

UC Santa Cruz

UC Santa Cruz Electronic Theses and Dissertations

Title

The Paradox of the Primary-Secondary Quality Distinction and Husserl's Genealogy of the Mathematization of Nature

Permalink

<https://escholarship.org/uc/item/2cv034zh>

Author

Durt, Christoph

Publication Date

2012

Peer reviewed|Thesis/dissertation

**The Paradox of the
Primary-Secondary Quality Distinction
and Husserl's Genealogy of the
Mathematization of Nature**

by

Christoph Durt

A dissertation submitted in partial satisfaction
of the requirements for the degree of

DOCTOR OF PHILOSOPHY
in
PHILOSOPHY

UNIVERSITY OF CALIFORNIA
SANTA CRUZ
December 2012

The Dissertation of Christoph Durt
is approved:

Professor Abraham Stone, Chair

Professor David Couzens Hoy

Professor Hans Sluga

Tyrus Miller
Vice Provost and Dean of Graduate Studies

© 2012 by Christoph Durt

Contents

Abbreviations viii

Acknowledgements x

1	Introduction.....	1
1.1	The paradox of the distinction between primary and secondary qualities....	1
1.2	Attempts at ameliorating the paradox.....	6
1.3	Leading intuitions and thoughts, and the resulting explanations.....	10
1.4	Simple adjustments and complicated implications.....	18
1.5	A new approach to the paradox	23

PART I: THE DISTINCTION BETWEEN PRIMARY AND SECONDARY QUALITIES, AND ITS ORIGIN IN THE EARLY MODERN MATHEMATICAL CONCEPT OF NATURE

2	Descartes's and Locke's explanations of the relation between primary and secondary qualities.....	30
2.1	Dispositionalism	30
2.2	Physicalism.....	36
2.3	Projectivism	39
2.4	Eliminativism.....	42
2.5	The origin of the fluctuations	48

3	Predecessors of the early modern primary-secondary quality distinction	52
3.1	Fundamental and derived qualities, and real and merely apparent qualities	52
3.2	Ancient atomism and modern corpuscularianism.....	57
3.3	The distinction between <i>proper</i> and <i>common sensibles</i>	63
4	Arguments and reasons for the distinction.....	71
4.1	Boyle on experiential induction.....	73
4.2	Resemblance and the lack of it	77
4.2.1	Locke’s limitation of the resemblance thesis	79
4.2.2	Descartes’s complete rejection of sensible resemblances	88
4.2.3	Imagination and pure intellect	92
4.3	The universality of primary qualities and its reason in the mathematical divisibility of space.....	99
4.3.1	Locke’s argument for the universality of primary qualities	100
4.3.2	Descartes’s argument from exclusion and his concept of the <i>res extensa</i>	105
4.4	The origin of the distinction in Galileo’s concept of the mathematical universe.....	110
4.4.1	Removal of the perceiver, vanishing of secondary qualities	111
4.4.2	The perceiver as a byproduct of the modern concept of reality	117
4.4.3	Galileo’s mathematical universe	120

PART II: HUSSERL ON THE ORIGIN OF THE MODERN DISTINCTION BETWEEN PRIMARY
AND SECONDARY QUALITIES —“GALILEO’S MATHEMATIZATION OF NATURE”

5	Mathematics and the problem of applying it to experience	126
5.1	The development of Husserl’s concern for mathematics	131
5.2	The idea of a mathematically ideal world, and its application to the intuitively experienceable world	135
5.3	Generalization, idealization, formalization, and symbolization	145
6	The genesis of the equivocation.....	151
6.1	First step—idealization: The approximation of ideal limit-objects and the substruction of reality	151
6.2	Second step—formalization: The development of formal mathematics and its application to the modern picture of the world.....	158
6.3	Third step—symbolization: Its contribution to mathematization and confusion	163
6.4	The paradox as a result of the confusion of reality with a method.....	166
7	The overlooked life-world and the resulting crisis	173
7.1	Husserl’s call for a new concept of experience reconsidered.....	175
7.2	The origin of all abstraction: the life-world.....	179
7.3	Philosophy as rigorous science between “positivism” and “historicism”	187
7.4	The concept of “crisis” and the “historical a priori”	194
	Literature	206

Abstract

The Paradox of the Primary-Secondary Quality Distinction and Husserl's Genealogy of the Mathematization of Nature

by Christoph Durt

Since the time of Galileo, philosophers widely agree on a distinction that has been known since Locke as the distinction between “primary” and “secondary” qualities. In spite of claiming that experiences or ideas of secondary qualities must be produced by configurations and movements of particles constituted of primary qualities, philosophers such as Descartes and Locke also claim that the connection between primary qualities and ideas of secondary qualities is inconceivable. The combination of the two claims I call the “paradox of the primary-secondary quality distinction.” The philosophical disputes around the distinction usually ignore the paradox, and instead circle around different types of explanations of secondary qualities in terms of primary qualities: projectivism, eliminativism, physicalism, and dispositionalism. These contradict each other ontologically, but nevertheless they share a common origin: the view that the world is mathematical in itself.

Edmund Husserl claims in the *Crisis* that this conception entails a misunderstanding and sets out to explain the confusion in the genesis of the mathematical concept of the world; a genesis he calls the “mathematization of

nature.” I analyze four different steps in the mathematization: generalization, idealization, formalization, and symbolization. The combination of these steps leads to, in Husserl’s estimation, a confusion of “true being” with “a method.” Husserl thinks that true being is experienced in the life-world, and that it can only be substructured, but never replaced with mathematizations. Contrary to what is often thought, Husserl’s concept of the life-world is not simply a belated response to Heidegger, but Husserl’s ultimate expression of his lifelong study of the relation of mathematics and experience. The result of the forgetting of original experience is, according to Husserl, the “crisis of the European sciences.” The recovery of the experience that is the origin of the mathematization is for Husserl thus not only a way to avoid the philosophical misunderstanding of science, but also an answer to a profound crisis of meaning.

Husserl’s genealogy of the mathematization allows for a neat explanation for why the paradox seems unavoidable. Ideas of secondary qualities are not directly mathematizable, and therefore it seems that they must be produced by primary qualities. Yet, the connection between them is inconceivable because mathematizations are compared to something radically different, namely experiential qualities. Whether we agree with Husserl’s own account of life-worldly experience and crisis or not: his genealogy of the development of the paradox reveals the need to reconsider the role of experience in the scientific concept of the world.

Abbreviations

AT: Descartes, René. *Oeuvres de Descartes*, 11 vols., revised edition, eds. Charles Adam and Paul Tannery, Paris: J. Vrin/C.N.R.S: 1964–1976. Passages are cited by volume and page numbers, respectively, separated by a colon.

Crisis: Husserl, Edmund. *Die Krisis der Europäischen Wissenschaften und die transzendente Phänomenologie: Eine Einleitung in die phänomenologische Philosophie*. Ed. Walter Biemel. 2nd edition. De Haag: Nijhoff, 1976 (Husserliana VI). If the citation is taken from Carr’s translation, the reference states “*Crisis*,” followed by a number indicating the page in the translation, and the original German text. If my translation deviates from Carr’s, I first include the text from *Krisis*, followed by the respective page number in Carr’s translation.

CSM/CSMK: *The Philosophical Writings of Descartes*, trans. John Cottingham, Robert Stoothoff, Dugald Murdoch, and, for CSMK (vol. 3) Anthony Kenny. Cambridge: Cambridge University Press, 1984.

Essay: Locke, John. *An Essay concerning Human Understanding*. London: Tegg, 1836.

H XXIX: Husserl, Edmund. *Die Krisis der Europäischen Wissenschaften und die transzendente Phänomenologie: Ergänzungsband: Texte aus dem Nachlass 1934-1937*. Edited by Reinhold N. Smid. The Hague: Kluwer Academic Publishers, 1992.

Ideas I: Husserl, Edmund. *Ideen zu einer Reinen Phänomenologie und Phänomenologischen Philosophie: Erstes Buch, Allgemeine Einführung in die reine Phänomenologie*. Ed. Karl Schuhmann. Den Haag: Martinus Nijhoff, 1976.

Krisis: Husserl, Edmund. *Die Krisis der europäischen Wissenschaften und die transzendente Phänomenologie*. Edited by Walter Biemel. Den Haag: Martinus Nijhoff, 1962 (Husserliana VI). The numbers after “*Krisis*” always refer to the respective page number.

LI I: Husserl, Edmund. *Logische Untersuchungen I: Prolegomena zur Reinen Logik*. Halle: Niemeyer, 1900.

LI II: Husserl, Edmund. *Logische Untersuchungen*. Halle: Niemeyer, 1901.

Metaphysics: Aristotle. *Aristotle's Metaphysics*, ed. W.D. Ross. Oxford: Clarendon Press, 1953.

Principles: Descartes, René. *Principia Philosophiæ*. (AT 8)

Saggiatore: Galilei, Galileo. *Il Saggiatore*. Rome, 1623. http://it.wikisource.org/wiki/Il_Saggiatore

Acknowledgements

This dissertation is the result of the work of a number of people. I was very fortunate to receive the altruistic support of profound and inspiring thinkers, whose distinct contributions left their marks throughout my writing.

First of all, I would like to thank my three advisers, who were always there when I needed them, and sacrificed huge amounts of time from their own important work and urgent obligations. They unconditionally supported my work, regardless of the direction it took. And they were patient even when their confidence in a successful outcome was very unsubstantiated.

In particular, Abraham Stone engaged me in frequent and long philosophical discussions on numerous topics, such as nominalism, rationalism, philosophy of mathematics, and the development of Husserl's thought. The discussions often took off from some scanty draft I had sent him, which he scrutinized in detail, sent back meticulous comments, and then brought to my attention to the full meaning of issues I had rather inadvertently touched. Working closely with such a brilliant mind guided me to numerous insights, only some of which found their way into the text.

David Hoy embraced me in his endless dedication to the work of his students. Through regular discussions of my writing, and by writing together the article "What Subjectivity Isn't," he taught me about Husserl's heritage in later French and German continental philosophy, and showed me connections to more analytic thinkers such as

Donald Davidson. David's personal strength and character, for instance when dealing with undeserved hardship, is a great role model for me.

Hans Sluga accompanied my work in a long series of mind-opening conversations on topics such as the notion of crisis, genealogy, foundational problems of mathematics, and on many of the ideas and philosophers of Husserl's time, some famous (e.g. Heidegger), and others who did not become famous or became forgotten, but who nevertheless constitute missing links between the big names.

I was fortunate enough to keep contact to the latest research in Germany thanks to Julian Nida-Rümelin's engagement. A presentation of his had inspired me to the original project of this dissertation, and I am grateful that he accompanied my work over the years, encouraging me to dare taking new paths, and always happy to discuss the dissertation throughout its different stages.

I would also like to thank for the feedback on earlier drafts David Carr, Andy Delunas, Lester Embree, Lucas McGraham, Toby Loeffler, Kaija Mortensen, Paul Roth, and Marc Selway. Other philosophers contributed through inspiring discussions of feedback on other work, for instance Burt Hopkins, Ram Adhar Mall, Claudio Majolino, Jitendranath Mohanty, and Bernhard Waldenfels. In addition, the responses to my teaching by my students and by listeners at conference presentations contributed substantially. I'm grateful to the support and engagement of the members of the UCSC philosophy department, and many others I cannot list here.

Financially, this dissertation was generously supported by several fellowships. The Friedrich-Ebert Foundation awarded a three-year fellowship for research and writing, part of which I pursued at the University of Munich, and other parts at the University of California in Berkeley and in Santa Cruz. I am grateful for the privilege of this support, inclusive of the helpful advice by Martin Graefe, as well as for several later fellowships by the DFG, the University of California, and especially the University of California at Santa Cruz, which also provided an about perfect environment for the writing of this dissertation.

To my parents, who always have been supportive of my peculiar interests.

1 Introduction

1.1 The paradox of the distinction between primary and secondary qualities

Since the beginning of modern philosophy, philosophers have widely agreed on a notion that most philosophers before would have decidedly dismissed. According to the new way of thinking, sensible qualities such as colors, sounds, tastes, and smells have to be explained in terms of modes of extension. Since Locke, the sensible qualities have been widely known as “secondary qualities,” while the qualities of extension that produce them have been known as “primary qualities.”¹

Most philosophers since Galileo take as a matter of course the claim that, if secondary qualities are coherent entities at all, they can be explained by states and movements of particles constituted of primary qualities. Following this claim, there seem to be only four possible explanations. Secondary qualities are either in the (material) bodies they are attributed to, or they are not. If they are in the bodies, they may be real physical qualities (physicalism), or configurations and movements of particles that cause in the perceiver the respective sensations (dispositionalism). If

¹ To allow for a uniform terminology, these terms will be applied even to philosophers who did not use them, such as Galileo and Descartes, but whose thoughts contributed to Locke’s terminology.

they are not in the bodies they are attributed to, they are either in the mind and merely projected upon bodies (projectivism), or they are not coherent things at all (eliminativism).²

From inside the debates it appears that dispositionalism, projectivism, eliminativism, and physicalism cover all main possibilities, so one of them must be right, and, since they contradict and exclude each other, only one of them can be right. The arguments for either side become increasingly refined, but, after hundreds of years, the debate seems as far from being settled as ever. If one takes a step away from the heated disputes, it is hard to avoid the impression that there is something fundamental that is not well understood. The different positions appear to be contained by an indivisible border, very much like Wittgenstein's fly in the fly-bottle.

Circling around the same questions forever might not be as bad if there were not a paradox disturbing the distinction between primary and secondary qualities.

² One may, of course, find further refinements, but I think that these four concepts comprise the major possibilities of explaining secondary qualities in terms of states and movements of particles constituted of primary qualities that have been pursued since Galileo. Other authors use "dispositionalism," "physicalism," "projectivism," and "eliminativism" to denote related positions on other kinds of qualities or problems, and, even if it should turn out that all of the respective explanations of secondary qualities are confused, there may be still be uses for the concepts associated with these terms for related or other problems. A lot of what the discussion reveals about accounts of secondary qualities, however, is likely to be applicable, *mutatis mutandi*, to other problems due to the similarity of the intuitions behind the respective arguments, the analogousness of the arguments, the parallels of the problems they intend to solve, and the symmetry of the "explanations" given. The following discussion of dispositionalism, projectivism, eliminativism, and physicalism about secondary qualities and their origin with modern authors such as Descartes and Locke may thus also be revealing for related disputes, such as those around "consciousness" and the "mind-body-problem."

Early modern philosophers subsume all kinds of representations, such as appearances, perceptions, imaginations, and concepts, under the term “idea.” The distinction between primary and secondary qualities is one possible way to make sense of the perennial philosophical distinction between veridical ideas from mere appearances. There is widespread agreement that there are *ideas* of secondary qualities (even though they may be confused), and wide disagreement over the nature of the secondary *qualities* represented by such ideas. Since primary qualities are alleged to be the only real qualities of bodies, and ideas of secondary qualities must be caused by something real, it must be the primary qualities that produce the ideas of secondary qualities; ideas of secondary qualities must, in one way or another, be produced by configurations and movements of particles constituted of primary qualities.

Given that most philosophers from quite different schools such as rationalism and empiricism agree on that ideas of secondary qualities must be produced by primary qualities, it may come as a surprise that the same philosophers also agree that we cannot even conceive how the connection between primary qualities and perceptions or ideas of secondary qualities comes about. Descartes states that we are “wholly unable” to conceive how size, figure and motion can “produce something

else of a nature entirely different from themselves,”³ and Locke claims that we “can by no means conceive how any size, figure, or motion of any particles, can possibly produce in us the idea of any colour, taste, or sound whatsoever; there is no conceivable connexion between the one and the other.”⁴

Just knowing which sizes, figures, or motions of any particles produce in us ideas of colors, tastes, or sounds is by itself not sufficient to make conceivable their connection. The reason is not only that the “faculties we have”⁵ for rationally conceiving the connections are too limited. True, if our senses were good enough, we could possibly see the smallest particles directly. But even that would not tell us why they produce in us ideas of colors, tastes, or sounds; qualities and ideas seem to be two completely different things. I call the combination of, on the one hand, the inconceivability of the connection between primary qualities and experiences of secondary qualities, and, on the other, the assumption that experiences of secondary qualities are produced by configurations and movements of particles constituted of primary qualities, the “paradox of the primary-secondary quality distinction.”

Descartes and Locke agree that a connection between the real qualities in the world and the perceived yet merely apparent qualities is inconceivable. But both also admit that qualities such as colors appear to exist, and both affirm that the

³ “[N]ullo autem modo possumus intelligere, quo pacto ab iisdem (magnitudine scilicet, figurâ & motu) aliquid aliud producatur, omnino diversæ ab ipsis naturæ. (*Principles*, IV, §198)

⁴ *Essay*, IV, iii, 13.

⁵ *Essay*, IV, iii, 16.

appearances must somehow be accounted for in terms of real causes. From a rationalistic point of view, the two claims seem to be incompatible; Descartes's confession that the connection is inconceivable seems to straightforwardly contradict its alleged necessity. How can we know that secondary qualities must be produced by primary qualities if we don't even have a clue of how primary qualities could possibly do so? For empiricists, this may not seem as contradictory, for they do not think that reality in itself is to be understood by reason alone. But for empiricists, too, the statement that there is a necessary connection does not go well together with the inability to conceive how it could possibly come about, which would usually be taken as an indicator for there being something contradictory in the conception that yields the inconceivability. In either case, it is an embarrassment to the early modern concept of the world if we cannot even conceive of a way in which real causes might give rise to ideas of secondary qualities. As long as the connection remains enigmatic, the early modern concept of the world has a fundamental problem, and together with its account of real and merely apparent qualities, the whole early modern concept of the world may be called into doubt.

1.2 Attempts at ameliorating the paradox

A direct attack on this paradox by investigating how primary qualities produce *ideas* of secondary qualities seems hopeless since qualities and ideas are alleged to be totally different kinds of things, and, at least according to Descartes and Locke, we cannot conceive how the connection could come about. Since the connection between *ideas* of secondary qualities and primary qualities is alleged to be inconceivable, it may seem that the best strategy for approaching the distinction is to set aside the question of the connection and to start by treating the problems that are not inconceivable. Rather than asking how *ideas* of secondary qualities are produced by primary qualities, the question becomes how secondary *qualities* relate to primary qualities.

If we could thus attain a clearer concept of the nature of secondary qualities, the paradox might seem less pressing. Gaining a clearer understanding of the relation between primary and secondary qualities would seem to allow us to explain the nature of secondary qualities in terms of the real qualities of the world. For those who believe that the ultimate goal of science is to explain everything there is in objective terms, explaining secondary *qualities* in terms of primary qualities may be the ultimate purpose in the first place, and thus seem good enough. Even if we could never understand what *ideas* of secondary qualities are, explaining secondary *qualities* in terms of primary *qualities* would seemingly explain everything that can

be explained scientifically. Furthermore, once we managed to do so, or at least understand how this is possible, we could apply this knowledge when seeking to determine the nature of *ideas* of secondary qualities. Once we knew what the qualities were, we would be in a better position to make sense of our *ideas* of them. This would not explain away the paradox, but would seemingly ameliorate it.

Driven by the above and other considerations, the question of the nature of secondary qualities and how they are produced by configurations and movements of particles constituted of primary qualities became the central question around which the modern primary-secondary quality distinction revolves until today. There is some dispute concerning whether *ideas* of secondary qualities are clear or confused, and if they are projected upon bodies or not, but there is very little dispute over what ideas of secondary qualities are; whether, for instance, ideas of colors and tones are really the same kind of ideas, and how colors and tones are related to each other. Most proponents of the primary-secondary quality distinction moreover tend to neglect the question of what the regularities between ideas of secondary qualities are; for example why some colors are perceived as dark and others as light, or why there are synesthetic perceptions of secondary qualities. The answers to such questions are simply taken to be obvious (if ideas of secondary qualities are “clear”), or inscrutable (if they are “confused”). Correspondingly, there is little dispute over what *ideas* of *primary* qualities are, and how they can present the qualities of the world correctly beyond the asserted fact that they are true representations.

The question of what *ideas* of secondary qualities themselves are, however, is important, since the primary-secondary quality distinction defines secondary qualities by means of the ideas we have of them. Given that this and other important questions are left out of the discussion of secondary qualities, it is no wonder that a lot of it remains rather general and indefinite. The result is an unsteadiness in and fluctuation of the accounts of secondary qualities, with big shifts resulting from just small adjustments in some part or other of the explanation.

The respective answer to the question of how primary qualities can produce secondary qualities depends largely on the direction of the approach taken. If we start by asking whether secondary qualities are in the world or in the mind, then we presuppose that there are such entities, and the suggestion is that there are only these two answers. If we start by asking if our ideas of secondary qualities are even coherent, then we are likely to come to a very different kind of answer, which may entail that really there are no entities that correspond to our words for secondary qualities. The respective ontological explanation of secondary qualities depends very much on—to use a popular term from contemporary philosophy of mind—the “intuitions,” the preconceived opinions one finds most plausible when one starts thinking about the distinction, and about which one is least likely to compromise. The next section explains roughly which “intuitions” and small adjustments lead to which

dramatic shifts in the ontology of secondary qualities.⁶

⁶ How small adjustments in the interpretation of details in Descartes's and Locke's explanations of the distinction lead to ascriptions of contradicting conceptions will be discussed in chapter 2.

1.3 Leading intuitions and thoughts, and the resulting explanations

The central question of the four ontologically contradicting ways of explaining secondary qualities in terms of primary qualities—dispositionalism, projectivism, eliminativism, or physicalism—concerns the nature of secondary qualities, and that means, according to the claim that primary qualities are the only real qualities, how they are reducible to configurations and movements of particles constituted of primary qualities. The question of how our *ideas* of secondary qualities are produced by primary qualities is, due to the alleged inconceivability, set aside, in spite of the fact that ideas of secondary qualities are sometimes used in the definition of secondary qualities.

Dispositionalism, physicalism, projectivism, and eliminativism all agree on which qualities of the world are primary, and mostly on which qualities are secondary. Yet, each of them provides a distinct answer to the question of the nature of secondary qualities. All of these positions ramify into many different philosophical fields, and which one is chosen may not merely depend on what it says about the primary-secondary distinction. But the fact that the different ontological positions can be distinguished so clearly with respect to their account of the distinction suggests that the distinction provides a conceptual origin for them. The suggestion gains further impetus from the fact that all the different ontological conceptions can already be found in early modern philosophy, and that the primary-secondary distinction

thereafter becomes a common centerpiece of otherwise very distinct modern philosophies.

To avoid confusions as they seem to be common in contemporary discussions of the primary-secondary quality distinction, I would like to point out that not all sensible qualities fall under the distinction. Modern philosophers presuppose that the fundamental qualities must be simple.⁷ Since complex ideas do not even purport to be of simple qualities, they are not in the run in the search for ideas of fundamental qualities, and the distinction between primary and secondary qualities is made within the class of the referents of simple ideas. Primary qualities are those simple qualities that bear a resemblance to the ideas of them, while ideas of secondary qualities lack any resemblance with simple qualities. Because the ideas of secondary qualities lack resemblance, they misrepresent the intrinsic qualities of the objects they purport to present.

In ordinary perception and thought about colors and other secondary qualities, it is hard to avoid perceiving or thinking of them as parts of bodies in the world. If we accept the ordinary “intuition” that takes secondary qualities to be part of the fabric of the world, then the idea that only primary qualities are simple and fundamental qualities of bodies naturally leads to the conclusion that secondary qualities must be

⁷ A.D. Smith makes this point and gives several examples of contemporary confusions in his article “Of Primary and Secondary Qualities,” *The Philosophical Review*, Vol. XCIX, 2 (April 1990): 221-54.

