actions upon bodies of “the minds of men or Angels”).

<sup>58</sup> Locke, *Essay*, II, xxiii, §28; p. 311.

§24. . . . For since Body is no farther, nor otherwise extended, than by the union and cohesion of its solid parts, we shall very ill comprehend the *extension* of Body, without understanding wherein consists the union and cohesion of its parts; which seems to me as incomprehensible, as the manner of Thinking, and how it is performed.<sup>59</sup>

In the light of these remarks, it is hard to understand what grounds Locke thought there were for the belief that the “ideas” of extension and solidity have a privileged status in our knowledge. *Solidity*, indeed, can only by courtesy be accorded the status of a “simple idea of sensation” at all: it is something we perceive, not through the mere passive process of “sensing,” but as, e.g., a pressure exerted upon our hands when we attempt to bring the hands together while a body stands between them. In the chapter—viii of Book II—in which the status of primary in contrast to secondary qualities is broached, Locke apologizes for having digressed into “Physical Enquiries,” and made a “little Excursion into Natural Philosophy”;<sup>60</sup> this, one would think, in the light of the views about natural philosophy expressed in the *Essay*, is in effect an admission that the distinction is actually based upon a *probable hypothesis*.

We are left, at any rate, more generally, with the questions: (a) why one should suppose that *any* “primary” or fundamental properties of bodies appear “immediately” to us in sensation; and (b) why, on the other hand, the possibility should be excluded of our discovering, among “potential” qualities of bodies or “qualities *mediately* perceived,” some that are “primary” —*in the sense* that they are fundamental. It is just here that Newton’s method of inquiry exploits an

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<sup>59</sup> *Ibid.*, §§23, 24; pp. 308, 309.

<sup>60</sup> For both these phrases (the first of which has been quoted earlier), see *Essay*, II, viii, 22; p. 140.

opportunity that Locke, along with most or all of the natural philosophers of the time, did not recognize. In the optical investigations we have a veritable paradigm of a response to Locke's skeptical doubts concerning the possibility of a science of physics: the discovery, by the study of *processes—interactions—*of properties of light that are not immediately apparent to sensation, and that deserve to be regarded as "Original and connate" properties; properties, moreover, of *elements* of the light (what Newton calls the "*rays*") that are themselves hidden from us in quite the way the minute particles of bodies are; and finally, as I have briefly remarked before, properties one of which is a *length*, of submicroscopic magnitude, which nonetheless Newton succeeded in determining quantitatively—in still more dramatic confutation of Locke's belief that the properties of the minute parts of things are forever beyond our reach.

This most crucial insight, present implicitly in Locke's own skeptical reflections on the "comprehensibility" (or the reverse) of the primary qualities of body, and present, one might say, "objectively" in Newton's investigative practice, seems missing from the body of commentary on Locke to which I have alluded above. For example—to take an eminent and learned commentator, who has thought seriously and sympathetically about Locke's views—Michael Ayers says the following, in his important paper "The Ideas of Power and Substance in Locke's Philosophy": "[I]f he let in the possibility that powers or phenomenal properties should belong to things as a matter of brute or miraculous fact not naturally intelligible, Locke's whole carefully constructed philosophy of science and his support for the corpuscularian case against the Aristotelians would collapse."<sup>61</sup>—Well, perhaps so; but this structure *does* collapse. And, indeed, Locke's own question about the intelligibility of the transfer of motion by "impulse" ought to remind us that the laws of that transfer, "wherein as much

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<sup>61</sup> M. R. Ayers, "The Ideas of Power and Substance in Locke's Philosophy," *The Philosophical Quarterly*, 25 (1975), 1-27; the passage quoted is on p. 22.