(complex) configurations and movements of particles constituted of primary qualities. There are two ways of accounting for this conclusion, depending on the stance taken toward the ideas and appearances of secondary qualities. If the ideas and appearances are taken to be essential for the notion of secondary qualities, the consequent position is dispositionalism, but if they are taken to be ultimately irrelevant for the notion of secondary qualities, the consequent position is physicalism.

In accordance with ordinary philosophical usage, I will call the powers in the objects to produce ideas in us “dispositions.” Any theory that claims that secondary qualities really are dispositions of primary qualities to produce the ideas of secondary qualities in the perceiver will be called *dispositionalism*. Dispositionalists hold that secondary qualities are powers of objects of the world that produce the corresponding ideas within us. Supposedly, they are qualities of the objects themselves, although they are alleged to have nothing in common with the experiences produced by them. Like ideas of primary qualities, ideas of secondary qualities appear to be simple. This is purported to be an error, however; secondary qualities are really complexes and movements of primary qualities.

But the error is not supposed to go so far as to present us with distinctive qualities of the world where in fact there are none at all. Rather, it allegedly consists in the confusion of complex and simple qualities. Secondary qualities are real; they are distinctive configurations and movements of particles constituted of primary qualities, namely those that cause in us the respective ideas. If our senses were fine

enough, we would see which configurations and movements lead to something that our senses, given how coarse they are, cannot distinguish by means other than appearances of simple qualities, such as the appearance of green. Our ideas of secondary qualities are only misleading in so far as we take them to be simple qualities that exist in the way experience presents them to us. But they distinguish between features of the world that are truly distinct. For dispositionalism it is thus not a problem to define secondary qualities via the ideas we have of them. Our ideas do not present the true nature of secondary qualities to us, but they present us with true qualities of the world.

I mentioned above that, besides dispositionalism, physicalism about secondary qualities holds that secondary qualities are real qualities of external objects. *Physicalism* in general is the thesis that everything is physical or is necessitated by the physical, and applied to secondary qualities this means that they are really primary qualities, or complexes of primary qualities. So far this sounds like dispositionalism, but, in contrast to dispositionalists, physicalists do not think that secondary qualities are relational. Rather, they suppose them to be intrinsic to the objects to which they are attributed. Some physicalists would agree with dispositionalists that secondary qualities are configurations and movements of particles constituted of primary qualities, and they may even agree that the configurations and movements usually cause the respective ideas in us. In contrast to dispositionalists, however, physicalists think that our ideas of secondary qualities pick

out distinct physical qualities of the world, qualities that exist in their own right independent of any observer. For physicalists it is thus a possibility that normal observers under normal conditions err about some colored object. For instance, normal perceivers may normally have a green perception while in reality the object is red, according to some objective physical standard to be determined once we understand which configurations and movements of particles constituted of primary qualities are accurately named by the respective color term. Dispositionalism, on the other side, holds that this is not possible; secondary qualities are exactly those configurations and movements of particles constituted of primary qualities that cause in us the respective ideas.

If we do not accept the “intuition” that secondary qualities are part of the world and instead find it more intuitive to assume that they are nothing that could be part of a scientific explanation of nature, we will probably be tempted to think that secondary qualities are only attributed by error to bodies. The allegation of error fits well together with the notion that in the objects there are powers that have the disposition to cause in us corresponding ideas. True “error” theories however, go much beyond the error asserted by dispositionalism. They may take it that the objects of the world have dispositions to cause secondary qualities in us, and dispositionalism may hold that our ideas of secondary qualities are erroneously projected upon external objects. Nevertheless, from an ontological perspective, “error” theories and dispositionalism are incompatible. “Error” theories hold that secondary qualities, for

example colors, are only attributed by error to the external world. In reality, there is nothing that corresponds to our ideas of secondary qualities. “Error” theories do not necessarily locate secondary qualities in the mind. This is only one possible direction “error” theories can take, and it is pursued in projectivism, internalism, and subjectivism. These three theories emphasize different aspects of the same notion, according to which sensible qualities are internal qualities of perception that are erroneously attributed to the things in the world. To pick the (hopefully) least confusing term, this form of “error” theory will from now on be referred to as *projectivism* about secondary qualities.

Yet there are two different types of “error” theory, which can be distinguished according to the stance they take towards the reality of secondary qualities. The one type of “error” theory is projectivism, which takes them to be real, even though they are only in the mind and not qualities of the world. The other type of “error” theory is a form of eliminativism, according to which secondary qualities are really not qualities of anything; nothing in the mind, nothing in the body, and nothing in between. If they are not really qualities of anything, it is an error to attribute them to something. “Error” theories that claim secondary qualities are neither in the world nor in the mind nor anywhere else will from now on be referred to as *eliminativism* about secondary qualities. But we need to specify this definition further. When it comes to the claim that there are really no secondary qualities, the definition of “eliminativism” can be interpreted in different ways.

One way of defining eliminativism entails that there are simply no appearances of secondary qualities at all. But such eliminativists would reject the fundamental premise of modern philosophers that there are appearances of secondary qualities, and we do not need to further consider this kind of eliminativism. Another way of defining eliminativism is to take it as an affirmation of the notion that qualitative experiences of colors are clear and distinct ideas, while denying that colors are these experiences. Such eliminativists would claim that, if there are colors, they have to belong to the objects of the world. But since there is nothing in the world corresponding to our ordinary use of color words, our color words do not refer to colors, if there are any. But this form of eliminativism is not what is in question here either. It would basically put forward the same story as projectivism, with the only disagreement concerning the definition of colors as experiences or qualities in the world.

The eliminativism about secondary qualities to be considered here, by contrast, is more refined. It is incompatible with projectivism for it tries to eliminate not only secondary qualities from the true concept of the world, but also the judgment that ideas of secondary qualities are clear and distinct. Eliminativists do not need to deny that there are appearances of secondary qualities, but they deny that there is any kind of coherent structure to the appearances that would explain why we apply terms such as “color” to them. Eliminativists think that, in the strict sense, there is nothing like secondary qualities. They are confident that talk about secondary qualities will

meet the same fate as many other “folk” ways of talking that have been overcome by science, and that one day it will be replaced with a better, scientific account of the real causes of our sense perceptions.

If I halted my description of how the different “intuitions” and contrasts play out for the ontology of secondary qualities here, the resulting picture would seem rather neat. There are, however, many more “intuitions” and notions in play, which lead to other parallels and contradictions, and make the picture much more confusing.

1.4 Simple adjustments and complicated implications

This section describes some more of the “intuitions” and notions in play in the choice of the “accurate” explanation of secondary qualities in terms of primary qualities, which lead to other parallels and contradictions, and make the picture much more confusing. For instance, dispositionalism and projectivism both follow the “intuition” that ideas of secondary qualities are clear and relevant for the correct explanation of the nature of secondary qualities. Even before we think about what colors or other secondary qualities are, we have clear and distinct color perceptions and can apply the respective concepts correctly. Dispositionalists take it that ideas of secondary qualities determine secondary qualities, while projectivists hold that ideas of secondary qualities *are* secondary qualities. Eliminativists and physicalists, by contrast, claim that our ideas of secondary qualities are confused and ultimately irrelevant for the scientific explanation of secondary qualities. Eliminativists contend that ideas of secondary qualities do not refer to anything real, while physicalists think our ideas of secondary qualities refer to real qualities of material objects, but our ideas of them are confused and in need of scientific correction.

Against eliminativism, physicalism about secondary qualities shares with dispositionalism realism about these qualities: They are supposed to be real qualities. The boundary with eliminativism can become somewhat blurred, for some physicalists may also subscribe to the eliminativist thesis that a complete description

of the world doesn't need any color words. But, nevertheless, physicalists about secondary qualities believe that secondary qualities refer to real properties of bodies, while eliminativists about secondary qualities think that such terms are confused and that, for instance, colors do not refer to any one type of qualities or their complexes and movements. In a strict ontological sense, physicalism and eliminativism contradict each other. Projectivism, too, contradicts physicalism, since it contends that secondary qualities are internal and that they are only by projection part of the world.

In a strict ontological sense, eliminativism and dispositionalism, too, contradict each other. Eliminativism holds that there is really nothing that corresponds to what we call colors, sounds, smells, etc. Allegedly, there are no such qualities—neither in the mind, nor in the world. Dispositionalists, by contrast, think that such qualities are indeed in bodies, even though, in contrast to projectivists, they do not think that colors are what they appear to be. Dispositionalists agree with eliminativists that it would be wrong to attempt to locate secondary qualities in the mind, or in the body. But, when we switch from the eliminativistic position that secondary qualities have no more than just nominal existence to the position that they are complexes of primary qualities that have the disposition to cause in us ideas of secondary qualities, then the result is either dispositionalism or physicalism.

Like dispositionalism, and in contrast to projectivism and eliminativism, physicalism about secondary qualities holds that secondary qualities are really

qualities of bodies in the world. A physicalist may either assert that colors or other secondary qualities are simple physical qualities of bodies, or that they are either supervenient on or identical to certain configurations and movements of bodies that have only primary qualities. Philosophers who make the modern primary-secondary quality distinction have to take the latter route, for the distinction denies that secondary qualities are simple qualities of bodies; if they are qualities of bodies at all, they are complex.

Physicalism contradicts dispositionalism in that the latter takes secondary qualities to be relational, while physicalism about secondary qualities holds that they are intrinsic qualities of the bodies themselves. Dispositionalists think that the reason for the alleged fact that certain configurations and motions of primary qualities constitute secondary qualities is that they cause in us the respective ideas, while physicalists think that there really is something about those configurations and motions that makes them intrinsic qualities of the world, independent from the perceptions they may cause, and even though they are not simple.

This latter difference may be even harder to see than that between the other pairs of ontological positions. Dispositionalists and physicalists who make the distinction both admit that secondary qualities are not simple, which makes the question of whether they are intrinsic or not look less radical. For the dispositionalist, secondary qualities are powers of configurations and movements of particles constituted of primary qualities, while, for the physicalist, they are these

configurations and movements themselves. Ontologically that does make a difference, but the difference doesn't arise from a dispute about how secondary qualities relate to primary qualities. Rather, it stems from a difference in the answer to the question of whether secondary qualities are defined via their relation to the ideas they cause, or if they can be defined independently from any ideas they cause. Dispositionalists take the former, and physicalists the latter position. Nevertheless, both agree that secondary qualities are configurations and movements of particles constituted of primary qualities, and that goes a long way when it comes to the question of how secondary qualities relate to primary qualities; dispositionalists and physicalists both give the same answer here.

Both may even agree on the fact that we usually pick out secondary qualities because they appear to us in certain ways. The physicalist merely needs to add the thesis that the qualities picked out are indeed intrinsic qualities of bodies, and that their appearance doesn't at all contribute to the nature of secondary qualities. The physicalist may for example hold that appearances of secondary qualities are "supervenient" on their physical structure: they completely depend on it, while causal changes in the physical structure are always caused by physical processes and never by appearances.

The physicalist's contention that secondary qualities are intrinsic to bodies has fewer teeth when it doesn't include the notion that the fundamental qualities are simple. Since then both dispositionalist and physicalists agree that secondary qualities

are configurations and movements of particles constituted of primary qualities, the dispute circles around the problem of which if any of the secondary qualities are intrinsic qualities, for example in the form of “natural kinds.” Physicalists about secondary qualities say that they are natural kinds, while dispositionalists think that they are dependent on (human) experience and classification. This is a further dispute prone to lead to different kinds of questions, which complicates the distinction between dispositionalism and physicalism.

The list of parallels and contradictions between dispositionalism, physicalism, projectivism and eliminativism could be continued indefinitely and seems only limited by the degree of detail discussed. The ongoing philosophical discussions on secondary qualities give the same impression: They become more and more fine-grained, but agreement on the correct explanation seems as far away as ever.

1.5 A new approach to the paradox

Above (1.1) and to many participants in the debates around secondary qualities, it has seemed to be a good idea to set aside the paradox of the primary-secondary quality distinction and to start off with a discussion of the nature of secondary qualities and their relation to primary qualities. The discussion of these problems is, or so I hope, indeed helpful for understanding the implications of the primary-secondary distinction. But, rather than settling the issues in question, it shows how easily the problems multiply and lead to a myriad of implications and complications, thereby evoking the danger of becoming entangled in some subset of problems.

Instead of ameliorating the paradox, the discussed positions are prone to cause further confusion. It is as if the debates around the question of how secondary qualities are produced by primary qualities were limited by invisible borders, and thus always circle around the same questions. If we want to find a way out of the limitations, we, like Wittgenstein's fly in the fly-bottle, are well advised to take a radically different direction. Instead of arguing for some purportedly best solution to the problem of how secondary qualities can be explained in terms of primary qualities, the attention will now be radically shifted to the reasons at work behind the alleged inconceivability. Part I investigates the reasons for introducing the distinction in the way it has traditionally been presented, and Part II investigates Husserl's analysis of the fundamental conception behind the early modern way of thinking

about primary and secondary qualities, and the confusion he sees in it.

Section 1.3 gave examples for that it needs only few changes in the preference for one or the other side of contrasting intuitions or thoughts to come from one ontological position to the other. This indicates that dispositionalism, physicalism, projectivism, and eliminativism are not just different answers to the primary-secondary quality distinction, but that they share an underlying origin in a common philosophical account. In so far as they are replies to the distinction, their origin is at the same time the origin of the early modern primary-secondary quality distinction. From the outside, dispositionalism, projectivism, eliminativism and physicalism look very different, and, in a strict sense, they contradict each other. But if they have the same origin beyond the fact that they are answers to the same distinction, they are not radically different, for a common origin is a common *radix*.

The obvious place to look for an origin would seem to be the writings of the first major philosophers that advocated dispositionalism, projectivism, eliminativism and physicalism. Chapter 2 therefore investigates Descartes's and Locke's explanations of secondary qualities in terms of primary qualities. Descartes and Locke both make the distinction, and both offer explanations for secondary qualities in terms of modes of primary qualities. In spite of their fundamental agreement on the necessity of making the distinction, however, already these two philosophers seem to disagree in their explanations. Moreover, interpreters widely disagree about the question as to whether either Descartes or Locke is best described as a

dispositionalist, physicalist, projectivist, or eliminativist about secondary qualities. Chapter 2 explains some of the reasons for ascribing either of these positions to Descartes or Locke. Some interpreters even think that most modern authors “vacillate” in their explanations. The difficulties of determining the accurate interpretations and the question of whether there even is *one* accurate interpretation, again confirms the suspicion that the different positions have a common origin. But “origin” now needs to be conceived in a broader sense; not simply in the sense of the respective positions in actual philosophers, but in the sense of the fundamental notions that lead those philosophers to the respective positions.

One place in which to look for the origin of the fundamental notions is in earlier distinctions that resemble the modern primary-secondary distinction, and which may have been used for the modern distinction. Chapter 3 draws a few general parallels of the primary-secondary quality distinction to the distinction between fundamental and derived qualities, and that between appearance and reality (3.1), an atomistic distinction between real qualities and qualities that are dependent upon human contribution (3.2), and the distinction between proper and *common sensibles* (3.3). Each of these distinctions involves so many issues that any attempt to work out the precise relations would require a huge study. The purpose of the discussion of possible predecessor distinctions in this chapter is therefore confined to contributing to the analysis by discussing some thoughts that come together in the modern distinction, and to allude to wider problems that may have been given rise to the

distinction. It will remain rather short and doesn't attempt to describe any details of the actual historical development.

The investigation into the origin of the primary-secondary distinction cannot conclude by discussing predecessor positions. What also needs to be understood is why certain thoughts were picked out and elaborated, and why other aspects were rejected. The "why" asks for a good reason, or at least a reason that looks good from the modern perspective. A reason can be an explicit reason or argument given by the respective philosophers, or it may be a reason that is only implicit and so basic that it may appear self-evident and unquestionable. The question for the origin of the distinction is the question for such reasons, their interplay, and their development. It asks for a genealogical description, not a list of mere facts in chronological order, but an explanation of the motivating reasons for the distinction and its development. In particular, the question of the origin aims to reveal the basic assumption, if there is one, which guides the development of the different arguments and positions.

Chapter 4 thus investigates the arguments and reasons given for the modern primary-secondary quality distinction. It does so in three steps. First, the resemblance thesis is investigated, then the divisibility argument, and then the argument from elimination of the perceiver. The investigation of the argument from lack of resemblance shows that the early modern primary-secondary quality distinction is more than just a reconfiguration of old ideas. The investigation into the universality of primary qualities suggest that in fact there is a radical new conception at work

behind the modern distinction, which distinguishes it from earlier conceptions. The section on the origin of the distinction in Galileo's concept of the mathematical universe explains that the radical new notion is the conception of the mathematical universe.

The task now is to investigate how the idea of the mathematical universe leads to the separation of primary and secondary qualities, and if and how its application to nature causes philosophical misunderstandings. Edmund Husserl attempted to explain exactly this, and Part II describes his account of the "mathematization," and the consequences he draws from it. It starts with a description of Husserl's development from a mathematician to a philosopher concerned with problem of the foundation of mathematics, and then to a philosopher concerned with the role of mathematics for the philosophical concept of the world (5.1), and explains what the application of mathematics for the philosophical concept of the world means (5.2). I then, in a systematic fashion, analyze four different ways of constituting concepts in Husserl: generalization, idealization, formalization, and symbolization (5.3).

The latter three coincide with the three steps I analyze in Husserl's account of the genesis of the alleged equivocation behind apparent inscrutabilities, which is the topic of Chapter 6. It explains by reference to different parts of *Crisis* how "Galileo's mathematization of nature" leads to the paradox. Each step by itself can be useful, but their combination can lead to confusions of different kinds of meanings, and the inscrutability of the role of experience for the constitution of scientific meaning.

Husserl's own plot in *Crisis* is at the center of Chapter 7, which inquires into his concept of the life-world, which allegedly was overlooked in the mathematization of nature, and into the "crisis," which is the alleged consequence of the misunderstanding of experience in the early modern picture of the world. Since the crisis is the result of the development of a way of thinking that developed in history, the problem of the "historical a priori" becomes an explicit topic for Husserl himself. The previous chapters investigated one concrete example: the history and logic of the mathematization of nature. Chapter 7 is not attempt to discuss Husserl's meta-considerations in a nutshell. Rather, it is a finishing thought that could become the starting point for carrying his notion of the "historical a priori" to other philosophical problems.

PART I

THE DISTINCTION

BETWEEN PRIMARY AND SECONDARY QUALITIES

AND ITS ORIGIN IN THE EARLY MODERN

MATHEMATICAL CONCEPT OF NATURE

2 Descartes's and Locke's explanations of the relation between primary and secondary qualities

This chapter considers several interpretations of Descartes's and Locke's explanations of the relation between primary and secondary qualities. Some of them are more plausible than others, but most have been attributed to Descartes or Locke by at least some interpreters. The aim here is not to come to a final interpretation of either philosopher, but to understand why the contradicting accounts of primary qualities—dispositionalism, projectivism, eliminativism, and physicalism—have all been ascribed to Descartes or Locke.

2.1 Dispositionalism

Descartes declares, directly after the text cited in the introduction in which he claims that we are “wholly unable” to conceive of the connection, that several sensations of secondary qualities are really caused by motions of primary qualities:

[W]e have every reason to conclude that the properties in external objects to which we apply the terms light, color, smell, taste, sound, heat or cold—as well as the other tactile qualities and even what are called ‘substantial

forms’—are, so far as we can see, simply various dispositions in those objects which make them able to set up various kinds of motions in our nerves.⁸

Descartes doesn’t here preclude the possibility of other affections of the mind, but since he thinks that the diverse motions of body are sufficient to cause all our sensations, and we never observe anything but such motions affecting our brains, he holds it to be very likely that our sensations are produced by motions of bodies. Perceptions of “light, color, smell, taste, sound, heat or cold and the other tactile qualities” are perceptions of secondary qualities. Since they, like all perceptions, are caused by changes of primary qualities of bodies, in the objects there is nothing corresponding to our perceptions of secondary qualities but the dispositions of primary qualities to produce perceptions of secondary qualities.

We might be tempted to infer from Descartes’s claim above that the objects

⁸ “[O]mnino concludendum est, nonetiam à nobis animadverti, ea, quæ in objectis externis, luminis, coloris, odoris, saporis, soni, caloris, frigoris & aliarum tactilium qualitatum, vel etiam formarum substantialium, nominibus indigitamus, quicquam aliud esse quàm istorum objectorum varias dispositiones, quæ efficiunt ut nervos nostros variis modis movere possint.” (AT 8A:322f, *Principles* IV, §198)

French: “Or puis que ... nous sçavons que nostre ame est de telle nature que les diuers mouuemens de quelque corps suffisent pour luy faire auoir tous les diuers sentimens qu'elle a, & que nous voyons bien par experience que plusieurs de ses sentimens sont veritablement causez par de tels mouuemens, mais que nous n'apperceuons point qu'aucune autre chose que ces mouuemens passe jamais par les organes des sens... jusques au cerueau, nous auons sujet de conclure que nous n'apperceuons point ausi en aucune façon que tout ce qui est dans les objets..., que nous appelons leur lumiere, leurs couleurs, leurs odeurs, leurs gousts, leurs sons, leur chaleur ou froideur, & leurs autres qualitez qui se sentent par l'attouchement, & ausi ce que nous appellons leurs formes substantielles, soit en eux autre chose que les diuerses *figures, situations, grandeurs* | & *mouuemens de leurs parties*, qui sont tellement disposées qu'elles peuuent mouoir nos nerfs en toutes les diuerses façons *qui sont requises pour exciter en nostre ame tous les diuers sentimens qu'ils y exitent.*” (AT 9B:317. Ellipses (...) and italics in original. The former indicate omissions from the Latin original, and the latter additions.)

that cause the respective perceptions have dispositions to do so, that he is proposing a dispositional theory of secondary qualities. Secondary qualities would be qualities of extended objects that have the disposition to cause in us the respective sensations. But the citation by itself is insufficient to establish dispositionalism, since it doesn't even talk about the true nature of sensible qualities. Rather, it concerns that which correlates to the respective words we use; that which "we call light, color, smell, taste, sound, heat or cold, and other tactile qualities." These words refer, according to Descartes, to actual qualities in the world. There really is something in external bodies that correlates to the use of these words: something that has the disposition to affect nerves in ways that cause the respective sensations.

The dispositionalistic interpretation entails that what is ordinarily called light, color, smell, taste, sound, heat, and the other tactile qualities of bodies coincides with what we, as philosophers, mean by these words. The guiding thought could be that ordinary language is usually fine as it is, and that philosophy cannot reframe its most basic meanings, such as that colors are part of objects. Philosophy would have to accept this notion, although it may reveal that colors are not exactly what we think they are, and are instead powers that produce in us the respective sensations.

But Descartes's expression "what we call" refers to a way of speaking, and, since we may err in our talk, each way of speaking can be explained with different ontologies. If Descartes thinks that our ordinary talk about colors is wrong, he may hold some form of error theory. He may, for instance, assume that colors really are

sensations intrinsic to the perceiver, which, however, are caused by “various” dispositions. Or he may think that there are “various” dispositions that cause sensations, but that there is nothing that systematically corresponds to our way of speaking. Going by the above citation alone, Descartes neither establishes nor precludes dispositionalism about secondary qualities, nor does he preclude the possibility of other accounts of the nature of secondary qualities.

Whether Descartes here is promoting an error theory or dispositionalism depends on the answer to the question of whether he is identifying colors with what we call colors in the objects. If so, the citation speaks in favor of dispositionalism. If not, and colors are really in the mind, the citation is compatible with projectivism. If there is neither something in the objects nor in the mind corresponding to what we assume colors to be, it is compatible with eliminativism. The consequent sections establish that either kind of “error” theory—projectivism or eliminativism—fits Descartes’s work better than dispositionalism.

Nevertheless, dispositionalism is surely one way of trying to explain the relation between primary and secondary qualities, and it is frequently attributed to other philosophers, first and foremost, to Locke.⁹ There is plenty of textual evidence in support of this interpretation. Locke claims at key passages that secondary qualities

⁹ For instance in Chapter IV of Jonathan Bennett *Locke, Berkeley, Hume* (Oxford: Clarendon Press, 1971). Also: Hilbert, D. R. *Color and Color Perception* (Stanford: Centre for the Study of Language and Information, 1987).

are only dispositions or powers of primary qualities to produce ideas of secondary qualities:

[T]he ideas of primary qualities of bodies, are resemblances of them, and their patterns do really exist in the bodies themselves; but the ideas produced in us by these secondary qualities, have no resemblance of them at all. There is nothing like our ideas existing in the bodies themselves. They are in the bodies we denominate from them, only a power to produce those sensations in us; and what is sweet, blue, or warm, in idea, is but the certain bulk, figure, and motion of the insensible parts in the bodies themselves, which we call so.¹⁰

Locke here defines secondary qualities via the ideas they produce. Secondary qualities are supposed to be those combinations of qualities of bodies that have the disposition to produce ideas of secondary qualities. Certainly, they do not have to produce such ideas all the time, but only under the appropriate conditions. Locke, too, speaks about “what we call” sweet, blue, or warm, and thereby he, too, introduces a qualification. But it is clear why he does so: because we think that words of secondary qualities refer to something that resembles our ideas, while, in fact, the bodies themselves have only bare powers that produce the respective ideas in us. This doesn’t mean that there are no colors, just that they are very different from what we usually think they are.

In spite of some clear indications that Locke is a dispositionalist, there are also

¹⁰ *Essay*, II, viii, 15.

reasons for assuming the contrary, and there are interpreters,¹¹ who object to the interpretation of Locke's thought as dispositional. Some of the apparent ambiguities in Locke's account may be clarified by considering that Locke distinguishes explicitly, although not always consistently, between ideas and qualities. As is well known, according to Locke, ideas are "in the mind," they are the "immediate object of perception, thought, or understanding." Qualities, by contrast, are "in the bodies,"¹² they are the "power to produce any idea in our mind."¹³ Since primary and secondary qualities are qualities of bodies, they are not internal. In respect to qualities of bodies, projectivism is for Locke not an option, since this would mean that secondary qualities are not qualities of bodies. But if qualities and ideas are confused, then it may easily seem as if Locke was a projectivist, since he alleges that the latter are frequently projected upon the objects. Yet, other ambiguities remain, and I do not pretend I could solve them.

¹¹ For instance, Paul A. Boghossian & J. David Vellman, *Colour as a Secondary Quality*, p. 103 fn. 15, 1989. Also, and more detailed: Smith, "Of Primary and Secondary Qualities."

¹² *Essay*, II, viii, 7.

¹³ *Essay*, II, viii, 8.

2.2 Physicalism

Due to the large amount of agreement between physicalism and dispositionalism, and the complexity of the problems arising from their disagreements, it may sometimes be hard to distinguish between dispositionalism and physicalism. I do not think that physicalistic interpretations of either Descartes or Locke can make sense of all of their writings; physicalism is a rather unlikely interpretation for Descartes or Locke. But there are passages to which physicalism is one of the possible interpretations. I would like to include just an example from Descartes:

I would have you consider the light in bodies we call “luminous” [*nomme lumineux*] to be nothing other than a certain movement, or very rapid and lively action, which passes to our eyes through the medium of the air and other transparent bodies, just as the movement or resistance of the bodies encountered by a blind man passes to his hand by means of his stick. ... Nor will you find it strange that by means of this action we can see all sorts of colours. You may perhaps even be prepared to believe that in the bodies we call “coloured” [*nomme colorés*] the colours are nothing other than the various ways in which the bodies receive light and reflect it against our eyes.¹⁴

Similarly, Descartes writes about an allegedly red object and claims that to be red means that it is disposed to spin the original straight “little parts of this subtle matter” in the “proportion which is required to make us sense the color red.”¹⁵ Celia Wolf-Devine interprets the above block citation as an expression of physicalism:

¹⁴ AT 6:84, CSM 1:153.

¹⁵ René Descartes, “Dioptrics,” transl. Paul Olscamp, *Discourse on Method, Optics, Geometry and Meteorology*. New York: Bobbs-Merrill, 1965. (AT 6:118)

The property in the object that we call color is picked out in terms of the sensations it causes in us, but Descartes does not appear to doubt that there is some physical property out there that causes the objects to reflect light in the way they do. We can say, thus, that objects are colored in the sense that their surfaces have certain structural properties that account for the ways in which they reflect light, and although scientists have not yet adequately understood just what it is about the surfaces that accounts for their way of reflecting light, there are doubtless such properties and when we know them, we will know what colors are.¹⁶

That the physical property in the object is picked out by its disposition to cause in us certain color perceptions is, according to Wolf-Devine, inessential to the property, which is defined in physical terms and without reference to perceptions. Wolf-Devine interprets Descartes to mean that colors are really qualities of bodies—not relational, but intrinsic qualities of bodies.

Wolf-Devine's ascription of physicalism may be a possible interpretation of the above passage, but it surely is not the most plausible. A dispositionalistic interpretation may seem just as plausible, since surface reflectance properties are only one part of a much larger story, which includes ideas and perceptions of colors. Dispositionalists have no troubles explaining why we usually use color terms in just the right way, since colors are defined via the disposition to cause the respective color ideas in us. Since physicalists, to the contrary, claim that colors are intrinsic and independent from our ideas of them, they need another way to explain why we are

¹⁶ Celia Wolf-Devine *Descartes on Seeing: Epistemology and Visual Perception* (Carbondale: Southern Illinois University Press, 1993), 46.

usually right in our applications of color terms. Descartes's physics had no description of physical properties that would straightforwardly account for why we are normally correct in our application of color terms. Today, this seems no more plausible, since colors are very different from, for example, chemical elements. One can plausibly claim that "water" always means H₂O, but a sensation of "red" can be caused by many different wavelengths and surface properties. It is not easy to identify intrinsic properties that would exactly correspond to color perception, if it is possible at all, and this seems to suggest that colors are relational qualities.

Another possible interpretation of the above citation is eliminativism, since Descartes there uses the expression "bodies we call 'colored,'" thereby avoiding the claim that there really are colors. Projectivism, too, is a possibility, if the colors we see are internal to the perceiver, and then projected upon bodies. All four ontological explanations of the nature of secondary qualities can be applied to the same citation by Descartes, with more or less good reasons.

2.3 Projectivism

Projectivism holds that secondary qualities exist in the mind. It is a rather unlikely interpretation of Locke's account of secondary qualities, since he holds that ideas are in the mind, and qualities in the bodies. To make projectivism fit Locke, one would need to show that Locke means to say that secondary qualities are really ideas and not qualities. But that seems incompatible with his choice to call secondary qualities "qualities" and not "ideas."

Projectivism is much easier to combine with Descartes's description of the distinction. Similar to Locke's distinction between ideas and qualities, Descartes distinguishes between two ways of judging colors, namely colors as part of objects, and colors as ideas. But, unlike Locke, he suggests that our ordinary judgment, according to which colors are qualities of bodies, is confused:

In order to distinguish what is clear in this connection from what is obscure, we must be very careful to note that pain and colour and so on are clearly and distinctly perceived when they are regarded merely as sensations or thoughts. But when they are judged to be certain things existing outside our mind, there is no way of understanding what sort of things they are.¹⁷

Like Locke, Descartes thinks that we are confused when we think that colors exist in the object in exactly the way our ideas present them to us. But Descartes goes further and suggests that colors are not clearly and distinctly perceived when we think of

¹⁷ CSM 1:217, AT 8A:33.

them as qualities of bodies. Since dispositionalism about secondary qualities holds that they are clearly and distinctly perceived when we think of them as dispositions of bodies, Descartes's remark is incompatible with dispositionalism.

If Descartes thinks that secondary qualities are clearly and distinctly perceived when they are regarded merely as sensations or thoughts, but not when they are taken to be things existing outside of the mind, then this seems to imply that they really are in the mind only, and merely by projection attributed to the things outside of it. Descartes would be a projectivist. Descartes definitely thinks that we often commit the error of ascribing sensations or thoughts of colors to bodies:

[W]hen we think we perceive colors in objects, although we are ignorant of what we call color, and are unable to conceive any resemblance between the color we suppose to be in objects, and that of which we are conscious in sensation: yet because we do not notice this, or because there are in objects several qualities, such as size, figure, number, etc., which, as we clearly know, exist, or may exist in them as they are perceived by our senses or conceived by our understanding: we easily glide into the error of holding that what is called color in objects is something entirely resembling the color we perceive, and thereafter of supposing that we have a clear perception of what is in no way perceived by us.¹⁸

The error identified by Descartes consists in the ascription of something that exists

¹⁸ "Cùm verò putamus nos percipere colores in objectis, etsi revera nesciamus quidnam sit, quod tunc nomine coloris appellamus, nec ullam similitudinem intelligere possimus, inter colorem quem supponimus esse in objectis, & illum quem experimur esse in sensu: quia tamen hoc ipsum non advertimus & multa alia sunt, ut magnitudo, figura, numerus & c., quæ clarè percipimus non aliter à nobis sentiri vel intelligi, quàm ut sunt aut saltem esse possunt in objectis: facilè in eum errorem delabimur, ut judicemus id, quod in objectis vocamus colorem, esse quid omnino simile colori quem sentimus, atque ita ut id, quod nullo modo percipimus, à nobis clarè percipi arbitremur." (*Principles*, LXX)

only in our minds to bodies in the world. One may object that, on Descartes's own account, the mind is a different substance and no mode of it, i.e., nothing that is in the mind, could also exist as a mode of the *res extensa*, and thus even primary qualities are attributed to the world by error. Descartes would surely have to agree that everything we perceive or think of is mediated by our ideas of it in the mind. When we think about extension, the thought is in the mind, but the particular extension the thought refers to is not. That is the case for all qualities, primary and secondary alike.

But Descartes's argument doesn't rely on an already established substance dualism. Rather, the alleged difference between the qualities rests on the fact that ideas of extension, which, while they are themselves not extended, nevertheless are analogous to what they represent, and thus truly represent what there is in the *res extensa*. By contrast, ideas of colors and other secondary qualities do not represent what they appear to represent. The reason is, as I will explain in section 4.2.3, that Descartes draws the line between intuitively perceived and thus erroneous representations, on the one hand, and intellectual and thus analogous representations, on the other.

But first, let's consider the question of whether Descartes could be a proponent of the other kind of "error" theory, eliminativism. The projectivistic interpretation of the above two texts holds that Descartes takes colors to have a clear and distinct existence in the mind. Eliminativists deny this, and any eliminativistic interpretation of Descartes thus needs to challenge that interpretation.

2.4 Eliminativism

An eliminativist interpretation of Descartes's last cited passage can agree with the projectivist interpretation that Descartes is claiming that we project our ideas of colors upon bodies in the world. But it would deny that Descartes means to say that colors are really in the mind. Nothing in the last citation says that colors really are in the mind; it merely states that perceptions of colors are projected upon bodies, not that colors *are* such projections. Descartes may mean that colors are not coherent entities at all.

True, in the preceding passage,¹⁹ Descartes states that colors are clearly and distinctly perceived when they are regarded merely as sensations or thoughts. But Descartes may have been ambiguous in his word choice and in fact merely meant to say that color *sensations* are clearly and distinctly known when they are regarded as sensations or thoughts in the mind. The French translation of the *Principles*²⁰ speaks of sensations or feelings (sentiments) rather than colors, and that Descartes only means sensations of colors is also suggested by the context of the citation. This seems to justify the interpretation that Descartes meant that color sensations are clear and distinct when they are thought to be in the mind, but they do not yield a clear and distinct concept of color qualities; colors are neither in the world nor in the mind.

¹⁹ The first citation of the last section.

²⁰ AT 9B:56.

In a recent essay,²¹ Lawrence Nolan develops an eliminativistic interpretation of Descartes along these lines. According to Nolan, Descartes claims that “with respect to bodies, ‘color’ is just a name that we ordinarily use to refer to the physical causes of our sensations in the absence of a scientific account of the nature of these causes.”²² This is eliminativism, for it entails that really there is nothing corresponding to our ordinary use of color words; neither in the bodies, nor in the mind. If our scientific knowledge was sufficient, a different kind of ontology founded by science could replace our confused ordinary way of speaking with a more accurate ontology.

Nolan calls this type of “error” theory “nominalism.” The kind of nominalism he means, however, should not be confused with medieval forms of nominalism, which stood in a very different kind of context. In fact, the qualities nominalists took to be real and non-real, such as colors and numbers, were basically reversed from Descartes’s list. Since the term “nominalism” is normally used in the medieval sense, calling Descartes a “nominalist” is prone to lead to confusion. A further problem with the term is that it aligns Descartes’s account with that of Galileo and Locke. It is surely good to point out parallels, but both Galileo and Locke compare secondary qualities with names in very similar text passages and would thus probably all have to

²¹ Lawrence Nolan, “Descartes on What We Call Colour,” ed. id. *Primary and Secondary Qualities* (Oxford: Oxford University Press, 2011), printed from Oxford Scholarship Online, 23f.

²² Op. cit., 7.

be called “nominalists.” Yet, as we have seen above, it may well be the case that each of them is pursuing a very different ontology of secondary qualities. Calling Descartes a nominalist thus blurs the fundamental differences between medieval nominalists and Descartes, and between philosophers such as Descartes, Galileo, and Locke. Rather than speaking of “nominalism” I will use the term “eliminativism” for Nolan’s interpretation.

Setting aside the problems around the term “nominalism,” Nolan presents good reasons for ascribing eliminativism to Descartes. Nolan rejects the “‘realist’ assumption” in interpretations of Descartes as a projectivist,²³ dispositionalist, or physicalist, which all presume that Descartes takes “‘colors’ to be real entities with distinctive natures.”²⁴ Nolan cites Descartes’s reply to Burman, who had inquired about a passage from the third meditation, in which Descartes writes that “[o]f course, if I considered just the ideas themselves simply as modes of my thought, without referring them to anything else, they could scarcely give me any material for error.”²⁵ Burman takes Descartes to mean that, while we can err if we think that there is such a resemblance, “there seems to be no subject-matter for error whatsoever if they are not referred to externals.” For secondary qualities this would mean that it is an error to project them upon bodies, but not to consider them to have their existence in the

²³ Nolan uses the term “subjectivist.”

²⁴ *Op. cit.*, 2.

²⁵ CSM II 26; AT 8:37 (3rd Meditation)

mind; Descartes would be a projectivist. If, to the contrary, Descartes holds that secondary qualities are not things or qualities; neither in the world, nor in the mind, then he seems to be an eliminativist. Descartes's reply to Burman suggests exactly this:

Even if I do not refer my ideas to anything outside myself, there is still subject-matter for error, since I can make a mistake with regard to the actual nature of the ideas. For example, I may consider the idea of colour, and say that it is a thing or a quality; or I may say that the colour itself, which is represented by this idea, is something of the kind. For example, I may say whiteness is a quality; and even if I do not refer this idea to anything outside myself—even if I do not say or suppose that there is any white thing—I may still make a mistake in the abstract, with regard to whiteness itself and its nature or the idea I have of it.²⁶

Descartes apparently told Burman that one can be in error not only when ascribing ideas of secondary qualities to bodies, but also when taking them to be things or qualities independent from any body in which they inhere. Since no quality can exist without any subject in which it would inhere, it is a mistake to think that the idea of color is a thing or quality independent of any body in which it would inhere. It is easy to commit this error, since ideas of secondary qualities are clear and distinct as ideas, and can thus be considered in abstraction from the bodies in which they inhere. But

²⁶ CSMK 3:337. Original Latin: “Est nihilominus materia errandi, etiamsi eas ad nullas res extra me referam, cum possim errare in ipsâ earum naturâ, ut si considerem ideam coloris, et dicam eam esse rem, qualitatem, seu potius ipsum colorem, qui per eam ideam repraesentatur, tale quid esse; ut si dicam albedo est qualitas, etiamsi illam ideam ad nullam rem extra me referam, ac dicam vel supponam nullum esse album, possem tamen in abstracto, et in ipsâ albedine ejusque naturâ seu ideâ, errare.” (AT 5:152)

what is clear and distinct is an idea, and not a quality of a body. Colors and other secondary qualities thus seem to have no existence as qualities; such entities would have to be eliminated from the philosophical concept of the world. In fact, words for colors or other secondary qualities either refer to mere sensations in the mind, or to the causes of such sensations in the world, of which we have not yet a clear scientific understanding.

By itself, Burman's second-hand report on Descartes's reply is not sufficient to prove either interpretation, and even all reasons given by Nolan would surely not convince all scholars that Descartes is an eliminativist. Projectivistic interpreters may try to defend themselves by claiming that projectivism doesn't have to claim that secondary qualities are qualities independent of any object they inhere in. Rather, they may inhere in representations of objects and not in the objects upon which they are projected. Or, they may agree that secondary qualities are not really qualities at all, but sensations in the mind, and are only projected upon bodies as if they were qualities.

The discussion so far has shown that there are plausible *prima facie* reasons for attributing eliminativism to Descartes, even though nothing said so far could possibly settle the quest for the best interpretation. With regard to Locke, section 2.3 states that "error" theory in the form of projectivism is not a very plausible interpretation. But an "error" theory in the sense of eliminativism may fit better, since Locke claims that secondary qualities are only parts of the bodies because they are

due to configurations and movements of particles constituted of primary qualities. We may claim that there are really only primary qualities, and that secondary qualities could be reduced to primary qualities once we know which of their configurations and movements make up secondary qualities.

But such a claim becomes implausible when we distinguish the kind of reduction that is possible under Locke's account from the kind of eliminativism that would not be possible. Since Locke defines primary and secondary qualities via the ideas they cause, and since there is no doubt that we have ideas of secondary qualities, he cannot simply disregard them. Secondary qualities are not simply primary qualities, but specific configurations and movements of particles constituted of primary qualities. Eliminativists strive to abandon the notion of secondary qualities, the ideas of which they take to be incoherent. For Locke, secondary qualities are real—not because they are simple qualities, but because they are configurations and movements of particles constituted of simple qualities. Even when we talk about colors in the sense of ideas of colors, they are simple and distinct, and thus have some sort of existence in the mind. Eliminativists think that it would be best to give up color words, but Locke doesn't think so; they make sense both when we think of colors as qualities of objects, and when we think of colors as ideas in the mind.

2.5 The origin of the fluctuations

The above considerations speak most in favor of Locke advocating a dispositional account of secondary qualities, and projectivism with regard to our ideas of them. The passages cited from Descartes mostly speak in favor of some flavor of “error” theory. Projectivism seems to be the more likely and more frequently attributed type of error theory, but I have also discussed some good reasons for ascribing eliminativism to Descartes. The above considerations alone are insufficient for excluding other interpretations of either Locke or Descartes, and different interpreters give reasons for different interpretations in an ongoing debate.

A more thorough investigation than the above could maybe lead to an unambiguous interpretation of Descartes’s or Locke’s explanation of secondary qualities in terms of primary qualities, although the continued existence of distinguished yet contradicting interpretations make this possibility appear unlikely. For this dissertation, nothing really hinges on the question of whether Descartes, Locke, or any other modern philosopher is best described as a dispositionalist, projectivist, eliminativist, or even something else.

Even if we could clearly and unambiguously determine if Descartes or Locke is a dispositionalist, projectivist, eliminativist, or physicalist, that would not be the end but the beginning of the investigation into the story they have to tell us. The point is not to settle the debates around the right interpretation of Descartes or Locke, but to

understand how modern philosophers clear the way for the variety of different philosophical accounts of secondary qualities that have been discussed since then. The fact that all four explanations of secondary qualities in terms as configurations and movements of particles constituted of primary qualities have been attributed to Descartes and Locke does not mean that they themselves give all four explanations. But it suggests that the notions that allow giving them are already given in Descartes and Locke.

There is something important to learn from the difficulties of unambiguously attributing dispositionalism, physicalism, projectivism, or eliminativism to Descartes or Locke. The difficulties of ascribing one or the other position to them have even led to ascriptions of contradicting positions to the one and same author. Margaret Wilson concludes that most early modern authors have “a tendency to vacillate, just as Locke does, over whether terms like ‘color’ and ‘red’ denominate physical structures, or the ‘powers’ that (partly) result from the structures to cause sensations, or (as Locke seems usually to suppose) the sensations themselves.”²⁷ In the first case mentioned by Wilson, Locke or the respective modern author would be a physicalist, in the second a dispositionalist, and in the third a projectivist.

Wilson’s term “vacillate” is confusing, however, for it suggests that the one

²⁷ Margret Wilson “History of Philosophy in Philosophy Today; and the Case of the Sensible Qualities,” *The Philosophical Review* 101, (1992) 228. Cf. also Mackie 1972, p. 15.

and the same author puts forward contradicting accounts, and it seems unlikely that philosophers as intellectually sharp as Descartes and Locke blatantly contradict themselves. One reason for apparent or real vacillations may be that Descartes's and Locke's main aim is not to explain how secondary qualities can be conceived in terms of primary qualities, but to single out the fundamental building blocks of reality. They may thus not always put utmost attention to the distinction between the possible denominations of color terms, and may vacillate, or appear to vacillate. For instance, in some cases color words used by these authors have different meanings in different contexts, and the respective author may sometimes leave it to the reader to guess which meaning he is talking about at the respective place.

But, while some of the vacillations may be explained in this way, the fact that most of the contradicting positions can be applied to philosophers such as Descartes and Locke suggests something more profound, namely that the accounts, which contradict each other on the surface, are connected beneath the surface. Already section 1.5 had raised the suspicion that there is a common origin to the different conceptions, a suspicion that gains further impetus from the fact that the qualities on either side of the distinction are mostly the same, regardless of the respective ontology. On the one hand, it is clear which qualities Descartes or Locke think are primary and secondary, while, on the other hand, the correct interpretations of the respective ontological accounts are widely disputed. Descartes and Locke may have had other reasons for the distinction and its specific division of qualities, and have put

forward the respective ontological explanations only as after-the-fact justifications.

In section 1.4, I explained that the attempt to work out the “best” explanation of secondary qualities in terms of primary qualities is in a danger of circling always around the same questions. The same danger lurks when we investigate some philosopher’s account of secondary qualities as configurations and movements of particles constituted of primary qualities, without paying attention to her or his reasons for the primary-secondary quality distinction itself. These may be arguments for the distinction, or reasons given explicitly, or other reasons, reasons that may or may not have been conscious to the respective author. The study of Descartes’s and Locke’s explanations of secondary qualities as movements and configurations of primary qualities again leads to the demand from section 1.5, namely to search for the origin of the primary-secondary distinction.

3 Predecessors of the early modern primary-secondary quality distinction

3.1 Fundamental and derived qualities, and real and merely apparent qualities

This section describes how the modern primary-secondary distinction can be conceived of as a combination of two perennial philosophical distinctions: The distinction between the fundamental and derivative qualities of perceptible objects, and the distinction between appearance and reality. Both distinctions are here conceived in their wider meaning and thus remain somewhat vague. The purpose is merely to describe in how far both are entailed in the modern primary-secondary distinction, not to reconstruct the complicated factual influences of concrete expressions of both perennial distinctions upon specific modern philosophers.

According to the distinction between fundamental and derived qualities, the derived qualities are dependent on the fundamental qualities, which are thought to cause or constitute them. The fundamental qualities are supposed to be inherent to reality itself and are thus explanatorily basic, while derived qualities are alleged to be causally inert and ultimately irrelevant for a complete account of the world.