Motion is lost to one Body, as is got to the other," require a fundamental property—*mass*, without which the quantity of motion cannot be defined—that ranks as a typical instance of a “secondary quality, mediately perceived”: detectable only in the interactions of bodies with one another.—In a rather similar vein, McDowell writes:

If one gives up the Lockean use of resemblance, but retains the idea that primary and secondary qualities are experientially on a par, one will be led to suppose that the properties attributed to objects in the “manifest image” are all equally phenomenal . . . . Properties that are objective, in the contrasting sense, can then figure only in the “scientific image” [the phrases in quotes allude, of course, to Wilfrid Sellars]. *On these lines one altogether loses hold of Locke’s intuition that primary qualities are distinctive in being both objective and perceptible.*<sup>62</sup>

The “intuition” to which McDowell here alludes is the very one I have been challenging—and the one Locke himself put in doubt. I have called this critical reflection of Locke’s “profound.” I rather suspect that many readers will think this doubt in some sense *recherché*; a (merely) “foundational” doubt: “*How do we know that ‘extension’ and ‘solidity’ are objective fundamental properties of bodies?—But of course, however that may be, we do know this [in Isaac Levi’s sense: “we” have admitted it into the corpus of our knowledge].*” —But no! Let us consider very carefully and literally what Locke said: “since Body is no farther, nor otherwise extended, than by the union and cohesion of its solid parts, we shall very ill comprehend the *extension* of Body, without understanding wherein consists the union and cohesion of its parts . . . .” When we *perceive* extension and Lockean “solidity,” it is of course in bodies of manageable size—“ordinary”

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<sup>62</sup> McDowell, *Mind, Value, and Reality*, p. 138 (emphasis added; the quotation is from “Values and Secondary Qualities”).

bodies. The problem of cohesion, to which Locke refers, was one of the dominating concerns of seventeenth-century natural philosophy. It has been solved by the physics of the twentieth century—with the help of principles of physics that were discovered about three years before I myself was born. According to these principles, the basic constituents whose interactions account for the bodies we are familiar with are *not* extended solid things; the interactions of these constituents are *radically different* from “transfers of motion by impulse”; and indeed the “primary” notions that enter into this account are exceedingly remote from any we are acquainted with in sense-perception. If Newton, with all his mental powers, and with the knowledge he had attained in his lifetime, could be brought back, to teach him the *ideas*—the *concepts*—with which this modern theory operates, one would have to offer him a graduate curriculum in mathematics and physics—in “conceptions” and (empirical) “knowledge” *together*. It seems to me a very grave fault in the philosophical climate of our time that leading philosophers should be entirely ignorant of this situation: I do not mean of its substantive details, for these are highly technical and require years of special study for their mastery (cf. what I have said of Newton); I mean, ignorant of the very *existence* of such a situation. In Lockean terms, the state of affairs can be expressed by saying that *all “ideas of sensation” are ideas of secondary qualities*.<sup>63</sup>

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<sup>63</sup> Is there, then, *nothing* distinctive about the traditional “primary” qualities?—There is indeed something: there is a richer intrinsic structural nexus among these qualities than among the traditional secondary ones. A way of expressing this is the following: *All* the “ideas of sensation” convey to us information about our environment (to wit, that there is something present that has “the power to produce such ideas in us”). But the structural richness of the “primary” qualities means that *their* “ideas” convey much *stronger* information than do those of the secondary qualities. It is the presumption that to these structural relations among the sensory “ideas”—notably, *geometrical* relationships (among the “ideas of extension”), and the property of “being occupied, to the exclusion of other things” (Lockean “solidity”) attaching to certain extended regions—there correspond, “isomorphically,” relations in or among the things that cause the sensations, that constitutes the intelligible core of Locke’s claim that the ideas of primary qualities “are Resemblances” of the qualities; he himself in fact goes on

13. But if all the foregoing discussion, historical and philosophical, is accepted, it may yet seem that what McDowell wishes to maintain about values could be sound: for what he urges is that values should be accorded a status analogous – but not identical – to the one he ascribes to secondary qualities; and even if that is not the best way to regard secondary qualities, the analogous way might be the best way to regard values.

What, then, exactly, is the analogy, and what is the difference, according to McDowell?