During the millennia before Galileo, there was one distinction between fundamental and derived qualities that was nearly universally held, namely that

between, on the one side, the four elements fire, air, earth, and water and, on the other side, all the bodies made from a mixture of these elements. In ancient Greece, philosophers as diverse as Parmenides, Anaxagoras, Empedocles, Plato, and Aristotle, all promoted this theory in one form or another. The four elements themselves are sometimes taken to be due to two pairs of opposites, which are usually rendered “primary qualities.” These are, on the one hand, hot and cold, and, on the other, moist and dry. Fire is thought to be due to the combination of hot and dry, air to the combination of hot and moist, earth to the combination of cold and dry, and water to the combination of cold and moist.

The ancient distinction between fundamental and derived qualities, like the modern distinction between primary and secondary qualities, strives to reveal the simple building blocks of reality, which are in both cases called “primary qualities.” In spite of the same name, however, the ancient and the modern conception of primary qualities do not have very much in common, not even the qualities on either side.

The reason is that the early modern distinction between fundamental and derived qualities is distorted by the influence of another distinction, namely that between appearance and reality. This distinction is a fundamental experience of every human: not everything that appears to us is in fact the way it appears to us; sometimes things or qualities appear to us that turn out, under closer inspection, to have different qualities, or to be of a different kind, or to be mere hallucinations. Philosophers of all

times have distinguished between real objects or qualities and merely apparent objects or qualities; that what is part of reality from that what is only imagined to be part of it.

By itself, the distinction between fundamental and derived qualities neither presupposes an answer to the question how the derivative qualities appear, nor to how they are conceptualized. Vice versa, the distinction between appearance and reality doesn't necessitate a distinction between fundamental and derived qualities; what makes a merely apparent thing merely apparent is not that it is fundamental or derived, but that it is or is not part of reality. But in early modern philosophy, both distinctions come together: primary qualities are fundamental because the appearances of them are veridical, while secondary qualities are derived because they are mere appearances.

The early modern combination of the distinction of fundamental and derived qualities with the distinction between reality and appearance goes along with a representationalistic turn of perspective. Rather than asking which simple *qualities* are real and which merely apparent, the question becomes which of our *ideas* of simple qualities are veridical and which are merely apparent. The ultimate goal still is to distinguish real from merely apparent *qualities*, but the starting point are now our representations or *ideas* of simple qualities. As mentioned in section 1.1, ideas are conceived to be representations of all kinds; early modern philosophy embraces representationalism, according to which we do not perceive bodies and their qualities,

but only ideas of them. Ideas are representations of something that may or may not exist. If they correspond to simple qualities, they are veridical, if not they are merely apparent.

The distinction between appearance and reality may concern things that appear, but it may also concern qualities; for instance, one may wonder if a tower in the distance is round or cornered. But either case is about particular things or qualities. The primary-secondary quality distinction, in contrast, concerns a whole class of qualities.²⁸ This makes the modern distinction between primary and secondary qualities incommensurable with most expressions of the ancient distinction between fundamental and derived qualities. Most ancient authors did not hold that either derived or fundamental qualities lack any resemblance to our experience of them. In modern philosophy, by contrast, the lack of resemblance is a major argument in favor of the distinction between primary and secondary qualities.

While both the distinction of fundamental and derived qualities and the distinction between reality and appearance surely have contributed to the modern primary-secondary quality distinction, their combination makes the modern distinction incompatible with either of the distinctions as they had usually been conceived. Bringing the two distinctions together in the way early modern philosophy did is not a function of a certain time, but of a certain form of thinking, which found a

²⁸ In Aristotelian terminology, the class of “proper sensibles” (see section 3.3).

good soil in early Renaissance science and thought. But they could be held at other times, and, given the wide variety of Ancient thought, it would come as no surprise if one would find that some ancient author had already made a distinction that is very much like the early modern distinction between primary and secondary qualities—if not a mainstream author, then at least some more remote figure, possibly in one of those pre-Socratics whose thoughts had been suppressed due to their rejection by Plato or Aristotle. The next section explains that this may be the case with Democritus.

3.2 Ancient atomism and modern corpuscularianism

There indeed is one ancient distinction between fundamental and derived qualities that, while not sharing the same name, mostly matches the modern distinction between primary and secondary qualities with respect to the actual qualities on either side, such as, on the one hand, shape, arrangement, and position of smallest parts, and, on the other, taste, temperature, and color. Furthermore, it also relates to the distinction between reality and appearance in that it holds that the non-fundamental yet apparent qualities are due to human contribution. The distinction is connected to ancient atomism. Leucippus coined the term atom (*ἄτομος*) in approximately 450 BCE, and his student Democritus writes in a fragment: “By convention sweet, by convention bitter, by convention hot, by convention cold, by convention colored; but in reality there are atoms and void.”²⁹

Democritus here sets apart reality or truth (*ἐτεῆ*) from what is only due to law, convention, custom, or tradition (*νόμος*). These latter three translations of *νόμος* do not completely capture what Democritus could have meant, for if they did, Democritus would have had in mind something akin to the view that cultures create colors, which seems unlikely. Democritus himself may have used the term metaphorically, or in a technical sense, which would accord to the fact that both *ἐτεῆ*

²⁹ “νόμοι γλυκύ, [καὶ] νόμοι πικρόν, νόμοι θερμόν, νόμοι ψυχρόν, νόμοι χροίη, ἐτεῆ δὲ ἄτομα καὶ κενόν” (Democritus, Fragment 9, ed. Hermann Diels *Die Fragmente der Vorsokratiker: Griechisch und Deutsch* (1952), 139)

and *νόμος* are rare words in texts of that period. One possible interpretation is that Democritus's "laws" are not human laws, but regularities established by certain types of configurations of atoms.

But whatever translation is the best interpretation of Democritus's fragment, it is clear that he makes two claims, each of which corresponds to one of the two distinctions interwoven in the modern account of primary and secondary qualities. One, he claims that there is only one type of elements, namely atoms, and that besides them there is only void (*κενόν*).³⁰ Since Democritus defines atoms by their position, movement, shape and extension, these qualities are supposed to be real, and indeed match the early modern primary qualities. Two, he claims that the listed sensible qualities are not simple features of the objects they are ordinarily attributed to, but that their existence depends on something like convention.

According to Aristotle, Democritus thinks that these latter qualities in fact derive from the smallest parts and their shape, arrangement, and position.³¹ Again, this claim matches the modern explanation of secondary qualities. All this suggests that the step from Democritus's atomism to the modern concept of the world may be smaller than suggested by the amount of philosophical discussion that happened in between.

³⁰ If *κενόν* is empty space, then Democritus differs from Descartes in the supposition that there is empty space, and accords with Boyle and Locke.

³¹ "σχῆμά τε καὶ τάξιν καὶ θέσιν" (Aristotle, *Metaphysics* 1.4 1.985β)

We have to, however, be careful with drawing conclusions from the limited evidence available. We may be in a worse position than Aristotle, since there are only very few fragments of Democritus's work preserved, and the rare bequeathed second-hand descriptions are not sufficiently detailed. Even the accuracy of Aristotle's description of Democritus's arguments is questionable. After all, Aristotle rejected it, and he may not always have been fair to Democritus, or even known the details of Democritus's thought. But there are a few general correlations that are worth mentioning here.

In its turn against Aristotelianism, corpuscularianism resurrected some of the atomistic notions. Like Democritus's atoms, corpuscles are thought to produce all observable phenomena in virtue of their configurations and movements. Of course, corpuscularianism stood in a different context, and that is not only due to Aristotelianism. In spite of reviving atomism in a new form, corpuscularians were eager to distinguish their work from the ancient atomists.³² I would like to point out two main reasons for calling their own theories "corpuscularianism" instead of "atomism."

One reason is that to many it seemed that Aristotle had shown that Leucippus's and Democritus's atomism was incoherent, and using a different term would make clear that they attempted to go well beyond ancient atomism. Of course,

³² Cf. e.g. *Principles*, §202.

corpuscularians themselves did not think that Aristotle refuted all aspects of atomism. But they also thought that there were problems with ancient atomism and that its perceived speculative excesses had to be curbed, that its implications on the origin of the world had to be replaced with a Christian context, and that it should be aligned with the results of modern empirical investigation.

The other reason for using a new word is that corpuscles usually are thought to lack one essential feature of atoms; in contrast to atoms, they are not thought to be indivisible. Boyle, for instance, thinks that corpuscles could be divided into “minima naturalia,” which themselves could possibly be divided into even smaller parts.³³ He asserts that even divisions of minima naturalia are possible, at least by God, though unlikely. He affirms that divisions in corpuscles, in contrast, happen frequently. In an analogy with chemical science today, Boyle’s corpuscles can be compared to molecules, and his minima naturalia to atoms. In comparison to Ancient atomism, however, neither corpuscles nor minima naturalia are identical with the classical concept of the indivisible *α-τομος*.

Yet, these differences between atomism and corpuscularianism are less important than the similarities between them when it comes to the distinction between primary and secondary qualities. That proponents of both came to very similar

³³ Cf. Robert Boyle “The Origin of Forms and Qualities, According to Corpuscularian Philosophy,” *The Works of the Honourable Robert Boyle in Six Volumes*, Vol. III. (London: J. and F. Rivington 1772), 30.

distinctions between real and merely apparent qualities indicates that there is a relation between reality as conceived in atomistic or corpuscularian terms and the two distinctions. The relation is not one of necessity. That atomism as compatible with contradicting accounts of sensible qualities may be seen in Plato, who, like Democritus, subscribed both to some form of atomism, and to the theory of the four elements. Plato explains in *Timaeus* that there are four types of atoms, each having a characteristic geometrical shape corresponding to one the four elements. But in contrast to the modern primary-secondary distinction, Plato thinks that sensible qualities do have a resemblance with the ideas they derive from. He thus may serve as an example for a form of atomism that doesn't necessitate a distinction between real and merely apparent qualities.

But, nevertheless, to Democritus and early modern philosophers alike, their respective conceptions of the smallest particles of the universe seemed to be compatible with their respective distinctions between primary and secondary qualities. Why, is an interesting question that cannot be answered here, and there may never be enough evidence to answer it. But I would like to indicate one possible approach for answering it. There is another parallel between Democritus and early modern philosophers, the meaning of which will become clear only later in the course of this dissertation. Democritus was not only very interested in empirical study and mathematics, he also made calculations that make use of notions which, two millennia later, were developed upon in the infinitesimal calculus. Like other ancient

philosophers, Democritus's conception of atomism may have been inspired by his mathematical research. The relation between the mathematical conception of the world and the early modern concept of primary-secondary qualities will be explored in the next chapters, and its results may be an interesting starting point for other studies looking into the relation between Democritus's mathematical research and the fragment cited above.

3.3 The distinction between *proper* and *common sensibles*

Aristotle himself advocated another distinction that, in contrast to atomism, was widely held until Galileo. Because it basically matches the respective qualities on each side of the modern distinction between primary and secondary qualities, one may think that the modern distinction is simply a continuation of the ancient distinction. I here argue that at least in Descartes's writings there are thoughts that suggest such a continuation thesis, but that ultimately this is not the case, and that the modern and the ancient distinction are incompatible.

The ancient distinction is Aristotle's distinction between *common sensibles* (*αἰσθητά κοινά*) and *proper sensibles* (*αἰσθητά ἴδια*). *Common sensibles* are common to different senses, and Aristotle lists motion, rest, shape, magnitude, number, and unity.³⁴ The *proper sensibles*, by contrast, are particular to one sense only. Aristotle lists warmth, color, taste, smell and sound.³⁵ Aristotle thinks that being perceived by different senses helps to identify and distinguish the *common sensibles* from each other and from the *proper sensibles*.³⁶

There are plenty of authors who draw connections between the ancient and the modern distinction,³⁷ and some claim that Aristotle's distinction is at work behind the

³⁴ Cf. *De Anima* III.1 425a16.

³⁵ Ibid.

³⁶ Cf. *ibid.*

³⁷ See for example Bennett, Jonathan (1965). "Substance, reality, and primary qualities," *American*

primary-secondary distinction. For instance, Robert Pasnau writes that the distinction between primary and secondary qualities is understood better when it is viewed in terms of Aristotle's distinction between *common* and *proper sensibles*, because the latter is closer to the truth of what the primary-secondary distinction is trying to account for:

It is an ironic implication of the present account that the early modern authors with whom we associate the primary-secondary distinction were in fact rather far from understanding it correctly. Instead, it turns out to be the Aristotelian tradition that comes closer to getting the distinction right, with its contrast between proper and *common sensibles*, and its insistence that the senses cannot err regarding the *proper sensibles*.³⁸

Pasnau's question about who is "closer to getting the distinction right" presupposes that the ancient and the modern authors basically put forward one and the same distinction. Pasnau rightly acknowledges that the ancient distinction "leaves out, most significantly, ... the essential role played by the way we conceive of those qualities," and that "[t]he Aristotelian tradition took only a few steps toward an adequate account."³⁹ But here again, he presupposes that there is one "adequate account." There is a limited way in which this makes sense: Aristotle and Descartes basically distinguish the same qualities on either side, and in that respect they make the same

Philosophical Quarterly 2 (1965); George Pitcher *A Theory of Perception* (Princeton, NJ: Princeton University Press, 1971); and Robert Pasnau "A Theory of Secondary Qualities," *Philosophy and Phenomenological Research* LXXIII 3 (2006), 568–591.

³⁸ Pasnau, "Secondary Qualities," 589.

³⁹ *Ibid.*

distinction. Yet, as I will show now, the reasons given for distinguishing the respective qualities are so different—in fact, incompatible—that really the Aristotelian and the early modern account are of two fundamentally different distinctions.

Descartes, of course, knew of the ancient distinction, and in fact explicitly related to it. Descartes suggests that his distinction is compatible with Aristotle's distinction when he cites it as a reason to think that some qualities are more fundamental than others. He writes with regard to our perceptions of the movements of bodies, their variation in size and figure, and their workings upon each other:

We detect these facts not just with one sense, but several—sight, touch and hearing; and they can also be distinctly imagined and understood by us. But the same cannot be said of the other characteristics like color, sounds and the rest, each of which is perceived not by several senses but by one alone; for the images of them which we have in our thought are always confused, and we do not know what they really are.⁴⁰

Descartes puts forward this claim shortly after announcing that he had “made use of no principle which was not received and approved by Aristotle, and by the other philosophers of all ages.” Descartes did not explicitly say that he is referring to Aristotle's *common* and *proper sensibles*, but this announcement is another indicator

⁴⁰ CSM 1:286 (*Principles IV*, CC). “Hoc non uno tantum sensu, sed pluribus, visu, tactu, auditu deprehendimus; hoc etiam distinctè imaginamur & intelligimus; quod de reliquis, ut de coloribus, de sonis & cæteris, quæ non ope plurium sensuum, sed fingulorum duntaxat percipiuntur, dici non potest: semper enim eorum imagines in cogitatione nostrâ sunt confusæ, nec quidnam illa sint scimus.” (AT 8:323-4)

that he indeed addressed Aristotelian thought. He could assume that his contemporary readers, who were well acquainted with Aristotle, recognized the connection to the notion of *common* and *proper sensibles*.

Descartes attempts to convince his Aristotelian readers that his own distinction between the two kinds of qualities, which may have been perceived to be incompatible with Aristotelian thought, is in fact supported by Aristotle himself. He also, however, formulated the difference between the two kinds of qualities in a way Aristotle clearly would not have approved of. In the last section above, I analyzed the modern distinction in two ways: as a distinction between fundamental and derived, and as one between real and merely apparent qualities. Separating these aspects helps to show the discrepancies more clearly.

If one concentrates on the difference between fundamental and derived qualities, one may find a parallel in Aristotle, but with switched qualities on either side. For Aristotle, if one kind of qualities is derived from the other, it is the *common sensibles* that are derived from *proper sensibles*. *Proper sensibles* are immediately perceived, and *common sensibles* only via perceptions of *proper sensibles*. So even though there is a sense in which Aristotle considers some qualities as fundamental, and others as derived, the dependence relation between the respective qualities is reversed. Both distinctions build upon different kinds of dependence. On the one hand, for Aristotle, *common sensibles* are perceived via *proper sensibles*, but there is no corresponding sense of “perceived via” in the modern distinction, according to

which all qualities are perceived via the ideas that represent them, and some qualities are perceived via ideas of primary, and others via ideas of secondary qualities, but no quality is perceived through another quality. On the other hand, according to the modern distinction, secondary qualities are derived in the sense that they, if they are part of bodies at all, can be analyzed in terms of configurations and movements of particles that have only primary qualities, but there is no such sense of fundamental and derived in Aristotle.

The other main part of the modern distinction discussed in the last section, that between real and merely apparent qualities, is obviously not compatible with Aristotle's account. Descartes holds that there is an ontological difference between qualities that really belong to the bodies they are attributed to and those that do not. Aristotle, by contrast, thought that all qualities—*common* and *proper sensibles* alike—belong to the bodies they are attributed to. For Aristotle, neither kind of qualities is merely apparent. For him, as for Plato and nearly all other philosophers until the beginning of modern philosophy, any conception of substance that doesn't include the whole class of *proper sensibles* would necessarily be incomplete.

Yet, in the above citation, Descartes seems to make a major concession to the Aristotelian tradition by distinguishing two types of imaginations: Those that are distinct, and those that are not. He seems to suggest that, because we can perceive colors, sounds, and other qualities with only one sense, we only have confused images of them. Other sensible qualities, such as forms and movement, can be

perceived through different senses. This appears to allow us a distinct imagination of *common sensibles*, which in turn, or so Descartes seems to think, contributes to our knowledge of which qualities are really nothing like they appear to be.

But the fact that colors, sounds, and other qualities are perceived by merely one sense is hardly apt to explain why they are not really part of the body. Why do all real qualities have to be perceptible by all senses? Could it not be the case that some of our senses are sensitive to certain aspects of reality, but not to others? Descartes doesn't give an answer to these questions, for a reason. His case for the distinction between primary and secondary qualities derives from very different considerations. For Descartes, understanding and imagination are two completely different faculties, and only understanding can lead to true knowledge.⁴¹

Descartes uses the Aristotelian distinction to make plausible his distinction, but his explanation really goes the other way around: the reason why secondary qualities are perceived only by one sense is that they are nothing but modes of the faculty of sense. On the other hand, the reason the *common sensibles* seem to affect more than one sense is that they are real qualities of the world. Aristotle's main rationale behind the distinction—that some qualities are perceived with one sense only and others are common to several senses—is for Descartes at best an indication

⁴¹ Descartes's crucial distinction between intellectual understanding and intuitive experience will be the topic of section 4.2.3.

that confirms a distinction he made for other reasons, reasons that do not depend on primary qualities being perceivable by several, or any, senses.

That the connection to Aristotle is, for Descartes, merely a means to make his distinction between primary and secondary qualities palatable to Aristotelians becomes obvious when he mocks the idea that the combination of senses in a “‘common’ sense” would lead us to knowledge of the true qualities of the world:

So let us proceed, and consider on which occasion my perception of the nature of the wax was more perfect and evident. Was it when I first looked at it, and believed I knew it by my external sense, or at least by what they call the ‘common’ sense—that is, the power of imagination? Or is my knowledge more perfect now, after a more careful investigation of the nature of the wax and of the means by which it is known?⁴²

The correct answer is supposed to be, of course, that not imagination but intellectual understanding leads to true knowledge. For Descartes, the distinction doesn’t run between different sensible qualities in the first place, but between qualities that are perceived by imagination or intuition, and qualities that are understood by the intellect.⁴³ According to this line of Cartesian thought, Aristotle’s distinction is confused because it is a distinction between two kinds of sensible qualities, and sensible qualities are never clearly and distinctly understood when thought to be qualities of external objects.

⁴² CSM 2:21-22 (2nd Meditation)

⁴³ See section 4.2.3.

The discussion of the relation of the distinction between common and *proper sensibles* and Descartes's distinction between primary and secondary qualities showed that there are resemblances between the two distinctions, but that Descartes's distinction between primary and secondary qualities is a break with the former distinction, and not simply its continuation. In particular, Descartes's distinction is rooted in his specific distinction between intellectual understanding and intuitive experience, which needs to be investigated to make sense out of Descartes's distinction. The next chapter does so in the context of Descartes's rejection of the resemblance thesis.

4 Arguments and reasons for the distinction

This chapter investigates the arguments and reasons for the distinction between primary and secondary qualities explicitly given by early modern authors, and reasons that are implicit and work more in the background of the distinction. The first section (4.1) investigates Boyle's claimed restriction to experiential justifications of the primary-secondary quality distinction, but finds that, at a crucial point, even Boyle makes use of an a priori argument. In contrast to Boyle, philosophers such as Descartes and Locke present explicit and detailed arguments and justifications for the distinction between primary and secondary qualities, even though it is not always clear what is a definition and what an argument is, or what may be an *ad hoc* justification.

The following sections investigate some of the most prominent arguments. Section 4.2 discusses the important notion that ideas of secondary qualities lack resemblance with the qualities in the world that produce them, and the different explanations given by rationalists and empiricists.

This, in turn, requires a more fundamental investigation into the concept of primary qualities and the role of mathematics in relation to them, as is pursued in Section 4.3. My investigation leads not to a direct answer to the question for the nature of *secondary* qualities, but to a problematization of the concept of the nature of *primary* qualities. They are supposed to be universal, and because everything

universal must withstand the test of infinite divisibility, only modes of extension fulfill this criterion.

A charitable reading of the arguments for the distinction implies that they were also reasons for making the distinction. Nevertheless, this chapter also discusses some indications that the arguments were neither the only nor the strongest reasons. For instance, the same kinds of arguments, such as the argument from lack of resemblance and the universality argument, are frequently taken to confirm quite different positions, such as empiricism and rationalism. Furthermore, the arguments themselves are often not very strong, and they rely on other, presupposed, notions. Most importantly, all seem to rely on the mathematical conception of bodies. The fact that the nature of primary qualities is determined with mathematical means necessitates a look into the modern concept of the world as a mathematical universe, which will be done in the following section (4.4). Descartes's and Locke's arguments already point towards the importance of the concept of the mathematical universe for the definition of primary qualities, but no one is better known for the claim that the universe is mathematical more expressly than the earliest author investigated who makes the distinction, Galileo Galilei.

4.1 Boyle on experiential induction

The best example of a thinker who takes the distinction between primary and secondary qualities to be the result of the interpretation of empirical research is probably Robert Boyle. Locke is usually credited with having introduced the terms “primary” and “secondary qualities” for the modern primary-secondary quality distinction. Strictly speaking, this is probably correct, even though the distinction itself has clearly been around since Galileo, and similar terms were already in use. Locke’s mentor at Oxford, Boyle speaks of “secondary qualities” in his claim that “there are simpler and more primitive affections of matter, from which these secondary qualities, if I may so call them, do depend.”⁴⁴ Boyle’s wording “if I may so call them” may indicate that Boyle considers himself as having invented this expression, and the way he explains the respective qualities shows that he is talking about the primary-secondary quality distinction in the modern sense. He doesn’t use the term ‘primary qualities,’ but he speaks of “primary affections of bodies, to distinguish them from those less simple qualities (as colours, tastes and odours) that belong to bodies upon their account.”⁴⁵ The secondary qualities stem from “more primary and catholick affections of matter, bulk, shape, motion or rest, and the texture

⁴⁴ Boyle “Forms and Qualities,” 23-4.

⁴⁵ Op. cit., 16.

thence resulting.”⁴⁶

Boyle takes his reasons for distinguishing secondary qualities from primary affections of matter to be mainly empirical. His contempt for philosophical theorizing without experiential foundation becomes obvious when he writes that the theories of earlier philosophers were not of much use because they lacked experimental foundation: “[W]hatever be to be thought of the general theories of Aristotle or other philosophers concerning qualities, we evidently want that upon which a theory, to be solid and useful, must be built; I mean an experimental history of them.”⁴⁷ The idea of the primary affections of matter, by contrast, seems to comply well with the results of experiments.

In his writings, Boyle opposes philosophical speculation about the basic constituents of nature. In reference to Descartes he states that he “purposely forbore to peruse his system of philosophy.”⁴⁸ Boyle laments that, “yet I find by turning over the leaves that he has left most of the other qualities untreated of; and those that are more properly called sensible, he speaks but very briefly and generally, rather considering what they do upon the organs of sense, than what changes happen in the objects themselves.”⁴⁹ Boyle’s rationale for refraining from discussing in detail philosophers like Aristotle and Descartes is that he did not want his judgment to be

⁴⁶ Op. cit., 28.

⁴⁷ Op. cit., 12.

⁴⁸ Op. cit., 11.

⁴⁹ Ibid.

guided by the opinions of other philosophers, but only by the results of experiments. Boyle's writings suggest, however, that he was better informed about philosophy than he admits. In any case, even if it is true that he did not read much philosophy, this doesn't mean that his judgment was not indirectly guided by the thoughts of philosophers, for instance through their influence on other scientists such as Galileo. That Boyle's selection and interpretation of his experiments is guided by the thoughts of previous philosophers is suggested by the similarities of his arguments to their thoughts.

Moreover, even Boyle makes use of a priori arguments. His reasoning for the above mentioned three "essential properties" of size, shape, and motion or rest, is a combination of experiential and a priori reasoning:

[S]ince experience shews us (especially that which is afforded us by chymical operations, in many of which matter is divided into parts too small to be singly sensible) that this division of matter is frequently made into insensible corpuscles or particles, we may conclude, that the minutest fragments, as well as the biggest masses of the universal matter, are likewise endowed each with its peculiar bulk and shape. For being a finite body, its dimensions must be terminated and measurable: and though it may change its figure, yet for the same reason it must necessarily have some figure or other.⁵⁰

Boyle here is explaining his idea that matter is divided into corpuscles by referring to experiments, such as the transformation of mercury through different chemical processes. His reasoning for the essential accidents of matter, by contrast, is *a priori*:

⁵⁰ Op. cit., 16.

Because each finite body has dimensions, it must have some shape or other. Boyle doesn't seem to see much need for justifying this, but there must be a reason why dimensions are essential for every body, but not, for instance, color. Boyle seems to take this to be self-evident, but we may ask why it seems self-evident to him. His reason for the alleged fact that shape is universal—because every finite body must have dimensions—points towards the special importance of geometry for the explanation of primary qualities. That, too, is not a coincidence, as will be shown in the course of this chapter.

Since most modern proponents of the primary-secondary quality distinction were either themselves engaged in empirical investigation, or thinking about contemporary science, the perceived explicatory advantage of theories like mechanism and corpuscularianism over the plurality of substances in Aristotelianism was surely a motivation for making the distinction, which had been perceived by its modern proponents to be the best interpretation of the results of modern empirical science. Nevertheless, this doesn't mean that such a motivation is sufficient for making the distinction, since it doesn't answer the question as to why this specific distinction was perceived to be the best interpretation of the results of modern science. Even Boyle, who makes a strong case for the need for an experiential foundation to the investigation into primary and secondary qualities, ultimately recurs to an a priori argument.

4.2 Resemblance and the lack of it

Descartes's and Locke's assertion of the inconceivability of the connection between secondary qualities and our ideas of them is part of their rejection of the resemblance thesis. By "resemblance thesis," I mean the thesis that perceived qualities of things in the world refer to bodies because the perceived qualities resemble real qualities of the bodies. The resemblance thesis acknowledges that perceptions or ideas are not the same as the qualities of the objects they purport to represent.

Nevertheless, the resemblance thesis makes two claims about the relationship between perceptions or ideas and the qualities of the objects they purport to represent. On the one hand, it claims that they resemble the very qualities in the objects themselves. On the other hand, it supposes that the perceptions or ideas represent the bodies in virtue of this resemblance. The resemblance thesis doesn't necessitate that all qualities are revealed in perception; there may still be other, possibly occult, qualities that cannot be perceived by the human mind. Also, it can admit that perceptions can be misleading and that sometimes we may perceive qualities only in altered ways. But the qualities that are perceived are supposed to resemble the qualities of the objects as they are in themselves.

Which pre-modern philosophers actually promoted the resemblance thesis is a rather complex question, and any differentiated answer would take more space than is reasonable here. Some scholars claim that the modern representation of the

resemblance thesis misrepresents scholastic thought. For instance, Gary Hatfield writes that Descartes's mocking criticism of the resemblance thesis "distorts the late scholastic understanding of optical theory and intentional species."⁵¹ Descartes's writings indeed do not suggest that he intended to pay justice to the different scholastic conceptions of perception. Locke's claim that "perhaps usually" ideas are thought to be resemblances of something inherent in the objects of the extended world, too, is rather vague. But what matters to us here is not the question of whether Descartes and Locke rightly represented scholastic theories. Important is rather the role the resemblance thesis plays in their own accounts, even if they may merely have used it as a contrast to their own position.

The current chapter considers two fundamentally different ways of rejecting the original resemblance thesis. The first is a limitation of resemblances to certain qualities and their ideas, namely primary qualities and ideas of them. The other is a rejection of the resemblance thesis altogether. The limitation of the resemblance thesis to primary qualities and ideas of them fits empiricism well. Empiricism maintains that experience is the foundation of knowledge. Empiricists thus either have to deny the possibility of knowledge of the most fundamental qualities of the world, or acknowledge that we have the ability to perceive them at least somewhat truthfully. The resemblance thesis suggests itself as an explanation as to how this may

⁵¹ Hatfield, Gary, "The Cognitive Faculties," *Cambridge History of Seventeenth Century Philosophy*, ed. by M. Ayers & D. Garber (Cambridge: Cambridge University Press, 1998), 958.

happen: ideas of real qualities have some resemblance to the qualities they refer to. Accordingly, to the empiricist Locke it feels natural to claim that resemblances hold between the primary qualities of external objects and our ideas of them, while ideas of secondary qualities have no such resemblance. Rationalists, by contrast, are likely to reject the resemblance thesis altogether since they contend that knowledge of the most fundamental qualities of the world derives from intellectual understanding rather than from sense experience. Accordingly, Descartes rejects the idea that any of our ideas have an intuitive resemblance with the primary qualities of bodies.

4.2.1 Locke's limitation of the resemblance thesis

Locke expressly states that his distinction between primary and secondary qualities is directed against the resemblance thesis, which he suggests to be the prevalent idea of the connection between, on the one side, ideas and perceptions, and, on the other side, modifications of matter:

To discover the nature of our ideas the better, and to discourse of them intelligibly, it will be convenient to distinguish them, as they are ideas or perceptions in our minds; and as they are modifications of matter in the bodies that cause such perceptions in us; that so we may not think (as perhaps usually is done) that they are exactly the images and resemblances of something inherent in the subject; most of those of sensation being in the mind no more the likeness of something existing without us, than the names that stand for

them are the likeness of our ideas, which yet, upon hearing, they are apt to excite in us.⁵²

The ideas in question are simple because complex ideas do not even purport to represent simple qualities, and it is the simple building blocks of reality that Locke is after. Locke doesn't claim that none of our perceptions or ideas resembles qualities in the subject. His claim is rather that most ideas have no resemblance with qualities. We already know from the last block quote cited in section 2.1 that the ideas that lack resemblance with the qualities they purport to represent are ideas of secondary qualities. But Locke also asserts emphatically that there are other ideas, ideas that indeed do bear a resemblance to the qualities they appear to represent, i.e., ideas of primary qualities. Locke's distinction between ideas and qualities is not meant to draw a rigorous line between them as two kinds of entities that cannot resemble each other at all, but to introduce a criterion for distinguishing two kinds of simple ideas, ideas that appear to present us with real qualities of objects.

Locke doesn't subscribe to the resemblance thesis unconditionally, but only with respect to primary qualities and our ideas of them. His rejection of the resemblance thesis has a positive and a negative side. The positive side claims that ideas of primary qualities have resemblances with the bodies they are about, while the negative side claims that there are no such resemblances for secondary qualities and

⁵² *Essay*, II, viii, 7.

our ideas of them. Because of the lack of resemblance, Locke argues that the kinds of qualities suggested by our ideas of secondary qualities are not simple qualities of bodies, and can be sorted out as “secondary.”

Ideas of simple qualities that do resemble the qualities they allege to represent, by contrast, are true, and the corresponding qualities can rightly be called “primary qualities.” Ideas of primary qualities do bear a resemblance to the qualities as they are in reality, and because of that they really are simple, fundamental, and the qualities they refer to would continue to exist even if there were no humans:

First, The bulk, figure, number, situation, and motion or rest of their solid parts; those are in them, whether we perceive them or no; and when they are of that size, that we can discover them, we have by these an idea of the thing, as it is in itself; as is plain in artificial things. These I call primary qualities.⁵³

Our senses can present us with both right and with wrong appearances, and in either case, ideas of simple qualities are caused by some power in the world. But only ideas of primary qualities present us with the real qualities of material objects. The qualities presented by the ideas thus “may be properly called real, original, or primary qualities, because they are in the things themselves, whether they are perceived or no; and upon their different modifications it is that the secondary qualities depend.”⁵⁴

Locke asserts that all simple ideas of qualities have an appearance that makes

⁵³ *Essay* II, viii, 23.

⁵⁴ *Ibid.*

them seem to represent qualities of external objects, but only some bear a resemblance to the qualities of the world, namely ideas of primary qualities. This claim aligns with empiricism, according to which, if we have any direct contact to the world, it is by experience. All simple qualities are perceptible; there are no occult or other qualities hidden behind primary qualities. Under Locke's account, humans are built in a way that allows them to have perceptions of primary qualities.

Locke doesn't think that we directly see the individual ultimate building blocks of reality, the corpuscles. But the only reason why we cannot perceive them is that their size is tiny, and not that they have some non-perceptible qualities. When corpuscles come together in large numbers, they become perceptible to us, and they show us exactly the same qualities we would perceive if we had senses sensible enough to see individual corpuscles. Ideas of primary qualities present us directly with the qualities of the things as they are in themselves.

According to Locke, both primary and secondary qualities are powers capable of producing ideas in us. Locke also speaks of a third type of powers, which are usually not confused with the effect they cause. These are sometimes called tertiary qualities, although Locke usually calls them "bare powers," or simply "powers." In a well-known passage, Locke writes:

Secondary qualities.—*Secondly*, Such qualities, which, in truth, are nothing in the objects themselves, but powers to produce various sensations in us by their primary qualities, i.e. by the bulk, figure, texture, and motion of their insensible parts, as colours, sounds, tastes, &c., these I call secondary

qualities. To these might be added a third sort, which are allowed to be barely powers, though they are as much real qualities in the subject, as those which I, to comply with the common way of speaking, call qualities, but for distinction, secondary qualities.⁵⁵

“Bare powers”⁵⁶ cause a qualitative change in another object, such as fire melting lead, which gives the observer the idea of fluidity of lead. Since the idea of fluidity doesn’t immediately appear to resemble the qualities of the fire, we are not tempted to confuse it with primary qualities in the fire. Another example given by Locke is the sun’s ability to change the color of wax. The heat makes the wax turn white, but Locke does not think that the power that causes the whiteness resembles the whiteness it causes.

Only in the case of secondary qualities do the senses present us with ideas of qualities that, if we had senses sensitive enough, would appear as different ideas, namely as those of primary qualities. Locke writes that they are “[t]he power that is in any body, by reason of its insensible primary qualities, to operate after a peculiar manner on any of our senses, and thereby produce in us the different ideas of several colours, sounds, smells, tastes, &c. These are usually called sensible qualities.”⁵⁷ Like tertiary qualities, secondary qualities are mere powers, but in distinction to the former they are thought to be qualities of objects; secondary qualities appear to be of

⁵⁵ Op. cit., II, viii, 10.

⁵⁶ Op. cit., II, viii, 25.

⁵⁷ Ibid.

something else. Locke summarizes: “The first are resemblances. The second thought resemblances, but are not. The third neither are, nor are thought so.”⁵⁸

Resemblances play a central role in Locke’s explanation of what primary and secondary qualities are. *Prima facie*, they can plausibly explain the difference between primary and secondary qualities: Primary qualities cause ideas that resemble them, while ideas of secondary qualities do not resemble the qualities that cause them. On second thought, however, it is not clear what kind of resemblance it is that Locke has in mind in the case of ideas of primary qualities and those qualities. There are all kinds of resemblances, and resemblances may hold between all kinds of things. For instance, two red things resemble each other because they have a qualitative resemblance, and a picture of a house may resemble the house because both look alike. In these examples, however, the resemblance holds between material things. The resemblances Locke affirms, by contrast, are resemblances between two very different kinds of things: on the one hand, ideas, and on the other, qualities. The question is by what means they could be compared to each other. Two things can resemble each other because they have similar qualities, and two ideas can resemble each other because they appear similar, but it is not as obvious how one could determine a resemblance between an idea and the quality that is causing it.

Locke himself admits that, for secondary qualities, the alleged unlikeness is

⁵⁸ *Essay* II, viii, 24.

not apparent when they are considered under normal conditions:

But our senses not being able to discover any unlikeness between the idea produced in us, and the quality of the object producing it, we are apt to imagine that our ideas are resemblances of something in the objects, and not the effects of certain powers, placed in the modification of their primary qualities, with which primary qualities the ideas produced in us have no resemblance.⁵⁹

One way of reading Locke's concept of resemblance that avoids the problem of how a resemblance could possibly hold between ideas and qualities is to understand it as a conditional: If our senses were fine enough to perceive the smallest particles of the universe, the corpuscles, then our perceptions of primary qualities would still resemble the perceptions we have now, given that we have only limited perceptive capabilities. Even with respect to ideas of secondary qualities there is something real that gives rise to those ideas, but it is not accurately represented by the appearance we have of it. One can experience secondary qualities, but the way they appear to us is not the way they would appear if we had better senses. If our senses were better, we could directly see that in fact secondary qualities are complexes and movements of primary qualities, and we would experience them in the same way we experience primary qualities. But since the precision of our senses is limited, they present us with other apparent qualities, which enable us to distinguish relevant patterns of primary qualities. Ideas of secondary qualities are our limited means for telling what our

⁵⁹ *Essay II*, viii, 25.

senses could otherwise not distinguish.

According to this interpretation, Locke implies that the resemblance is established by comparison of two ideas—the ideas that we have now when we perceive primary qualities and the ideas we would have if our senses were more refined—and thus avoids the problem of a direct comparison between ideas and qualities. The problem, however, is that even those who believe there is a resemblance between our ideas of secondary qualities and secondary qualities themselves may agree that secondary qualities only appear in the way they do if the appropriate conditions are given. For instance, if the light conditions change, then the apparent color of an object changes. But that doesn't change the object's color, as one can verify by looking at the object under normal conditions. Primary qualities, too, frequently change their appearance. For instance, a square table seen from an angle is likely to have the appearance of a trapezoid. Under normal conditions we may not even become conscious of this, and maintain the idea that the table is square. The difference between ideas of primary and ideas of secondary qualities here seems to be more of a degree: ideas of primary qualities are somewhat more resilient to changed conditions, while ideas of secondary qualities are prone to change when material objects are seen. It may point towards a "greater" reality of primary qualities, but it surely is not a proof.

Both our ideas of primary and of secondary qualities change under different conditions. To show that there is a fundamental difference between primary and

secondary qualities under changing conditions, Locke needs to add another criterion. He indeed introduces such a criterion when he writes that the change in our ideas of primary qualities is strictly predictable, for primary qualities “constantly keep,”⁶⁰ even when they are, for instance, cut into pieces. This is due to the alleged fact that primary qualities are “utterly inseparable” from the body, and we cannot imagine a body that doesn’t have “solidity, extension, figure, and mobility.”⁶¹

But the notions of constancy and inseparability themselves are in need of justification. If Locke can prove them, he doesn’t need to rely on the resemblance thesis. The claim that every body necessarily has primary qualities, while secondary qualities are only contingent, would by itself speak in favor of the primary-secondary quality distinction. Necessary qualities are part of every body, and thus they fulfill the criterion of universality discussed below. If there were proof that primary qualities are necessary parts of every body, while secondary qualities are only contingent, then this would probably make for a stronger point than the alleged resemblance between ideas of primary qualities and primary qualities, which relies on it. Locke’s resemblance thesis may make more plausible his distinction between primary and secondary qualities, but by itself it is not a sufficient proof, and rather rests on other arguments. Section 4.3.1 investigates Locke’s claim of constancy and inseparability. First, however, let’s take a look into what Descartes has to say about the alleged

⁶⁰ *Essay* II, viii, 9.

⁶¹ *Ibid.*

resemblances.

4.2.2 Descartes's complete rejection of sensible resemblances

Locke's distinction between primary and secondary qualities is founded on the distinction between two kinds of relations between ideas of qualities and the qualities of objects of the world, namely those that resemble the simple and most fundamental qualities, and those that do not. Locke's claim that there are resemblances between primary qualities and the ideas of them seems, *prima facie*, like an empirical claim. This section shows that Descartes's distinction between primary and secondary qualities, by contrast, is unambiguously founded on an a priori distinction between two kinds of ideas: those that can clearly and distinctly be understood when they are thought to be part of the objects themselves, and those that cannot. Like Locke, Descartes rejects the resemblance thesis with regard to ideas of secondary qualities; these do not at all resemble any qualities in the world. But, unlike Locke, Descartes doesn't think that this is what distinguishes primary and secondary qualities. Whatever perceptions or imaginations of qualities in the world we have—regardless of the question whether they are primary or secondary, it is not some (possible) resemblance between the perception and the motions in the bodies that causes the sensations we have; the lack of resemblance between sensations and qualities concerns all of our sensations, regardless of whether they are sensations of colors, or of shapes. Descartes does not only limit the resemblance thesis, he rejects it

completely.

In *Optics*, Descartes explains his scientific account of the physiological mechanisms of visual perceptions. Some of the light reflected by the bodies goes through the lens of the eye of the perceiver and forms a picture on the back of the eye. There is a resemblance between the picture projected on the back of the eye and the bodies, even though the resemblance may be somewhat distorted. The structure of the nerve endings that perceive the picture on the back of the eye still show a resemblance to the forms of the objects, and even deeper within the brain there may be resemblances of some sort or another. Descartes warns us, however, that “we must not think that it is by means of this resemblance that the picture causes our sensory awareness of these objects.”⁶²

Descartes doesn't contradict the idea that there may be some resemblance between experienced bodies and movements in organs such as the brain. Descartes's point is that even if there is a resemblance between something like, for example, the form of an object and the location of the activity in the brain caused by the form, this doesn't mean that it is by means of this resemblance that we have the respective sensations. There may be resemblances of all kinds between the brain and the objects, such as the grey color of the brain and perceived grey objects. In this example, the resemblance is an obvious coincidence, but even in cases where the resemblance is

⁶² AT 6:130, CMS 1:167.

not due to chance but, for instance, to the functional structure of the sense apparatus and the brain, Descartes rejects the explanation that it is because of such a resemblance that we get the perceptions we have, and mocks the idea that this would be like supposing that in the brain there were yet other eyes. For the dualist Descartes, any resemblance between bodies doesn't explain the resemblance between bodily movements and mental appearances. But one doesn't need to be a dualist to acknowledge that Descartes has indeed a good point here. Every resemblance in the eye, the nerves, or the brain is another bodily state, and as long as we do not add an explanation of why this bodily state is identical to some perception, it is no more a perception than any other bodily state. The resemblance may contribute somehow to our perceptions being what they are, but the bodily resemblance by itself doesn't explain why it is perceived the way it is. If it is perceived due to some further resemblance, then that resemblance, too, would be in need of explanation, and so on, ad infinitum.

Descartes suggests that, rather than some resemblance causing our sensations, “the movements composing this picture which, acting directly upon our soul in so far as it is united to our body, are ordained by nature to make it have such sensations.”⁶³ This claim avoids some of the problems with the resemblance thesis, such as the risk of an infinite regress, but it is not very explicative. Any further location of the place

⁶³ AT 6:130, CMS 1:167.

of the affections of the soul, such as in the pineal gland, doesn't make it any more conceivable either; the question as to how this could possibly be the case remains unanswered.

Descartes himself admits that his claim that the soul is directly affected by the bodily movements that are passed on by the nerves doesn't help us to conceive how this could possibly happen. We are now in a position to better understand his claim that we are "wholly unable" to conceive how size, figure and motion can "produce something else of a nature entirely different from themselves."⁶⁴ It is not only that Descartes thinks such connections are not the reason for our representations of perceived bodies, he also states that we cannot conceive how the connection could possibly come about. The reason for Descartes's lack of understanding is not, of course, that he is not smart enough, or that he lacks knowledge of some detail. Rather, the lack of understanding derives from his notion that sensations and bodies do not have a directly perceptible connection such as resemblance, and that rather they are causally connected in ways we are unable to understand. Only from empirical observation can we know that the one causes the other, or, in more Cartesian words, from the teachings of nature, and not by reasoning. How that kind of causation happens, or how it could even be possible, is inscrutable to human reason. A priori, the connection is inconceivable, but a posteriori, it obviously is the case.

⁶⁴ "[N]ullo autem modo possumus intelligere, quo pacto ab iisdem (magnitudine scilicet, figurâ & motu) aliquid aliud producat, omnino diversæ ab ipsis naturæ. (AT 8:322; *Principles*, IV, §198)

But Descartes doesn't limit himself to claiming that there are such inconceivabilities; he also explains why they must hold. This is the focus of the next section.

4.2.3 Imagination and pure intellect

The inconceivability of the connection between sensations and the bodily movements causing them is, according to Descartes, due to a difference between two kinds of ideas. Each of them pertains to a different part of the soul. On the one hand, there are the ideas that are given in the faculty of imagination (*imaginandi facultate*),⁶⁵ and on the other hand, there are ideas that are given in the pure intellect (*puro intellectio*),⁶⁶ which is pure because it doesn't at all rely on the imagination. I will call the former ideas imaginative, and the latter intellectual. In the Sixth Meditation, Descartes elucidates this distinction with examples of geometrical figures. A triangle, for instance, can easily be imagined, and it seems that the imagination is clear and distinct, since it can clearly be differentiated from triangles or other geometrical figures, such as circles. When it comes to more complex geometrical figures, however, the apparent clarity and distinctness of imagination vanishes. We perceive or imagine a chiliagon to be no different than a thousand-and-one sided figure. Descartes doesn't say so, but in fact our imagination is probably not strong enough to

⁶⁵ AT 7:72.

⁶⁶ AT 7:72.

distinguish these figures from circles. Yet, we have a very clear and distinct understanding of the difference between a chiliagon and a thousand-and-one sided figure. Its clearness and distinctness doesn't derive from imagination, but from understanding.

According to Descartes, the human intellect always operates upon imagination, but imagination "is not required for understanding; this additional effort of mind clearly shows the difference between imagination and pure understanding."⁶⁷ Imagination is a human means for conceiving of objects, but the imaginative representation is never adequate for intellectual concepts. It may even obstruct understanding; Descartes thinks that the vividness of imagination that makes it so prominent is at the same time dangerous because it is prone to interfere with clear and distinct understanding.

Some may object to Descartes's theory that, in ordinary experience, the steps from imaginations of geometrical objects to their mathematical representations and vice versa appear to be seamless. We definitely seem to see a resemblance between simple geometrical figures such as circles; no matter whether they are imagined or perceived, and regardless of the question whether they were produced by nature or by geometrical construction. For instance, a drawing of an imagined circle from memory appears to resemble the imagined circle it is drawn from. In general, all imagined

⁶⁷ CSM 2:51.

circles seem to resemble perceived circles, regardless of the question of whether they are drawn from imagination or according to their geometrical representation. So it may seem that even a pure mathematical circle is something that can be perceived, and thus may or may not resemble an imagined circle.