Here is how he puts the matter:

To press the analogy is to stress that evaluative “attitudes”, or states of will, are like (say) colour experiences in being unintelligible except as modifications of a sensibility like ours. The idea of value experience involves taking admiration, say, to represent its object as having a property that (although there in the object) is essentially subjective in much the same way as the property that an object is represented as having by an experience of redness – that is, understood adequately only in terms of the appropriate modification of human (or similar) sensibility. The disanalogy, now, is that a virtue (say) is conceived to be not merely such as to elicit the appropriate “attitude” (as a colour is merely such as to cause the appropriate experiences), but rather such as to *merit* it.<sup>64</sup>

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to explicate this by saying: “and their Patterns do really exist in the bodies themselves” (Locke, *Essay*, II. viii. 15; p. 137. Cf. Stein, “On Locke, [etc.],” pp. 28-9).

<sup>64</sup> McDowell, *Mind, Value, and Reality*, p. 143 (in “Values and Secondary Qualities”).

In what does this “merit” consist?—I am afraid that McDowell does not tell us. What he *does* tell us he introduces by way of still another analogy—an intermediate one:

For simplicity’s sake, I shall elaborate this point in connection with something that is not a value, though it shares the crucial feature: namely danger or the fearful. On the face of it, this might seem a promising subject for a projectivist treatment (a treatment that appeals to what Hume called the mind’s “propensity to spread itself on external objects”). At any rate the response that, according to such a treatment, is projected into the world can be characterized, without phenomenological falsification, otherwise than in terms of seeming to find the supposed product of projection already there. And it would be obviously grotesque to fancy that a case of fear might be explained as the upshot of a mechanical (or perhaps para-mechanical) process initiated by an instance of “objective fearfulness”. But if what we are engaged in is an “attempt to understand ourselves”, then merely causal explanations of responses like fear will not be satisfying anyway. What we want here is a style of explanation that makes sense of what is explained (in so far as sense can be made of it). This means that a technique for giving satisfying explanations of cases of fear — which would perhaps amount to a satisfactory explanatory theory of danger . . . — must allow for the possibility of criticism; we make sense of fear by seeing it as a response to objects that *merit* such a response, or as the intelligibly defective product of a propensity towards responses that would be intelligible in that way. For an object to merit fear just is for it to be fearful. So explanations of fear that manifest our capacity to understand ourselves in this region of our lives will simply not cohere with the claim that reality contains nothing in the way of

fearfulness. Any such claim would undermine the intelligibility that the explanations confer on our responses.<sup>65</sup>

Fearfulness, then—or, as I prefer to call it, “fearsomeness”<sup>66</sup>—is to be placed in what McDowell has come, following Sellars, to call “the space of reasons”;<sup>67</sup> and what is sought for it is “a *style* of explanation that makes sense of what is explained,” as part of “an attempt to understand ourselves.”<sup>68</sup> And McDowell’s view of the desideratum in his theory of values is similar: the view that values are objective features of the world is really part of an enterprise of restoring to “us” a sense of being *at home* in the world. In his introduction to the newer edition of *Mind and World*, McDowell makes explicit his Wittgensteinian aim: he speaks of “the philosophical anxieties I aim to deal with,”<sup>69</sup> and deprecates “constructive philosophy [whose standpoint is] the naturalism that threatens to disenchant nature”;<sup>70</sup> of the concerns addressed by the latter he says that “we need to exorcize the questions rather than set about answering them.”<sup>71</sup>

My own view is obviously quite different. I agree entirely that any threat of “disenchantment of nature” — “unweaving of the rainbow,” not just in the sense

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<sup>65</sup> *Ibid.*, pp. 143-4.

<sup>66</sup> The English language is flexible here; but it seems to me most appropriate to say that the *rabbit* is fearful, whereas the stoat, to the rabbit, is fearsome.

<sup>67</sup> See John McDowell, *Mind and World – With a New Introduction by the Author* (Cambridge, Mass: Harvard University Press, 1996), *passim*.

<sup>68</sup> The last phrase is put in quotes by McDowell, since he takes it from Simon Blackburn; but the context makes clear that he endorses the view that such an attempt is “what we are engaged in.”

<sup>69</sup> McDowell, *Mind and World*, p. xxiv.

<sup>70</sup> *Ibid.*, p. 95.

<sup>71</sup> *Ibid.*, p. xxiv.

of *analyzing* it as a natural phenomenon, but of (somehow!) *destroying* it as a wondrous sight—deserves to be exorcised. But the anxiety that natural philosophy will perform any such “unweaving” seems to me—and here I unabashedly speak McDowell’s language—*unmerited* (indeed, neurotic!). It involves a *conceptual confusion* of the same kind as the old fear that if the earth were shown to be really rotating, we should all become motion-sick. The *atmosphere* may be poisoned by human activities, but the rainbow is safe from scientific knowledge; in the words of the old song, “Oh no, they can’t take that away from me!”—neither what is glorious in the world, nor what is fearsome.

In any case, we have still not seen a clue as to McDowell’s notion of what it is to *merit* the response that values evoke in us. I have said that he does not tell us. What he does say a little about is how we can come to *recognize* such merit.

On his account, to recognize that values merit a certain response is just to *have* that response, and to be able to defend its appropriateness against criticism. Unlike the case of secondary qualities (and, according to McDowell, unlike that of “the fearful”), *contentiousness* “is typical of values”; “the validation of the responses is controversial.”<sup>72</sup> Here is how controversy is to be joined:

The aspiration to understand oneself is an aspiration to change one’s responses, if that is necessary for them to become intelligible otherwise than as defective. But although a sensible person will never be confident that his evaluative outlook is incapable of improvement, that need not stop him supposing, of some of his evaluative responses, that their objects really do merit them. He will be able to back up this supposition with explanations that show how the responses are well-placed; the explanations will share the contentiousness of the values whose reality they certify, but that should not prevent him from

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<sup>72</sup> *Ibid.*, pp. 144, 145.

accepting the explanations any more than (what nobody thinks) it should prevent him from endorsing the values. There is perhaps an air of bootstrapping about this. But if we restrict ourselves to explanations from a more external standpoint, at which values are not in our field of view, we deprive ourselves of a kind of intelligibility that we aspire to; and projectivists have given no reason whatever to suppose that there would be anything better about whatever different kind of self-understanding the restriction would permit.<sup>73</sup>

The analogy to secondary qualities, according to McDowell, “renders irrelevant any worry about how something that is [brutally]<sup>74</sup> *there* could nevertheless stand in intenal relation to some exercise of human sensibility. Values are not [brutally] *there* – not *there* independently of our sensibility – any more than colours are.”<sup>75</sup> The disanalogy leads McDowell to this further suggestion:

Perhaps with Aristotle’s notion of practical wisdom in mind, one might ask why a training of the feelings (as long as the notion of feeling is comprehensive enough) cannot *be* the cultivation of an ability – utterly unmysterious just because of its connection with feelings – to spot (if you like) the fitness of things . . . .<sup>76</sup>

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<sup>73</sup> *Ibid.*, pp. 145-6.

<sup>74</sup> McDowell’s term is “brutely”; but in English, hitherto, one could not form an adverb by adding “ly” to a noun. One says, not “adverbly” but “adverbially”; “kingly” is an adjective; for the adverb, one says “royally” (or “regally”). In the case of the noun “brute,” the adjective is “brutal,” the adverb “brutally.” Perhaps in the present context “brutally” seemed too brutal; then “merely,” for example, might serve. To me it is regrettable that philosophers should do violence to a language that is under such brutalizing assault generally.

<sup>75</sup> *Ibid.*, p. 146.

<sup>76</sup> *Ibid.*, p. 147. – Cf. also the somewhat fuller statement in the essay “Might There Be External Reasons?” – *ibid.*, pp. 100-101: “If we think of ethical upbringing in a

– Thus, the discrimination of value is rescued as a *cognitive* act, by declaring that such discrimination is, *when made by a properly brought-up person*, a perception of *bona fide* merit or “fitness.” Training in moral feeling becomes – is *declared to be* – the training of a cognitive capacity. The moral consequences – the *social and political* consequences – of such a view are in my own judgment horrifying. McDowell hints that he would not insist on the *unique* propriety of one “evaluative point of view” – perhaps on the analogy of colors, regarded as genuinely *different* properties of things for a dichromate and a trichromate – and that the resulting relativism of values to the point of view of a culture, or mode of upbringing, does not disturb him.<sup>77</sup> What seem to me likely, and horrifying, consequences of this are of two contrary kinds: first, an encouragement of moral, and therefore social and political, intransigence *vis-à-vis* “the other” – whether from the other side of the world or the other side of the tracks or the other