But this objection is confused. The example was put in a way that merely shows a resemblance between the imagined circle and visually perceived circles, but not a resemblance between the imagined circle and a pure mathematical circle. Like fictitious ideas, visual perceptions are part of imagination. The imagined circle and the visually perceived circle both give rise to similar intuitive ideas. Likewise, the circle drawn from its pure mathematical conception is a material object that can be visually perceived, but that would not amount to knowledge of the mathematical conception used to draw the perceptible circle. True knowledge of the circle is purely mathematical, not imaginative. The fact that we use the same word “circles” to mean either a material, an intuited, or a mathematical circle (besides other circles) doesn’t imply that they are of the same kind.

Even though they are of different kinds, there may be resemblances between circles in the imagination, and circles in the intellect. For instance, in both cases each part of the circle has the same distance to its center. But we do not need to recur to such resemblances to decide which intellectual ideas are veridical. Rather than looking for resemblances, Descartes wants to distinguish the ideas that can clearly and distinctly be part of the bodies from those ideas that are not. If we can clearly and

distinctly understand them to be qualities of objects, they are at least possibly qualities of bodies. God can make them in the way we conceive of them, and, since God is not a deceiver, He would not deceive us about things that we can clearly and distinctly understand. We can clearly and distinctly understand primary qualities when we think of them as qualities of bodies, so they are possible qualities of external bodies. Secondary qualities, by contrast, are not clear and distinct when they are thought to be qualities of bodies. They are only clear and distinct when conceived to be mere ideas, as Descartes expresses in his claim that “pain and colour and so on are clearly and distinctly perceived when they are regarded merely as sensations or thoughts. But when they are judged to be certain things existing outside our mind, there is no way of understanding what sort of things they are.”⁶⁸

Since Descartes claims that ideas of secondary qualities are confused when thought to be part of external objects, there is no resemblance between ideas of secondary qualities and qualities of objects of the world. But the same holds for alleged resemblances between the visually perceived or imagined primary qualities and the intellectual representation of a shape. Ideas of primary qualities, too, would not be clear and distinct if we had to rely on imagination for understanding them. Nevertheless, he thinks that we can have a grasp on what the things themselves are, not through imagination, but by intellectual understanding. Ideas of primary qualities

⁶⁸ CSM 1:217; AT 8A:33. Cf. Section 2.3.

are clear and distinct representations of qualities in the world. But they are so because they are purely intellectual and not imaginative ideas.

There are many commonalities between philosophers classified as “empiricists” and “rationalists,” but that there is a fundamental difference becomes obvious when one compares their accounts of the role of sensations for the formation of veridical ideas. For the empiricist Locke, all ideas derive from experience, and simple ideas are basically equivalent to the sensations we have. Locke doesn’t make a fundamental distinction between sensations and other ideas. Our ideas of primary qualities derive just as much from experience as our ideas of secondary qualities do. They are all simple ideas, and the way they appear to us makes it seem like they all represent simple qualities of the world. But, in fact, only ideas of primary qualities do so. The rationalist Descartes, by contrast, differentiates between ideas derived from experience and ideas derived from a priori considerations. Only the latter can clearly and distinctly represent bodies, even though they do not have any resemblance with them. The former, by contrast, are confused when they are thought to be qualities of bodies.

Empiricism rejects the possibility of access to qualities of bodies that is not mediated by our perceptions of them. Rationalism, by contrast, aims to show that this is possible and, in fact, that it is the only access we have to real qualities. Descartes’s distinction between two radically different kinds of ideas of qualities such as shapes separates qualities that pertain to the imagination from those that pertain to the

intellect. The qualities that are understood with the intellect can, at least potentially, really be in the objects, while those that are merely suggested by imagination, and which cannot be clearly and distinctly understood as part of the objects, cannot even potentially be in the objects.

From a rationalist perspective, looking for imaginative resemblances is the wrong approach in the first place; only understanding and not imagination are alleged to lead to knowledge. Secondary qualities are only in the imagination, and they are clear and distinct only if we conceive of them as mere sensations. Primary qualities, by contrast, are clearly and distinctly understood with the intellect. There are also imaginations of qualities that are analogous to primary qualities, but these are not clear and distinct, just as imagined secondary qualities are not clear and distinct; only primary qualities are possible parts of the objects. Descartes thus writes, in his third Meditation:

I notice that the things which I perceive clearly and distinctly in them [corporal things] are very few in number. The list comprises size, or extension in length, breadth, and depth; shape, which is a function of the boundaries of the extension; position, which is a relation between various items possessing shape; and motion, or change in position; to these may be added substance, duration, and number. But as for the rest, including light and colours, sounds, smells, tastes, heat and cold and the other tactile qualities, I think of these only in a very confused and obscure way, to the extent that I do not even know

whether they are true or false, that is, whether the ideas I have of them are ideas of real things or of non-things.⁶⁹

For Descartes, every material body is extended, i.e., it is a *res extensa*. It is thus no surprise that all modes of extension can be clearly and distinctly apprehended. Qualities that somehow appear extended or are located in the *res extensa*, but which cannot directly be understood as modes of extension, by contrast, are confused when considered to be part of the *res extensa*. But why does Descartes, in the first place, define the external world as extended? Are modes of extension clearly and distinctly understood when they are thought to be part of the external world because the external world is defined as extended? Or is the opposite the case, is the external world extended because we can clearly and distinctly understand extension? The rationalistic justification for dividing the primary-secondary distinction is that primary qualities are clearly and distinctly understood by the intellect, while secondary qualities are merely part of the imagination. But how can we know which qualities can be clearly and distinctly understood by the intellect? In the following section I argue that Descartes thinks that qualities of extension can be clearly and distinctly apprehended because they are the subject-matter of mathematics.

⁶⁹ CMS 2:29-30.

4.3 The universality of primary qualities and its reason in the mathematical divisibility of space

Not only Descartes and Locke, but most early philosophers make an argument that presupposes that only universal qualities can be primary. They point out that cuts or other forms of division of bodies cause secondary qualities to either vanish, or at least change in their specific determination, while other qualities remain the same, or change only in completely predictable ways. Thus, the former qualities are secondary, while the latter are primary. Probably the most important question to ask in this context is why the respective primary qualities are supposed to remain the same or why they change only in completely predictable ways.

Descartes and Locke have each their own versions of this argument, which are investigated in the next two sections. Locke seems to make an argument that appeals to empirical rather than a priori knowledge, but I show that this is not enough, and that in fact Locke's argument rests on a priori reasoning. In Descartes, it becomes clear that primary qualities are conceived as modes of extension. Because Descartes and Locke have different concepts of space, their lists of primary qualities vary slightly. But I argue that for both philosophers, behind the somewhat confusing arguments there is an a priori reason at work, namely that primary qualities are modes of extension, and that these change only in predictable ways because they are conceived in geometrical and mathematical terms.

4.3.1 Locke's argument for the universality of primary qualities

Locke, too, gives a reason for why primary qualities are universal. It is less an empirical explanation than a thought experiment, for he claims that we cannot imagine a body without primary qualities. He asks us to divide a grain of wheat into always smaller parts, and claims that, down to the smallest parts, each part must still have solidity, extension, shape, mobility, and number.⁷⁰ Locke aims to show that it is impossible that, when we actually divide a body into smaller and smaller parts, at one point the body would lose its extension, but that this is possible for secondary qualities. Locke concludes that primary qualities are necessary qualities of every body.

Of course, primary qualities, too, change when a body is divided. For instance, the cutting diminishes the body's size (each body left over is smaller), and it changes its number (it makes two out of one). Furthermore, the cut changes the body's shape, etc. Locke could avoid the problem that this seems to undermine the universality of primary qualities if he meant the determinable rather than the determinate qualities of a body. He could thus admit that the size of a body, for example, changes when it is divided into two, and still hold that both bodies still must have a size. But why should this be different for secondary qualities? For instance, the determinate color may change when the grain is divided into increasingly smaller

⁷⁰ Cf. *Essay*, II viii, 9.

parts, but it seems reasonable to claim there still has to be a determinable color at all times. If this was possible under Locke's account, his argument would be flawed: It would rest on emphasizing the constancy of determinable primary qualities while ignoring the constancy of determinable secondary qualities. To avoid this flaw, Locke would either have to refine his criterion of constancy (1), or claim that the secondary qualities would vanish altogether (2).

Locke seems to take the latter route (2) when he refers to cases in which colors not only change, but vanish altogether. He writes that "sand, or pounded glass, which is opaque and white to the naked eye, is pellucid in a microscope," and makes similar observations for hairs and blood.⁷¹ Consequently, Locke claims:

Had we senses acute enough to discern the minute particles of bodies, and the real constitution on which their sensible qualities depends, I doubt not but they would produce quite different ideas in us; and that which is now the yellow colour of gold, would then disappear, and instead of it, we should see an admirable texture of parts of a certain size and figure.⁷²

Locke thinks that if our senses were sufficiently sharp, all distinctions otherwise made with recourse to colors could instead be made with recourse to surface textures. Having ideas of colors is our rough way of seeing, imagining, and thinking⁷³ of the composition of surface textures. It is only because our vision is not fine enough that

⁷¹ Op. cit., II, xxiii, 11.

⁷² Ibid.

⁷³ Locke's notion of "ideas" entail different cognitive operations, such as seeing something, imagining something, and thinking of something.

we need to see the surface structures mediated via their dispositions to break or reflect light in specific ways. Appearances of colors are like a simple cover put over a fine-grained reality to aid our imperfect sensual apparatus by comprising structures we otherwise could not perceive. An all-encompassing conception of reality would unmask the color appearances that stand between us and reality.

Locke here finally seems to give a real *a posteriori* reason for distinguishing between primary and secondary qualities. If he could show empirically that objects lose their color when enlarged, this would, under Locke's definition of primary qualities as constant, confirm that colors are not primary qualities. It is, however, easy to note several problems with this kind of reasoning, which call into doubt how far the *a posteriori* element carries the argument, and in how far it relies on other presuppositions.

One problem is that nobody would deny that objects produce perceptions of colors only when they are seen under the right illumination. A white sheet of paper doesn't look white under green light, but that doesn't prevent us from saying that it is white. The microscope, too, changes the illumination conditions, and one can question whether the colors seen through a microscope are the real colors of the objects they pertain to. Locke sometimes seems to suggest that the biggest enlargement provides the truest view of any object. But since the color of an object is usually determined according to "normal" illumination and observer conditions, this may not be appropriate. To make his argument strong, Locke would have to engage in

the task of determining the appropriate lightning conditions and “normal observers,” a task that is not only notoriously difficult, but also prone to objections in its many details. The notion that determinable secondary qualities may vanish while primary qualities always stay the same may sound plausible, but, in the little detail given by Locke, it is merely a supplementary thesis, and not a proof.

Locke does, however, also pursue the former route (1) for showing a difference in the change of determinate qualities by claiming that every determinate primary quality “constantly keeps.”⁷⁴ Determinate secondary qualities do not keep constant; even if colors never vanish as determinable qualities, the determinate color can change when the body they appear to pertain to is divided into smaller pieces, and the colors of the parts do not simply add up to the color of the whole body. The total amount of each primary quality, in contrast, remains constant. Locke writes:

[D]ivision ... can never take away either solidity, extension, figure, or mobility, from any body, but only makes two or more distinct, separate masses of matter, of that which was but one before; all which distinct masses, reckoned as so many distinct bodies, after division, make a certain number. These I call original or primary qualities of body, which, I think, we may observe to produce simple ideas in us, viz. solidity, extension, figure, motion or rest, and number.⁷⁵

The primary qualities of extension and figure clearly fulfill the criterion of constancy.

When a body is divided, both parts together have exactly the same extension as the

⁷⁴ *Essay*, II, viii, 9.

⁷⁵ *Ibid.*

original body. Their shape, too, is not changed apart from the cut. Also the total mass remains the same, and Locke thinks that the same holds for solidity and mobility. He takes this to show that the division of a body cannot take away solidity, extension, figure, or mobility. If Locke is right, not only the determinable primary qualities remain constant, but also the total of the determinate primary qualities.

But what is Locke's rationale for thinking that division cannot possibly take away primary qualities? Taking a step away from Locke's own justifications, which sound more empirical than they actually are, we may reconstruct the following reason: primary qualities are modes of extension, and the early modern way of conceiving of modes of extension is to think of them in geometrical terms. We know exactly and a priori what happens to geometrical objects when they are divided. Secondary qualities, in contrast, are not conceived straightforwardly in geometrical terms and we have to recur to experience to understand what happens with them when the bodies they pertain to are divided. That the difference in our ability to put primary and secondary qualities in geometrical terms stand behind the apparently empirical arguments for the distinction was suggested by Husserl, and his explanation will be discussed in Part II. Here, I would merely like to point out that even the empirically sounding arguments of Locke have to do with the applicability of mathematics to the respective qualities. In Descartes's argument from exclusion this becomes more obvious, and it is discussed next.

4.3.2 Descartes's argument from exclusion and his concept of the *res extensa*

Descartes argues that, apart from extension, one can exclude all qualities from the list of primary qualities, because for each of them there is at least one factual example in which it is not a quality of the body:

[W]e first of all exclude hardness, since if the stone is melted or pulverized it loses its hardness without thereby ceasing to be a body; next we exclude color, since we have often seen stones so transparent as to lack color; next we exclude heaviness, since although fire is extremely light it is still thought of as being corporeal; and finally we exclude cold and heat and all other such qualities, either because they are not thought of as being in the stone, or because if they change, the stone is not on that account reckoned to have lost its bodily nature. We thus see that nothing remains in the idea of the stone except that what is extended in length, breadth and depth.⁷⁶

Descartes claims that because hardness, color, heaviness, and temperature can all change without thereby annihilating the body they pertain to, they are not essential qualities of any body. The only quality that cannot be taken away from any body is, according to Descartes, extension: “The nature of body consists not in weight, hardness, color, or the like, but simply in extension.”⁷⁷

⁷⁶ “[N]empe rejiciamus primò durtiem, quia si lapis liquefiat aut in pulvisculos quàm minutissimos dividatur, illam amittet, neque tamen ideò desinet esse corpus; rejiciamus etiam colorem quia vidimus sæpe lapides adeò pellucidos, ut nullus in iis esset color; rejiciamus gravitatem, quia quamvis ignis sit levissimus, non ideò minus putatur esse corpus; ac denique rejiciamus frigus & calorem, aliasque omnes qualitates, quia vel non considerantur in lapide, vel iis mutatis, non ideò lapis corporis naturam amisisse existimatur. Ita enim advertemus, nihil plane in ejus idea remanere, præterquam quòd sit quid extensum in longum, latum & profundum [...]” (*Principles*, II, 11; cf. AT 1:227)

⁷⁷ CSM 1:224, *Principles*, II, §4.

Descartes's and Locke's arguments seem to follow the same line of thought, but it leads them to different conclusions. Locke's primary quality of solidity is not primary for Descartes. The cause of this disagreement is a result of different conceptions of space. Descartes did not need to introduce the primary quality of solidity because for him there is no empty space. If there is no empty space, then to have extension means to fill space, and no concept such as solidity is needed to explain how empty space could be filled. But Descartes's rejection of empty space makes it hard to understand how one part of space can be different from another; if there is nothing that fills some space, all space seems the same. Descartes's explanation that different parts of space move in different directions is far from convincing to everybody.⁷⁸ Locke avoids some of Descartes's mind-boggling problems by allowing for empty space. If there is empty space, however, then it needs to be distinguished from not-empty space. This is what Locke's notion of solidity does. This explanation of the difference between Locke's and Descartes's notion of space points again to the suggestion from the last section, according to which for Locke, too, determinable primary qualities cannot be changed by division because they are modes of extension.

Like Galileo and Locke, Descartes appeals to imagination as a means to determine which qualities necessarily belong to any body, besides factual empirical

⁷⁸ For instance, Descartes's contemporary Pierre Gassendi rejected the notion of the Cartesian plenum.

observations. But for the rationalist Descartes, intuitive experience and empirical observation do not necessitate understanding, and he would surely not infer from imaginative conceivability to how things are by necessity. Descartes uses empirical research and appeals to intuitive experience or imagination to support his way of distinguishing between primary and secondary qualities. But his skepticism about intuitive experience and about arguments that appeal to intuition suggests that his real reasons for drawing the primary-secondary distinction are a priori.

Descartes doesn't necessarily claim that we have no clear and distinct ideas of sensible qualities whatsoever. He writes that pain, color "and so on" are clearly and distinctly perceived when they are regarded merely as sensations or thoughts, even though, as will be discussed below, it has been argued that Descartes doesn't think they are clear.⁷⁹ But in either case, and this is what matters here, they are obscure and confused when they are considered to be qualities of external bodies. Because of this, we don't even know if the qualities they pretend to represent can exist at all in the *res extensa*. For instance, it may turn out that cold doesn't exist, and that it is a mere privation of heat. Other ideas of secondary qualities may be due to qualities that really exist, but they are not what we take them to be.

Descartes thinks that, because we can have a clear and distinct apprehension of primary qualities, these really can exist in the way we conceive them. This is

⁷⁹ See the discussion of *Principles I*, §68 in section 4.4.1.

crucial for Descartes's proof of the existence of material things. He argues that God can produce all things and qualities that we can clearly and distinctly conceive in exactly the way we conceive them. According to Descartes, the most befitting explanation of normal perceptions is that they are caused by external bodies, and thus, in the Sixth Meditation, he derives "by probable conjecture"⁸⁰ that bodies exist. Since he holds that God is not deceiving us into believing that corporal things exist while in fact they are something else, he can conclude:

It follows that corporeal things exist. They may not all exist in a way that exactly corresponds with my sensory grasp of them, for in many cases the grasp of the senses is very obscure and confused. But at least they possess all the properties which I clearly and distinctly understand, that is, all those which, viewed in general terms, are comprised within the subject-matter of pure mathematics.⁸¹

Descartes here declares that the qualities of bodies that can be clearly and distinctly understood are the subject-matter of pure mathematics. Descartes's reasoning for our knowledge that ideas of primary qualities represent real qualities of the world is rather intricate, but the ultimate reason is simple: primary qualities are the subject-matter of pure mathematics. This fits together well with Descartes's assertion that "even before, when I was completely preoccupied with the objects of the senses, I

⁸⁰ "probabiliter inde conjicio" (AT 7:73)

⁸¹ CSM 2:55. Latin original: "Ac proinde res corporeæ existunt. Non tamen forte omnes tales omnino existunt, quales illas sensu comprehendo, quoniam ista sensuum comprehensio in multis valde obscura est & confusa; sed faltem illa omnia in iis sunt, quæ clare & distincte intelligo, id est omnia, generaliter spectata, quæ in puræ Metheseos objecto comprehenduntur." (AT 7:80; 6th Meditation).

always held that the most certain truths of all were the kind which I recognized clearly in connection with shapes, or numbers or other items relating to arithmetic or geometry, or in general to pure and abstract mathematics.”⁸² Descartes claims that later, he in addition came to see that the certainty of pure mathematics leads to a clear and distinct understanding of all possible objects of the world. For Descartes, “the whole of corporeal nature ... is the subject-matter of pure mathematics.”⁸³ Since Descartes thinks that extension can be the subject-matter of pure mathematics, the material world is defined as an extended substance, the *res extensa*.

⁸² CSM 2:45. Latin original: “etiam ante hoc tempus cùm sensuum objectis quammaxime inhærerem, ejusmodi veritates, quæ nempe de figuris, aut numeris, aliisve ad Arithmeticam vel Geometriam vel in genera ad puram atque abstractam Methesim pertinentibus, evidenter agnoscebam, pro omnium certissimis habuisse.” (AT VII:65; 5th Meditation)

⁸³ CSM 2:49. Latin original: “omni illâ naturâ corporeâ ... est puræ Matheseos objectum” (AT 7:71; 5th Meditation)

4.4 The origin of the distinction in Galileo's concept of the mathematical universe

This chapter so far considered the possibility of an empirical justification of the primary-secondary distinction and examined several arguments and reasons for it. The result was each time that the justifications and arguments provide reasons for drawing the distinction in the specific modern way, some better, and some worse, but that none of them is a compelling reason. Some scholars think that the combination of several or all of the reasons makes a somewhat compelling case. For instance, J. L. Mackie argues that Locke's different reasons taken together "add up to something of a case for the primary/secondary distinction, but not a very strong one."⁸⁴

But if the addition of several more or less strong reasons were the end of the rationale for the distinction, the fact that so many great thinkers felt compelled to make it in very alike ways would truly be perplexing. That they all share a more fundamental reason is already suggested by the fact that they interpret the different justifications and arguments very differently, for instance in line with their rationalistic or empiricistic philosophy, while nevertheless advancing the same distinction. It should thus come as no surprise that, as was already shown in the above discussions, the empirical justifications tend to be mixed with a priori arguments. The last section traced back Locke's and Descartes's justifications and arguments to the

⁸⁴ John Leslie Mackie *Problems from Locke* (Oxford: Oxford University Press, 1976), 23.

effect that primary qualities are universal to the possibility of conceiving them in mathematical and, specifically, geometrical terms.

That the primary-secondary quality distinction is a result of the modern mathematical concept of nature becomes obvious in the first thinker who introduced the modern distinction—Galileo. In this section, I first discuss Galileo’s claim that secondary qualities would vanish if the perceiver were to be removed, and then explain that this claim is the other side of the notion that secondary qualities are merely nominal. Galileo picked up from medieval philosophy the nominalistic thought that certain qualities are merely nominal, but he regarded as nominal sensible qualities such as colors—precisely those qualities that most medieval nominalists had regarded as real. Numerical qualities,⁸⁵ by contrast, were previously usually regarded as nominal, but for Galileo they are constitutive for the nature of the world in itself. The idea that the universe is mathematical is more obvious in Galileo than in any other of the investigated modern philosophers.

4.4.1 Removal of the perceiver, vanishing of secondary qualities

There is another widespread argument for the distinction between primary and secondary qualities that also presupposes that only universal qualities can be primary,

⁸⁵ Numerical “qualities” are quantities, and it is confusing to call them “qualities.” I here follow the convention of modern philosophy, but do not mean to imply that nominalists regarded qualities and not quantities as nominal.

and very much resembles the above discussed arguments from exclusion. According to the claim of the removal of the perceiver, secondary qualities would vanish from the world if there were no perceivers with sense organs, while primary qualities would remain as they are. This claim can be used to make an argument for the distinction when it is put together with the assumption that the qualities that would vanish depend on the perceiver and are thus not universal and secondary, while the remaining qualities exist independently and are thus universal and primary. This section discusses some fundamental problems with this claim or argument, and shows that nevertheless it has a central place in the justification of the primary-secondary quality distinction.

Basically all proponents of the primary-secondary quality distinction claimed that secondary qualities are dependent on the perceiver. For instance, Boyle thinks that primary qualities are universal affections of bodies, which Boyle calls “catholick.” Secondary qualities are not universal, i.e., they do not necessarily belong to the bodies they are attributed to. In particular, their existence seems to depend on the perceiver, since Boyle claims that if there were no perceivers, secondary qualities would vanish:

[I]f there were no sensitive beings those bodies that are now the objects of our senses, would be but dispositively, if I may so speak, endowed with colours,

tastes, and the like; and actually, but only with those more catholick affections of bodies, figure, motion, texture, &c.⁸⁶

Boyle admits that secondary qualities appear to be independent of the perceiver: “Whereas we explicate colours, odours, and other such sensible qualities by a relation to our senses, it seems evident that those qualities have an absolute existence without relation to us.”⁸⁷ But the appearance is deceptive; in reality, these qualities depend on the perceiver. Primary qualities, however, are “more” universal, which brings Boyle’s removal argument close to Locke’s universality argument, as discussed in the last section. Locke, too, claims that secondary qualities would vanish if the perceiver was annihilated:

Take away the sensation of them; let not the eyes see light or colours, nor the ears hear sounds; let the palate not taste, nor the nose smell; and all colours, tastes, odours, and sounds, as they are such particular ideas, vanish and cease, and are reduced to their causes, i.e. bulk, figure, and motion of parts.⁸⁸

If all sense organs were taken away, secondary qualities would vanish, while real qualities would continue to exist. This claim almost sounds like it could be confirmed in a possible experiment. If we were to take away someone’s eyes she or he would not see colors anymore; without ears not hear sounds, etc. If we were to take away the sense organs, the perceiver would not perceive any secondary qualities anymore. But

⁸⁶ Op. cit., 25.