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roughly Aristotelian way, as a process of habituation into suitable modes of behavior, inextricably bound up with the inculcation of suitably related modes of thought, there is no mystery about how the process can be the acquisition, simultaneously, of a way of seeing things and of a collection of motivational directions or practical concerns, focused and activated in particular cases by exercises in the way of seeing things. And if the upbringing has gone as it should, [editorial comment: (!)] we shall want to say that the way of seeing things – the upshot, if you will, of the molding of the agent’s subjectivity – involves considering them aright, that is, having a *correct* [emphasis added; and, again: (!)] conception of their actual layout.

<sup>77</sup> The point is a little obscure; but that is what seems to me implied by n. 46 on p. 145: “I can see no reason why we should not regard the contentiousness [of value-judgments] as ineliminable. The effect of this would be to detach the explanatory test of reality from a requirement of convergence [à la Peirce]. As far as I can see, this separation would be a good thing. It would enable resistance to projectivism to free itself, with a good conscience, from some unnecessary worries about relativism. . . . With the requirement of consensus dropped, or at least radically relativized to a point of view, the question of the claim to truth of directives may come closer to the question of the truth status of evaluations than [David Wiggins has suggested].”

political ideology; second, and on the other hand, the encouragement of a passive complacency towards (and condonation of!) remote enormities—countenancing suttee, for instance (to take an extreme case), or the terrible oppression of women in Afghanistan today (for another).<sup>78</sup> I have no doubt that it is far from McDowell's intent to encourage either of these tendencies; but they seem to me dangers inherent in the view he recommends. And if it should be objected that bad consequences cannot count against the claim that a certain proposition is *true*, I grant the principle wholeheartedly—but I point out that McDowell has described his position here as a “hunch” that “poses a question of moral and aesthetic taste, which—like other questions of taste—should be capable of being argued about.”

**14.** I want in conclusion to review the principal themes of my argument, and to add just a little to the foregoing discussions both of theoretical and of moral philosophy.

I have been arguing in favor of a view of philosophy that sees its task, not as a kind of therapy designed to allay anxiety and to make us feel at home in the world, but as allied with the sciences in searching for the best understanding-and-knowledge of the world—*including* ourselves. It is not that I regard allaying anxiety and (if I may be allowed the double negative) dispelling disenchantment as ignoble ends, but that I think their proper home is elsewhere; I think that adopting them as ends in what claims to be a *cognitive* inquiry has a corrupting tendency. I have argued, historically, that the discussion of primary and secondary qualities by Locke falls quite clearly within the view of philosophy I here advocate; that the reading of Locke by philosophers has tended to distort both his aims and his position by a failure to recognize this; and that the history I have described—in Locke, in Newton, and in subsequent inquiry—provides a

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<sup>78</sup> Note—here, and also with reference to n. 41 above—that this paper was written in the year 2000.

genuinely instructive example of the way in which, as I have put it, “understanding” and “knowledge” are *in principle* intertwined.

On this large point of methodology, there are other very striking examples.<sup>79</sup> What I want to say now is that these examples illustrate the fact that a critical mistake has repeatedly been made by philosophers—certainly including natural philosophers. This mistake is the assumption that a clarification of “ideas,” or concepts, should always—or *can* always—*precede* the advance of knowledge. Descartes thought this, and integrated it deeply into his epistemology and metaphysics; it ruined his own program for natural philosophy. More recently, the logical empiricist school—in its early, and still best-known, positions—had the same view; Carnap’s later writings show a quite different view of the matter, and this development on his part is what makes me regard him as (to echo what I have already said about Locke) a far more interesting and a far deeper philosopher than is generally believed.<sup>80</sup> The mistake itself is most pithily expressed by Wittgenstein in his preface (“Vorwort”) to the *Tractatus Logico-Philosophicus*: “Was sich überhaupt sagen läßt, läßt sich klar sagen.”—The maxim is a noble one, but it is wrong. The implication, of course, is not only that what can be *stated* can be stated clearly, but that what can be *asked* can be *asked* clearly; and this led (for a time) to the practice of disposing wholesale of “pseudo-

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<sup>79</sup> A smaller example is provided by the state of affairs mentioned in n. 30 above; for to make the *concepts* involved in the construction of the Newton-Graßmann-Maxwell color-diagram quite cogent, it is necessary to use results that were only discovered with the help of the diagram itself—constructed on the basis of tentative and rough working principles. This is a kind of thing quite typical of scientific progress.

<sup>80</sup> For some indications on this point, see my paper “Was Carnap Entirely Wrong, After All?”, *Synthese* 93 (1992), 275-95; I have also touched on Carnap’s contribution in “Some Reflections on the Structure of Our Knowledge in Physics,” in *Logic, Methodology and Philosophy of Science IX* (Studies in Logic and the Foundations of Mathematics vol. 134), ed. D. Prawitz, B. Skyrms, and D. Westerståhl (Amsterdam: Elsevier, 1994), pp. 633-55.

questions.” –Not that there is no such thing as a pseudo-question; only that it can be hard to tell, and it can be premature to judge, whether a particular case is an example of one. For instance, in the year 1600—or the year 1633, in which Galileo published his *dialogue on the Two Principal World-Systems*—no one possessed a conception of motion that made really clear sense of the question whether the earth is at rest. But to dismiss that question as meaningless—or, in the variant preferred by the Church, to declare it beyond the competence of natural philosophy to decide—would not have been a fruitful move.<sup>81</sup> It was only with the advance of *knowledge about* motion that the very *concept of* motion could be (to use a Carnapian term) “explicated” so as to make that question clear.<sup>82</sup>

I believe this general reflection has a deep consequence for another issue on which McDowell, in my opinion, takes an unfortunate stand. Consider his remark, already quoted, that “it seems to be an illusion to suppose that [an understanding of “why things *appear variously coloured* to various observers”] could still be forthcoming after we had definitively left behind a view of the world that represents colours as properties things have.” He goes on to offer this clarification (using the phrase “the absolute conception of reality,” borrowed from Williams, to refer to that conception from which everything subjective has been removed): “I am not suggesting that there is a problem about the absolute conception’s capacity to encompass, as a possible explicandum, someone’s inclination to utter the word ‘green’ when visually confronted with something. But

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<sup>81</sup> Cf., for discussion both of the historical and the philosophical issue (but in the context of Newton’s decisive work—i.e., of the later 1600’s), my paper “Newtonian Space-Time,” *The Texas Quarterly* **10** (1967), 174-200; also in Robert Palter, ed. *The Annus Mirabilis of Sir Isaac Newton* (Cambridge, Mass.: The M. I. T. Press, 1970), pp. 258-84.

<sup>82</sup> To put this more precisely—as Carnap would certainly wish!—to *replace* it by a clear question.

that is not the same as crediting it with a capacity to encompass the fact that something *looks green* to someone.”<sup>83</sup> This is of course in accord with McDowell’s fundamental separation of the “manifest image” and the “space of reasons” or “realm of freedom (spontaneity)” from the “scientific image” and the “space of causes.” But consider the problem posed by biological evolution: We *know* that living organisms, and therefore in particular sentient organisms (including ourselves), have developed in a world in which there once were none. *Prima facie*, it is a very striking question how such a capacity as that of “seeing green” can have developed out of an inanimate world. According to old-line positivist principles, this *reduces* to the question of how it can have come about that there are natural systems which, when confronted e.g. with grass illuminated by daylight, emit such sounds as those of the words “Ah, the green grass!” Clearly McDowell does not accept this reduction; nor, I think, should he: *that* formulation of the question is certainly, at any rate, oversimplified. But it is also clear that McDowell wishes to reject the very question: it is one of those that his negative remark about the capacity of the “absolute view” – his polemic against “bald naturalism”<sup>84</sup> – aims to exorcise. My own view here is agnostic – but also (on the possibly over-optimistic assumption that a civilization that includes scientific inquiry is going to continue for a long time) hopeful: I believe that the question of *what it is*, from the point of view of the basic principles that govern the physical world, for a system to be “aware” – “conscious” – is at present both poignant and, from the point of view of natural philosophy, entirely unclear. I do not know whether that question can ever, possibly, acquire clarity – or *develop* into a *related* question that is clear (it is exactly this latter kind of thing that happened to the question about the motion of the earth). But I think it is important to recognize that this pres-

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<sup>83</sup> *Ibid.*, p. 124, n. 13 (in “Aesthetic Value, Objectivity, and the Fabric of the World”).