⁸⁷ Op. cit., 23.

⁸⁸ *Essay*, II, viii, 18.

this interpretation is questionable. Sure; if all perceivers lost their sense organs, they would surely not perceive colors anymore. But by itself this doesn't mean that colors would vanish any more than colors "vanish" when perceivers close their eyes. Once the perceivers open their eyes—or regain their sense organs—they would see the colors again. They would probably find it more natural to say that the colors were still there, rather than they had been brought back to existence. Without sense organs, shapes would also no longer be perceived, but neither Boyle nor Locke would take this to mean that they had vanished.

In spite of these problems, it seems plausible to claim that secondary qualities are more dependent on the perceiver than primary qualities. Maybe Boyle and Locke merely make a thought experiment rather than a deductive argument in the sense that they as it is supposed to appeal to imagination rather than intellectual understanding, and intended to point out an intuitively plausible difference that seems to confirm the modern primary-secondary quality distinction. Even if that were their purpose, however, there is a problem, which is that Aristotelians, too, would have an explanation for the apparent difference. They would say that the difference holds between common and *proper sensibles*, and that, since *common sensibles* are perceived by several senses, they seem more resilient with respect to disturbances of the senses. True, if all senses were taken away at the same time, Aristotelians would have difficulties explaining the difference; according to the distinction between common and *proper sensibles*, the *common sensibles* would then vanish as well. But

empiricism, too, would stand on shaky grounds without perceptions.

All these difficulties show that the removal argument is by itself neither proof of the primary-secondary quality distinction, nor clear confirmation of the early modern distinction and not of the ancient distinction between the same qualities. Nevertheless, the claim that secondary qualities would vanish if the perceiver were annihilated is much more than a side-comment that may make the distinction more plausible. In fact, it is given already in one of the first formulations of the modern distinction. Galileo writes in *The Assayer*, published in 1623:

I think that tastes, odors, colors, and so on, on part of the subject in which they appear to reside, are no more than pure names, but that they hold their residency only in the sensitive body. Hence, if the animal were removed, all these qualities would be wiped away and annihilated. Nevertheless, as soon as we in this way have imposed names on them, particular and different from those of the other primary and real accidents, we want to believe that they also exist just as truly and really as the latter.⁸⁹

The removal of the “sensitive body” would cause secondary qualities to vanish. Later, Galileo elaborates: “I think that if one takes away ears, tongues, and noses, there indeed remain the shapes, numbers, and motions, but not the odors, tastes, or sounds; outside of the living animal these are nothing but names ...”⁹⁰ The reason is that they

⁸⁹ “[V]o io pensando che questi sapori, odori, colori, etc., per la parte del soggetto nel quale ci par che riseggano, non sieno altro che puri nomi, ma tengano solamente lor residenza nel corpo sensitivo, sì che rimosso l’animale, sieno levate ed annichilate tutte queste qualità; tuttavolta però che noi, sì come gli abbiamo imposti nomi particolari e differenti da quelli de gli altri primi e reali accidenti, volessimo credere ch’esse ancora fussero veramente e realmente da quelli diverse.” (*Saggiatore*, Ch. XLVIII)

⁹⁰ “[S]timo che, tolti via gli orecchi le lingue e i nasi, restino bene le figure i numeri e i moti, ma non

have their “residency” only in the “sensitive body,” and not in the objects they are attributed to. *Prima facie*, it may seem like their dependence on the perceiver is Galileo’s reason for eliminating secondary qualities from the list of “primary and real accidents.”

But one should not overlook the fact that Galileo contrasts his formulation, “residency in the sensitive body,” with another issue, namely that they are “pure names.” By calling secondary qualities mere names, Galileo alludes to the scholastic debate around nominalism; in fact secondary qualities are supposed to be nominal. Our language allows us to assign names to what we think they are in the same way we would name real qualities, and that tempts us into believing that they are real qualities, while, in fact, they are not. This is a separate issue, for nominalism alone doesn’t need to make any claims about the perceiver. Galileo brings together two separate issues, namely the nominalistic assertion that secondary qualities are merely nominal, and the idea that they are dependent on the perceiver. The next section looks into the notion of the perceiver as a counterpart to reality, and the following into the revolutionary notion behind Galileo’s new form of nominalism.

già gli odori né i sapori né i suoni, li quali fuor dell'animal vivente non credo che sieno altro che nomi...” (ibid.)

4.4.2 The perceiver as a byproduct of the modern concept of reality

Galileo introduces the notion of the perceiver in the context of his distinction between primary and secondary qualities. There is no indication that Galileo has an elaborate account of the perceiver on his own independent of his notion of secondary qualities. Galileo's perceiver is a byproduct of his notion of reality, and in particular of his distinction between primary and secondary qualities.

Besides "sensitive body," in the same chapter Galileo also uses the expressions "animated body," "animal," and "living animal." He is talking about bodies of living beings, and holds that there is something special about living bodies, in contrast to inanimate bodies. Galileo's thinks of the "animal" as a special kind of body; he here continues the Aristotelian tradition. For Aristotle, the soul is a form of the body and thus cannot exist without the body. Galileo has no qualms about using the expression "sensitive soul" (*anima sensitiva*), which makes clear that he follows the Aristotelian notion of the embodied soul rather than the Cartesian concept of the disembodied soul. The most widespread translation of Galileo's work (by Stillman Drake⁹¹) renders the Italian expression "corpo sensitivo" as "consciousness." But this is an anachronism that presupposes too much; it suggests that Galileo already worked within a Cartesian framework, which is not the case.

⁹¹ Drake Stillman, *Discoveries and Opinions of Galileo*, 1957. Drake not only published prolifically on Galileo, he is also the only English translator of many of Galileo's works.

Galileo's notion of the perceiver contains a tension. On the one hand, it is supposed to be a body and thus part of the world, while, on the other, it is a counterpart to the world in that it is supposed to contain that which doesn't belong to the bodies as such. The tension holds between the mechanistic drive to eliminate sensible qualities from the world, and the notion that they are produced by the senses. Galileo takes a step towards the mechanistic concept of the world by trying to eliminate sensitive qualities from the list of real accidents, but at the same time he resists the mechanist drive towards a complete elimination of sensible qualities from nature, by assuming that the perceiver is itself a body. From Galileo's account alone, one would hardly predict that a radically disembodied notion of the perceiver would become such a central issue in the philosophical works of the following centuries, such as in Descartes's *Meditations*, published only 18 years after *The Assayer*.

The vanishing of secondary qualities in the case of the removal of the perceiver is merely the other side of the claim that primary qualities are universal qualities of any body, and thus allegedly have a real existence independent of the perceiver. Immediately before the citation in which Galileo claims that secondary qualities hold their residency only in the sensitive body, he writes:

[A]s soon as I conceive of a material or corporeal substance, I feel immediately drawn by necessity to also conceive it as bounded and having this or that shape; as being large or small in relation to other things, and as being in this or that location and existing at this or that time; as being in motion or at rest; as touching or not touching some other body; and as being one in number, or few, or many. Nor can I, by any stretch of imagination,

separate it from these conditions. But that it is white or red, bitter or sweet, noisy or quiet, and pleasantly or unpleasantly smelling, my mind doesn't feel compelled to have to bring in as necessary accompaniments. Indeed, without the senses as our guides, the intellect and the imagination by themselves would probably never arrive at these qualities.⁹²

Galileo claims that we cannot conceive or imagine a body without primary qualities, while we can well imagine a body without secondary qualities. Philosophers such as Berkeley have explicitly rejected the claim that bodies can be imagined without colors, and the question is whether Galileo presents it as a mere introspective truth one has to believe or not, or if he presents an underlying reason.⁹³ Section 4.3.1 already argued that does Locke indeed has such a reason, namely that primary qualities are modes of extension, and that they change in a constant way when they are cut, while this is not the case for secondary qualities. Galileo himself writes that no body can, “by any stretch of imagination,” be thought without primary qualities, and that they are thus universal. The primary qualities listed by Galileo, like those of Descartes, Boyle, Locke, all seem to be modes of extension or closely related to them, and are thus expressible in geometrical terms. The question now is whether Galileo

⁹² “[B]en sento tirarmi dalla necessità, subito che concepisco una materia o sostanza corporea, a concepire insieme ch'ella è terminata e figurata di questa o di quella figura, ch'ella in relazione ad altre è grande o piccola, ch'ella è in questo o quel luogo, in questo o quel tempo, ch'ella si muove o sta ferma, ch'ella tocca o non tocca un altro corpo, ch'ella è una, poche o molte, né per veruna imaginazione posso separarla da queste condizioni; ma ch'ella debba essere bianca o rossa, amara o dolce, sonora o muta, di grato o ingrato odore, non sento farmi forza alla mente di doverla apprendere da cotali condizioni necessariamente accompagnata: anzi, se i sensi non ci fossero scorta, forse il discorso o l'immaginazione per se stessa non v'arriverebbe già mai.” (Ch. XLVIII)

⁹³ Husserl discusses Berkeley's objection to the distinction between primary and secondary qualities in §40 of *Ideas* I.

himself presents the mathematical constitution of those qualities as a reason for why they are primary.

4.4.3 Galileo's mathematical universe

Galileo's claim that secondary qualities are "no more than pure names" connects his account of the primary-secondary quality distinction to the medieval discussions around nominalism. Medieval nominalists held that certain or all qualities of bodies are purely nominal, i.e., that they are not real bodies or real parts of bodies. One quality that would frequently be regarded as nominal is number. Nominalism about numbers entails that they are not another body or part of bodies, but merely a name that denominates them according to their quantity, not according to their substance. Sensible qualities, by contrast, would usually be regarded as real and not nominal, and even Ockham spared them from his "razor." By calling them nominal, Galileo added another potential source of conflict with church doctrines,⁹⁴ some of which had only been established after centuries of difficult debates. And, he revolutionized the

⁹⁴ Galileo's radically different concept of the world may have had as much potential for conflict with the church as his heliocentrism. For example, Galileo's classification of *proper sensibles* as subjective closed a loophole that William of Ockham had used to explain the compatibility of his account with the doctrine of transubstantiation. Ockham eliminated quantity from the Aristotelian list of categories, and was summoned to Avignon because of the resulting problems for the established doctrine of transubstantiation. According to it, the bread still smells, feels, and tastes the same (even though its substance allegedly has changed to the body and blood of Jesus) because these qualities inhere in quantity, which remains the same in spite of the change of substance. Without quantity, Ockham contradicted the established doctrine. But by sparing *proper sensibles* from his razor, Ockham left the door open for an explanation of transubstantiation: the *proper sensibles* continue to exist parallel to the changed substance.

prevalent classification of real and merely nominal qualities: since Galileo, sensible qualities have been considered as derivative, and mathematical qualities as fundamental.

Galileo lists as primary qualities, besides the already mentioned numbers, motion, shape, size, location, contact, number at other places also mass and penetration. Of these, numbers, extension, location, shape, and size can be relatively straightforwardly expressed in numbers and geometrical figures. For instance, any shape of a material object can be expressed as a—possibly complicated—geometrical figure, and its location can be put into geometrical coordinates.

Other qualities are less obviously geometrical, but nevertheless they fit the picture. Motion, for instance, accords with Galileo's idea of the mathematical universe. To account for change to bodies, Galileo needs to introduce some notion of time, and motion fulfills this purpose. Since extended things are supposed to consist of geometrical qualities, motion seems like a coherent addition to the other primary qualities. "Touch" or "contact" may be a little harder to fit into the picture, but Galileo means that a body can touch or border other bodies, which can also be made a part of the geometrical description of objects. Numbers, motion, extension, location, shape, size, and touch are all qualities that can be expressed in mathematical and geometrical terms, and it seems obvious that they can be part of the mathematical universe.

For mass and penetration it is harder to see how they are supposed to be constituted of numbers and geometrical figures. Descartes thinks that they are not direct expressions of mathematics, and thus doesn't include them in his list of primary qualities. Galileo, Boyle, and Locke are not as strict in this respect, but they nevertheless follow the same basic thought that the world is mathematical in itself. Galileo expressly contends that real qualities of the world are mathematical when he, in his best-known passage, writes that nature itself is mathematical:

Philosophy is written in this greatest book that is continually open before our eyes (I mean the universe), but it cannot be understood unless you have first learned to understand the language and know the characters in which it is written. It is written in mathematical language, and its characters are triangles, circles, and other geometrical figures, without which it is humanly impossible to understand a word of it; without these, one is wandering around in vain in a dark labyrinth.⁹⁵

That mathematics is supposed to provide us with direct access to reality as it is in itself, independent of any perceiver, is more articulated in Galileo than in any other modern philosopher. The passage is part of Galileo's polemic against a treatise by Orazio Grassi on the comets from 1618, who, under the pseudonym Sarsi, attacked Galileo's view that comets are optical illusions and instead argued that comets move above the moon. That he was factually right, and Galileo wrong, is here of little

⁹⁵ "La filosofia è scritta in questo grandissimo libro che continuamente ci sta aperto innanzi a gli occhi (io dico l'universo), ma non si può intendere se prima non s'impara a intender la lingua, e conoscer i caratteri, ne' quali è scritto. Egli è scritto in lingua matematica, e i caratteri son triangoli, cerchi, ed altre figure geometriche, senza i quali mezzi è impossibile a intenderne umanamente parola; senza questi è un aggirarsi vanamente per un oscuro laberinto." (*Saggiatore*, Ch. VI)

importance, for it did not hinder the triumph of Galileo's revolutionary way of thinking about the universe. By working with the concept of parallax and calculating the respective distances, Grassi presupposes that there are regularities in the world that can be put in numerical terms, and which can be calculated with. He would, like most Aristotelians, agree that the mathematical regularities can be abstracted from our experience of the world. But mathematics has a much more fundamental place in Galileo's ontology. Like the other philosophers discussed above, he holds that all primary qualities are simple and universal modes of extension, and he takes it that extension is fully describable in mathematical terms.

The latter notion of primary qualities is what Galileo expresses in his metaphor of the book of nature. Mathematics is to nature like words are to a book. If one wants to understand the content of a book, one has to parse and understand its words. If one wants to understand the story of nature, one has to parse and understand the geometrical figures that constitute it. Practically, when scientists try to understand the language of nature, they have to recur to observations and other experiences. But Galileo implies that experience is no more than a means for attaining reality, rather than revealing something about reality, since what is to be understood is already written in a language. True understanding is asserted when the language of the book of nature is deciphered. Since science ("philosophy") is directly written into the universe, and humans can have an understanding of this language, there is nothing occult about the real qualities of material bodies. Humans can understand the inner

workings of nature if they decipher the mathematical language that is the cause of human experience.

With his idea of the mathematical universe, Galileo radically turned against the Aristotelianism of his time. The notion that proper sensibles can be explained as deriving from the shape, arrangement, and position of atoms, was expressly rejected by Aristotle (see section 3.2), and the idea that all *proper sensibles* are in fact due to some mathematically defined primary qualities would have been considered contradictory, since Aristotle considered mathematical qualities to be abstractions from experiential qualities, which are thus prior. Unlike the Inquisition, however, we cannot simply reject Galileo's thought by pointing out to some apparent contradiction with some authoritative form of Aristotelianism. We need to analyze not merely how the mathematical conception of the universe led to the primary-secondary quality distinction, but also, where exactly, if at all, confusions creep in, which result in potential misunderstandings of the relation between mathematical and experiential qualities.

Exactly this is the project of the mathematician and founder of phenomenology, Edmund Husserl. The next part analyzes his description of the alleged confusions, of the kind of experience forgotten in "Galileo's mathematization of nature," and of the resulting "crisis" of the modern scientific concept of the world.

PART II

HUSSERL ON THE ORIGIN

OF THE EARLY MODERN DISTINCTION BETWEEN

PRIMARY AND SECONDARY QUALITIES:

“GALILEO’S MATHEMATIZATION OF NATURE”

5 Mathematics and the problem of applying it to experience

The introduction explained what I call the “paradox of the primary-secondary quality distinction,” which arises from two apparently contradicting claims. On the one hand, the idea that secondary qualities must be explicable by configurations and movements of primary qualities, and, on the other hand, the confession that we cannot conceive how this is even possible. Husserl sees the primary-secondary distinction as part of the wider development of the exclusion of subjective experience from the world. He doesn’t explicitly say that the paradox is one of the “mysterious, insoluble incomprehensibilities”⁹⁶ that arose with the modern picture of the world, but since the paradox is one expression of the modern treatment of subjective experience, the inconceivability of the connection of ideas of secondary qualities and primary qualities falls under the “insoluble incomprehensibilities.”

From what Husserl says about the primary-secondary quality distinction in major works such as *Ideas I* and *Crisis*, it is clear that he agrees with Descartes and Locke that we cannot a priori conceive *how* the connection could possibly be established. But, as discussed above, Descartes and Locke agree *that* there must be a connection between primary qualities and ideas of secondary qualities. Chapter 4

⁹⁶ “rätselhaften, unauflösbaren Unverständlichkeiten” (*Krisis*, 3)

discussed some more and some less straightforward a priori arguments, besides other reasons, such as the search for the best hypothesis. Husserl, however, doesn't think we can know a priori the alleged fact *that* there is such a connection. He names several things we can know a priori about the world,⁹⁷ but that experiences of secondary qualities are produced by primary qualities is not one of them:

[W]e cannot have an a priori insight that every change of specific qualities of intuited bodies which can be experienced, or is conceivable in every actual and possible experience, is causally dependent on occurrences in the abstract shape-⁹⁸stratum of the world...⁹⁹

In fact, Husserl finds the cause of the lamented enigmatic incomprehensibilities in the very premise that we know a priori that there has to be such a connection. From his point of view, the paradoxical result is a *reductio ad absurdum* of the alleged a priori knowledge that secondary qualities are produced by configurations and movements of

⁹⁷ See 7.1

⁹⁸ The original term is "Gestalt," but Husserl doesn't mean the Gestalten in the sense commonly known from "gestalt psychology." The later gestalt psychology emitting from Wolfgang Köhler's work researched into perceptual wholes, which could entail forms, but also their "fillings." For instance, Husserl's companion Christian von Ehrenfels, who also studied with Brentano, included color as one of the aspects of Gestalt. But, for Husserl, colors are precisely not "Gestalt-Aspekte." Rather, Husserl means that which stands in contrast to the proper sensible qualities, such as colors. He sometimes also calls the latter qualities "fillings" ("Füllen," *Krisis*, 33). Husserl doesn't use the usual antonym "Form," however, which he reserves for other purposes, such as to refer to logical form, or the space-time continuum. 'Gestalt' may have felt like the better alternative because it allows Husserl to reserve "Form" for other purposes. The translation of "Gestalt" in an ordinary use, independent from gestalt psychology, is "shape." I thus follow David Carr's translation of "Gestalt" in these contexts with "shape" (e.g. *Crisis*, 30, see also the footnote), and ask the reader to keep in mind that Husserl's "shapes" refer to more than just the outline of a body. I also follow Carr in translating the term "Fülle" (literally: filling) with "plenum."

⁹⁹ "[E]s ist nicht a priori einzusehen, daß jede erfahrbare, jede in wirklicher und möglicher Erfahrung erdenkliche Veränderung von spezifischen Qualitäten der anschaulichen Körper auf Vorkommnisse in der abstrakten Weltschicht der Gestalten kausal angewiesen wäre." (*Krisis*, 34)

particles constituted of primary qualities. Husserl sets out to understand why this premise seemed so self-evident to modern philosophy. He continues to describe the above idea (of which he denies a priori knowledge) in a more technical way:

... as it were that every such change has, so to speak, a *counterpart in the realm of shapes* in such a way that *the respective total change in the whole plenum has its causal counterpart in the sphere of shape.*

Put in this way, this conception might appear almost fantastic.¹⁰⁰

The context and similar uses in earlier works¹⁰¹ suggest that Husserl means by “specific qualities” that what he elsewhere calls the “proper sensible qualities,” and under which he subsumes “color, sound, smell, and the like.” With this term, Husserl alludes to Aristotle’s distinction between proper and common sensible, and thereby maintains a critical distance to its modern formulation. Nonetheless, Husserl’s object of investigation is the distinction between real and merely apparent qualities in its modern form, a distinction he finds ill-conceived.

Husserl’s concern with the modern distinction is expressed in the term “plenum”—which he often uses interchangeably with “proper sensible qualities.” The term “plenum” and its antonym “spaciotemporal shape-aspects”¹⁰² highlight what Husserl takes to be central to the distinction in its modern form. The real qualities are

¹⁰⁰ “... daß sie sozusagen ihr Gegenbild im Gestaltenreiche hätte derart, daß die *jeweilige Gesamtveränderung der Gesamtfülle ihr kausales Gegenbild in der Gestaltsphäre* hätte. So hingestellt, könnte dieser Gedanke geradezu abenteuerlich erscheinen.” (ibid., emphasis by Husserl)

¹⁰¹ For example in *Ideas* I, §40. I will come back to the context of this citation in Chapter 7.

¹⁰² *Crisis*, 33; “raumzeitlichen Gestaltmomente” (*Krisis*, 31)

those that can be expressed in terms of geometrical shapes, and the merely apparent qualities are those that are not expressible in geometrical terms. Nevertheless, the latter stand in connection to the shapes; they “fill in” the shapes. But being “full”—being a plenum as opposed to a vacuum of the same size and shape—is the aspect of appearances which primary qualities seem unable to account for. Even if it were possible to fill in one shape with another, the shape filling in would still have to be filled in by another shape, *ad infinitum*.

Reflections like this on the impossibility of conceiving of secondary qualities in terms of primary qualities make the claim that the latter are the causes of the former indeed look adventurous. But Husserl doesn't simply dismiss this notion. He tries to explain what motivated it, and that means to understand the best reasons in its favor. He assures us that the “adventurous” thought that all change in the proper sensible qualities goes back to changes in their counterpart in the realm of shapes was for Galileo not, as it was thereafter, taken for granted. Husserl writes that it became an explicit or implicit “matter of course”¹⁰³ for scientists and philosophers after Galileo, even if some expressly deny it. He thinks that it is not easy to recognize the underlying ideas because they form complexes that historically change and get covered by later developments.¹⁰⁴ In a combination of historical and conceptual analysis, Husserl sets out to explain why Galileo nevertheless came up with it, why

¹⁰³ “Selbstverständlichkeit” (*Krisis*, 35)

¹⁰⁴ Cf. the 1939 published *The Origin of Geometry*, in: *Krisis*, 366-386, esp. 373-4.

consequent philosophers explicitly or implicitly subscribed to it, and why it became so widely accepted thereafter.