<sup>84</sup> McDowell, *Mind and World*, *passim*.

ently unclear question does signalize a genuine gap in our present understanding of ourselves and the world (ourselves *in* the world); I find it hard to believe that an advance of science that actually does what McDowell acknowledges as possible—that actually explains “someone’s inclination to utter the word ‘green’ when visually confronted with something”—will not transform our understanding of that question; and I think that the philosophical attempt to deal with the question by explaining it away is an obfuscation.

That, then, is my comment on the issue that I “waived” in §11 above—the statement that “an account—a *theory* of some sort—of how neural processes produce ‘experience’ [is something that] we do not have at all today.” *Today* we do not even have a set of concepts that allow us clearly to *envisage* such a theory. McDowell is inclined to think—and he bases a considerable system of philosophy upon this—that such a theory is in principle impossible. *I* think—to make one last appeal to the history of philosophy—that the fate of Locke’s view that scientific physics is impossible; of Kant’s view that scientific chemistry is impossible; of Comte’s view that knowledge of the chemistry of the *stars* is impossible; should all conduce to skepticism about that kind of philosophical skepticism.

As to moral philosophy: I want to return to my in part personal theme, about the affinity between my view of philosophy and Isaac Levi’s. I have said that McDowell’s technique for rendering moral judgments as *cognitive* seems to me to lead to possibly monstrous consequences; in effect—although that is not the way I put it before—by making it *too easy* to deal with moral conflict. I repeat that I do not at all think that McDowell *desires* this outcome; but he makes it possible, and I am afraid all too likely, for supporters of his position to fall into this temptation.—Now, Isaac Levi has written a book about this subject—conflict of values, including moral conflict.<sup>85</sup> As its title intimates, it does not attempt to

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<sup>85</sup> Isaac Levi, *Hard Choices: Decision making under unresolved conflict* (Cambridge University Press, 1986).

make hard choices look easy. It does not assume, either, that a person of good character is necessarily always without *internal* moral conflict.<sup>86</sup> What it offers is a discussion of the techniques by which conflict—internal to a person; between or among persons; between or among groups—may be rationally managed. This, in my view, is genuinely constructive moral philosophy.

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<sup>86</sup> On this, cf. the contrary view suggested by McDowell in, for instance, his discussion of the distinction between virtue and (mere) continence: “The distinction becomes intelligible if we stop assuming that the virtuous person’s judgement is a result of balancing reasons for and against. The view of the situation that he arrives at by exercising his sensitivity is one in which some aspect of the situation is seen as constituting a reason for acting in some way; this reason is apprehended, not as outweighing or overriding any reasons for acting in other ways, . . . but as silencing them” (in “Virtue and Reason”; *Mind, Value, and Reality*, p. 57). McDowell is here offering an explication of Aristotle’s view; but it is clear that the position is one he favors; and he recurs to it in other essays, where the aim is not historical explication but, explicitly, theoretical discussion. The position is that the virtuous person is one who, having a right—i.e., veridical—moral perception of any given situation, knows, in any given situation, *what is the right thing to do*, in a way that “silences” competing considerations; and that this condition (namely, virtue) is achieved by right upbringing. Thus, in the essay “Are Moral Requirements Hypothetical Imperatives?” (*ibid.*, p. 85), we read: “In moral upbringing what one learns is not to behave in conformity with rules of conduct, but to see situations in a special light, as constituting reasons for acting; this perceptual capacity, once acquired, can be exercised in complex novel circumstances, not necessarily capable of being foreseen and legislated for by a codifier of the conduct required by virtue . . .” On this view, the existence of moral struggle in a person is evidence of a falling short of virtue: if the result of the struggle is, after all, right action, the person is “merely continent,” not virtuous.