5.1 The development of Husserl's concern for mathematics

In this section, I would like to delineate a few general observations on the development of the concern for mathematics in Husserl's writings. Husserl, who had started his academic career as a mathematician, was brought to philosophy through the quest for a foundation for mathematics. In his first major work in philosophy, *Philosophy of Arithmetic*,¹⁰⁵ published in 1891, he set out to find a foundation for mathematics—a common concern among the mathematical avant-garde of his time. In the following decades, the discussion gained further impetus. David Hilbert's attempt to found mathematics with an axiomatization of geometry from the late 1890's onwards and his famous "Hilbert's program" from 1920 stand in this context. Besides the perceived need for a foundation for mathematics, Husserl shared with many of the most brilliant mathematicians of his time a sense of the failure to meet this need. Foundationalist projects in their classical form were challenged from very different directions, such as Russell's paradox, Gödel's incompleteness theorems, or Brouwer's intuitionism. At the time of Husserl's *Crisis*, the view that there was a foundational crisis of mathematics, and with it a foundational crisis of science altogether, was commonplace.

By the time *Philosophy of Arithmetic* was published, i.e., before some of the

¹⁰⁵ Husserl, Edmund *Philosophie der Arithmetik: Logische und psychologische Untersuchungen*, in H XII, 1970.

developments just mentioned, Husserl had developed from a mathematician with philosophical interests to a philosopher concerned with the foundations of mathematics. He saw his field of study as a “border discipline equally important for the mathematician and the philosopher.”¹⁰⁶ Husserl himself saw the danger of a psychologistic interpretation of his arguments from *Philosophy of Arithmetic* as an attempt to explain logic with empirical facts of human cognition, and became famous for his thorough arguments *against* psychologism in *LI*. Nevertheless, the tension between psychological experience and mathematical, logical and conceptual structures continued to motivate his writings. In the *Crisis* and in particular its parts on Galileo and the “Origin of Geometry,” Husserl again puts mathematics at the center of his study. His philosophical concern, however, now reaches far beyond that of his first book.

The new extent of Husserl’s concern with mathematics can best be seen in the shift in his interest to the foundational role of mathematics for the philosophical picture of the world. There is a shift in two very different respects. The first pertains to the broadening of Husserl’s foundationalist project. In *Philosophy of Arithmetic*, the foundation of one field of study—arithmetic—was the focus. Husserl’s later foundationalism, by contrast, concerns all of science, and he thinks that it lies at the heart of philosophy. The foundational problem of science becomes, in Husserl’s last

¹⁰⁶ “für den Mathematiker and Philosophen gleich wichtigen Grenzdisciplin” (Op. cit., p. V)

work, *the* fundamental problem for an all-embracing philosophy. Husserl proclaims:

Thus what appeared to be merely a problem of foundation of the objective sciences, or a partial problem in the universal problem of objective science, has indeed proven to be in fact the genuine and most universal problem.¹⁰⁷

Chapter 7 will come back to Husserl's project of founding science. For the current investigation, Husserl's second shift of interest in foundations is of central importance: the turn towards an analysis of the foundation that mathematics provides for the modern picture of the world. The *Philosophy of Arithmetic* is a straightforward search for a foundational principle, even though, of all possibilities, Husserl finds it in the human psyche. In the *Crisis*, and in particular the parts on Galileo and the origin of geometry, Husserl again is interested in the foundations of mathematics. Here, however, mathematics is not the aim but rather the medium with which to explain how the application of a priori mathematics to empirical reality is distorting our concept of nature. Instead of straightforwardly searching for a foundation of either mathematics, or of science, Husserl takes a step back and tries to understand what in the development of modern science has led to the alleged foundational crisis (*Grundlagenkrise*) in the first place. He is now interested in the role of mathematics as a hidden player in our concept of reality. Through a genealogical understanding of the development of modern thought on the world and on subjectivity, he tries to reach

¹⁰⁷ "So hat sich für uns das vermeintlich bloße Grundlagenproblem der objektiven Wissenschaften, oder das vermeintliche Teilproblem des universalen Problems der objektiven Wissenschaft, in der Tat ... als das eigentliche und universalste Problem erwiesen." (*Krisis*, 137)

a position from which he can tackle the problem of the foundations of science anew. He still tries to find a foundation for science, but his own foundationalist project builds upon a critical analysis of a foundation in a different sense: the foundation mathematics provided for the modern picture of the world. This second interest in the foundational role of mathematics is the topic of this chapter.

5.2 The idea of a mathematically ideal world, and its application to the intuitively experienceable world

Husserl identifies Galileo as the major figure in the process of mathematization, which he also calls “Galileo’s mathematization of nature.”¹⁰⁸ While Husserl recognizes that important contributions were made by others before and after, he also writes that Galileo was the first who clearly stated the main idea, and that the arising sciences are thus rightly called “Galilean.”¹⁰⁹ Of course, Husserl was by no means alone in introducing Galileo as a central thinker. He may well have been influenced by other professors,¹¹⁰ or by the works of his students,¹¹¹ and there are even

¹⁰⁸ “Galileis Mathematisierung der Natur” (*Krisis*, 20). Husserl usually ignores and sometimes even dismisses the developments of mathematics in China, India, and the Arab world, together with most of the philosophical developments in Scholastic philosophy. The exclusion of these developments can in part be justified by Husserl’s aim of wishing to understand the development in the sciences that took place in Europe. But it fails to account for the contributions from other regions of the world during the developments in the European Renaissance, and it gives rise to suspicions of ethnocentrism.

¹⁰⁹ “Galileisch” (*Krisis*, 20)

¹¹⁰ Ernst Cassirer, in his 1906 *Das Erkenntnisproblem in der Philosophie und Wissenschaft in der neueren Zeit*, treated Galileo centrally in his evolutionary description of science. The book was part of Husserl’s personal library, but the chapter on Galileo not marked by Husserl (cf. H XXIX, p. IL, fn. 2).

¹¹¹ Alexander Koyré was working on Galileo and in 1959 published a detailed study of Galileo’s influence on the modern picture of the world. David Carr suggests that Husserl added the long Section 9 on Galileo after a visit by Koyré (*Krisis*, XIX). Reinhold Smid (H XXIX, p. IL, fn. 2) contradicts this idea and states that Koyré visited Husserl for the last time in 1932. There is no reason to assume, however, that this, or even earlier meetings with Koyré did not leave an impression on Husserl. At least Koyré, according to Aron Gurwitsch’s report, thought that Husserl’s analysis is largely right and “provides the key for a profound and radical understanding of Galileo’s work” (Gurwitsch, Aron, “Husserlian Perspectives on Galilean Physics,” in *Phenomenology and the Theory of Science* (Northwestern University Press, 1974), 33-59. An earlier book (1927) that directly focuses on the relationship between Galileo’s philosophical writing and Husserl’s phenomenology is Hans-Heinrich Grunwaldt’s *Ueber die Phänomenologie Husserls: mit besonderer Berücksichtigung der Wesensschau und der Forschungsmethode des Galileo Galilei*. Grunwaldt thinks that Galileo’s main search is that for abstraction (“Abstraktion,” 55), a thought that accords with Husserl’s account. In stark contrast to Husserl, however, Grunwaldt sees Galileo as an early proponent of the phenomenological ideation of

connections across the Atlantic.¹¹² Nor is Husserl talking for the first time about Galileo.¹¹³ But, in Husserl's description of the modern ontology of nature, Galileo's role as the originator is novel.

The name Galileo stands in Husserl more for a historical development than for a historical figure. Galileo's major contribution concerns the application of the notion of an ideal world from geometry and mathematics to the concept of the world that is experienced with the senses. But Husserl also acknowledges that Galileo's move had been prepared by mathematicians since ancient times; he mentions the sophisticated state of ancient Greek mathematics, and writes that its applications to philosophy were profound and important. Husserl does not spend much writing on the role of mathematics for Ancient cosmologies; much more detailed studies have been presented by his students, first of all Oskar Becker¹¹⁴ and Jacob Klein.¹¹⁵ Husserl

essences (*Wesensschau*). In the same year, Husserl's *Jahrbuch für Philosophie und phänomenologische Forschung* (vol. 8) comprised only two contributions: Martin Heidegger's *Being and Time*, and Oscar Becker's "Mathematische Existenz," and the latter may have influenced Husserl's view on the role of mathematics for the modern picture of the world.

¹¹² In 1924, Edwin Burtt published a detailed study of the role of Galileo and other related thinkers for the development of the modern worldview in his *The Metaphysical Foundations of Modern Physical Science*. Barry Stroud, in *The Quest for Reality: Subjectivism and the Metaphysics of Colour* (Oxford: Oxford University press, 2000), takes the translations of Galileo from Burtt's book. Husserl has probably not read the latter, but Burtt had strongly influenced Koyré (cf. Diane Villemaire, *E.A. Burtt, historian and philosopher: A study of the author of The metaphysical foundations of modern physical science* (Dordrecht: Kluwer Academic, 2002), 3-4).

¹¹³ For instance, in his 1911 *Philosophy as Rigorous Science*, he speaks of the "Galilean epoch" ("Galileische Epoche," 308) without, however, defining this notion beyond what he expects his readers to know already.

¹¹⁴ See Oskar Joachim Becker's *Grundlagen der Mathematik* (1954) and *Größe und Grenze der Mathematischen Denkweise* (1959). He describes, for instance, that Anaximander developed the premeval thought that nature is ordered according to harmonic numbers and geometrical forms.

mentions that the Pythagoreans were impressed by numerical relations such as that between the length of a string and the pitch of a tone, and he surely would acknowledge that many modern developments have ancient predecessors.

Besides the thought that the world is mathematically structured, the methodological rigor of the mathematics and the absolute certainty of its conclusions provided a model for philosophy. If philosophy could proceed in the same way, it surely could provide a secure foundation upon which all endeavors into knowledge could build. Husserl writes that already

[W]ith Euclidean geometry had grown up the highly impressive idea of a systematically coherent deductive theory, aimed at a most broadly and highly conceived ideal goal, resting on “axiomatic” fundamental concepts and principles, proceeding according to *apodictic conclusions*—a totality formed of *pure rationality*, a totality whose *unconditioned truth is available to insight* and which consists exclusively of unconditioned truths recognized through immediate and mediate insight.¹¹⁶

If philosophy is to follow the model of Euclidean geometry, it starts from axioms,

¹¹⁵ See “Die griechische Logistik und die Entstehung der Algebra“ in: *Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik*, Abteilung B: Studien, Band 3, Erstes Heft, Berlin 1934, 18-105 and Zweites Heft, Berlin 1936, 122-235. New English edition: *Greek Mathematical Thought and the Origin of Algebra*. Cambridge, Mass., 1968. A thorough study of Klein’s mathematical studies in connection with Husserl’s later thought has been presented by Burt C. Hopkins in his *The Origin of the Logic of Symbolic Mathematics: Edmund Husserl and Jacob Klein*. (Bloomington and Indianapolis: Indiana University Press, 2011).

¹¹⁶ *Crisis*, 21; “[M]it der Euklidischen Geometrie war die höchst eindrucksvolle Idee einer auf ein weit- und hochgestecktes ideales Ziel ausgerichteten, systematisch einheitlichen deduktiven Theorie erwachsen, beruhend auf ‘axiomatischen’ Grundbegriffen und Grundsätzen, in apodiktischen Schlußfolgerungen fortschreitend—ein Ganzes aus reiner Rationalität, ein in seiner unbedingten Wahrheit einsehbares Ganzes von lauter unbedingten unmittelbar und mittelbar einsichtigen Wahrheiten.” (*Krisis*, 18f)

proceeds systematically, and works its way forward through apodictic conclusions. “Apodictic” means that there is no reasonable doubt concerning their validity for all times, since the truth of the conclusions is evident from the fundamental concepts and principles. Husserl grants that the objects and methods of Euclidean geometry and ancient mathematics constitute an a priori, in a strong sense. Their knowledge derives from considerations that can be made independently of particular experience, and they concern conditions of possible experience. Furthermore, Euclidean geometry and its methods constitute a “totality formed of pure rationality,” and this entails that the objects of geometry are completely accessible to rationality. The original belief was that Aristotelian syllogistic determines all possible movements within the whole a priori, which is a rational whole.

Husserl thinks, however, that Galileo’s idea of a mathematical natural science is “*completely new*.”¹¹⁷ The “unprecedented”¹¹⁸ new idea is to equate empirical nature with the a priori of mathematics. Galileo’s mathematical regularities are no longer thought to be only part of an infinite that is not mathematically structured; we may, for instance, think of the ancient Greek concept of *ἄπειρον*. Rather, the infinite itself is a mathematical structure in which each object is ideally determined in its space and being. The empirical world itself is conceived of as consisting of rational idealities.

¹¹⁷ „völlig neu“ (*Krisis*, 20)

¹¹⁸ „das unerhört Neue“ (*Krisis*, 19). In contemporary German, “unerhört” is usually meant in the sense of “outrageous,” but other uses of this word by Husserl are clearly incompatible with this meaning, and he most likely used it always in the older meaning of “unprecedented.”

Both empirical space and the objects within it are thought to be fully describable in mathematical language. Reality seemed to be entirely open to scientific discovery, and science seemed to have the potential to exhaust every bit of it. Following this idea, science straightforwardly discovers what is already given in nature in an ideal mathematical form. The idea is that "... the infinite totality of actual being is in itself a rational totality that is mastered correlatively by a universal science, and that without remainder."¹¹⁹ The empirical world appears to be totally open to mathematically-scientific investigation because it is itself conceived of in mathematically ideal terms.

Some have sensed Platonism in this conception of reality,¹²⁰ but there is an instructive difference. Husserl concurs that, for Plato, behind the empirical reality there is the world of ideas.¹²¹ Husserl asserts that Plato holds empirical reality to have merely an imperfect participation, a *μέθεξις*, in the ideal. I interpret Husserl to mean the following: The empirical world is for Plato transient and ephemeral, while the ideal world is unchanging and eternal. Plato's concept of the ideal world follows the example of mathematics in that it regards its objects to be as clearly and a priori determined as mathematical objects. Potentially, the ideal world can be completely

¹¹⁹ *Crisis*, 32; "... daß die unendliche Allheit des überhaupt Seienden in sich eine rationale Alleinheit sei, die korrelativ durch eine universale Wissenschaft, und zwar restlos, zu beherrschen sei." (*Krisis*, 20)

¹²⁰ Gurwitsch calls Galileo a "Platonist" (Gurwitsch, "Husserlian Perspectives on Galilean Physics," 51).

¹²¹ Cf. *Krisis*, 20.

understood in ideal terms. But there is a radical difference to the modern mathematization of nature. For Plato, the empirical world is just an imperfect copy of the ideal world; it is not identical to the world of ideas, which has a higher level of reality. The application of ideal terms to the empirical world can thus only be more or less complete. Plato's concept of the ideal world may have been modeled upon mathematics, but his concept of the world of experience was not. For Plato, the real world may, as for Galileo, be written in the "language of mathematics,"¹²² but the real world is the ideal world we can know a priori, and not the empirical world, which is known merely a posteriori. Since he draws a radical ontological distinction between them, Plato clearly doesn't confuse ideal objects with empirical reality.

In contrast to Plato's account of the ideal world, "Galileo's mathematization" is executed upon the empirical world itself. For Plato, the ultimate cause of empirical reality is ideal, and even the four elements may correspond to geometrical figures,¹²³ but for Galileo, empirical nature itself is mathematical. The result is that the empirical world itself becomes an "objective world in the true sense—i.e., an infinite totality of ideal objects which are determinable univocally, methodically, and quite universally

¹²² Cf. *Saggiatore*, Ch. VI.

¹²³ Plato also advocated the much older idea that each of the four elements has a geometrically distinct shape (hexahedron, octahedron, icosahedron and tetrahedron) and may thus be taken as preceding some of Galileo's ideas concerning the mathematical structure of the world. Plato's view of the four elements, however, did not thus idealize empirical nature itself; the empirically existing elements, too, are considered imperfect copies of their original ideas.

for everyone.”¹²⁴ Because it concerns the empirical and not the ideal world, the Galilean concept of the world appears to overcome the Platonic notion of an intelligible world behind the empirical world. But if Husserl’s analysis is right, in fact the opposite is the case. The modern concept of nature conceives nature itself to be ideal, without even realizing it. In the mathematization of nature, unnoticed by its executors, empirical reality is underlain with an ideal world. Rather than revealing the true nature of empirical reality, the modern concept of nature disregards empirical reality, or so claims Husserl.

Rather than finding and rejecting Platonism in Galileo, Husserl thinks the modern concept of the world failed to fully appreciate an important distinction Plato had made. This connects to a fact about the Pythagoreans Husserl mentions in passing. Here, he mentions that they were excited about the functional dependence of the pitch of the length of a vibrating string. Husserl doesn’t elaborate any more on this, but it is usually assumed that the Pythagoreans promoted the idea that reality is mathematical.¹²⁵ The exact account is not preserved, and Aristotle attributes different things to the Pythagoreans. Allegedly, they think that numbers are in the things,¹²⁶

¹²⁴ *Crisis*, 32; “eine *objective* Welt im eigentlichen Sinne gemacht; nämlich eine unendliche Totalität von methodisch und ganz allgemein für jedermann eindeutig bestimmbar idealen Gegenständlichkeiten.” (*Krisis*, 30)

¹²⁵ For a more extensive study of Pythagoras, see *Größe und Grenze der Mathematischen Denkweise* by Husserl’s student Oscar Becker (1959).

¹²⁶ *Metaphysics* 6, 1080b, 1.

that things are made out of numbers,¹²⁷ and that things are numbers.¹²⁸ Aristotle also thinks that both the Pythagoreans and Plato left it to others to spell out the meaning of the participation of empirical objects in the more real numbers or forms.¹²⁹ Regardless whether Aristotle's description of the Pythagoreans is true or not, it is clear that Plato did something the Pythagoreans did not: He drew a radical distinction between ideal forms and empirical objects. By following some Pythagorean notion while neglecting Plato's distinction, Galileo did not overcome Platonism, but fell back onto a pre-Platonic notion of reality.

Husserl could not agree more with Plato that there is a radical difference between the experienceable world and the ideal world. Nevertheless, he doesn't think that reality in its highest form is the world of ideas, or that the objects of our experience are mere imperfect copies of the real ideas behind them. Husserl thinks, to the contrary, that ideal essences precisely lack the determinations that make the real objects real. That ideal essences are ideal entails that they are determinable in different ways; different real objects can instantiate one and the same ideal. Husserl's approach to reality is diametrically opposed to that of Plato. Accordingly, the main slogan of the phenomenological movement—"Back to the things themselves!"—expresses Husserl's goal of bringing theoretical concepts back to the intuitive

¹²⁷ *Metaphysics* A 8, 990a, 22.

¹²⁸ *Metaphysics* A 5, 987b, 28.

¹²⁹ *Metaphysics* A 6, 987b, 13.

experience from which he alleges they derive. In *LI II*, he writes:

Logical concepts, as valid thought-unities, must have their origin in intuition; they must arise out of an abstraction on the base of certain experiences, and must, when the abstraction is re-performed, always newly prove themselves and be recognized in their identity with themselves. Otherwise put: we absolutely do not want to rest content with ‘mere words,’ i.e. with a merely symbolic understanding of words. Meanings that are vitalized only from remote, confused, inauthentic intuitions—if by any intuitions at all—cannot be enough for us. We want to go back to the ‘things themselves.’¹³⁰

According to Husserl, perceptions are necessary for understanding the full meaning of logical concepts even, and the same holds, *a fortiori*, for concepts concerning things in the world. He claims that conceptual meaning cannot derive from a mere analysis of the meaning of the concepts. It is only fully understood when it is brought to the “intuition” (*Anschauung*), the foundational perceptions from which it derives its “fulfilling meaning.”¹³¹ But this sounds easier than it is. There are always different ways of bringing it to intuition, and not all lead to the correct meaning of the concept in question. Thus, if the connection of a concept to its fulfilling intuition is unclear or equivocated, its meaning also becomes unclear, or is equivocated with another. Furthermore, the fulfilling meanings may become completely forgotten, resulting in

¹³⁰ “Die logischen Begriffe als geltende Denkeinheiten müssen ihren Ursprung in der Anschauung haben; sie müssen durch Abstraction auf Grund gewisser Erlebnisse erwachsen und im Neuvollzuge dieser Abstraction immer wieder neu zu bewähren, in ihrer Identität mit sich selbst zu erlassen sein. Anders ausgedrückt: Wir wollen uns schlechterdings nicht mit ‘bloßen Worten,’ das ist mit einem bloß symbolischen Wortverständnis zufrieden geben. Bedeutungen, die nur von entfernten, verschwommenen, uneigentlichen Anschauungen—wenn überhaupt von irgendwelchen—belebt sind, können uns nicht genug thun. Wir wollen auf die ‘Sachen selbst’ zurückgehen.” (*Logische Untersuchungen II*, 7)

¹³¹ “erfüllende Sinn” (*Logische Untersuchungen II*, 72)

empty concepts.

The mistake of equivocation and forgetting of meanings, which Husserl describes in the *LI II*, becomes, in the *Crisis*, the fundamental mistake of the modern concept of the world. The mistake he alleges Galileo and his followers to commit is an equivocation of different kinds of meaning, and a forgetting of the original intuition which would be necessary for going beyond a mere symbolic understanding of words. It is a rather complex mistake, and it is made in the combination of several steps. I will now briefly describe the types of meaning that Husserl elaborates in his earlier works, and then look into their application in Husserl's diagnosis of the modern concept of the world in the *Crisis*.

5.3 Generalization, idealization, formalization, and symbolization

All constituting of concepts is, according to Husserl, an abstraction from concrete intuitive experience, and a concentration on some aspects of concrete experience. Yet, not all abstraction is the same. I will distinguish four fundamentally different kinds of abstraction in the constitution of concepts: generalization, idealization, formalization, and symbolization. In a nutshell, generalization abstracts from contingent moments of experience, and concentrates on the *eidōs* of a *concretum*, i.e., the essential features of a concrete object. Idealization abstracts from concrete objects, and concentrates on approximated objects. Formalization abstracts from material content altogether, and concentrates on formal relations that can hold between objects of all genera and species. Symbolization abstracts from all intuitive content and concentrates on the symbol as a representation of any kind of object. This section looks into each of these ways of constituting concepts one by one. The next chapter will be dedicated to how their combination and confusion lead to the mistake Husserl alleges in the modern concept of the world.

Generalizations can be directly applied to experience; they subsume experiences under universals that can be either genera or species. Unlike idealizations and formalizations and like exact essences, they are concerned with morphological essences; essences that have a determinate but vague material content. For instance, all triangular formed material objects have the morphological essence “triangle” in

common, and they are determined as triangles. Morphological essences are vague because there is no strict criterion of identity. For instance, triangularly shaped material objects are called “triangles” because they have more or less the same shape. It is true that, if we imagine in fantasy different geometrical objects, we gain “in a certain sense ‘ideal’ possibilities”¹³²; every imagination may fit several real objects. We must not overlook the single quotation marks Husserl put around “ideal.” He thereby makes clear that the experienced or imagined geometrical object is not really an ideal object. Intuition knows only a more-or-less, a rough estimate, an about similarity; its objects have only approximate identity. Accordingly, generalizations constitute only approximate meanings.

Idealizations, by contrast, constitute exact meanings; “only ideals have a rigorous identity.”¹³³ The principle of the excluded middle forbids that one geometrical shape is at the same time a different one, and in the case of ideal geometrical shapes any difference of shape is excluded. If it were shaped differently, even if only in one small detail, it would be a different object. For instance, we know that each angle of an equilateral triangle has 60 degrees, and a triangle in which one angle is 0.0001 bigger or smaller is not an equilateral triangle in the strict ideal sense. In fact, intuitive experience altogether seems dispensable, since everything there is to be known about ideal geometrical objects can be known a priori. But, for Husserl,

¹³² *Krisis*, 22.

¹³³ “nur Ideale haben eine strenge Identität” (*Krisis*, 292)

idealization ultimately derives from experience. It is either directly applied to experience, or indirectly, as an idealization of generalizations. If generalizations are idealized, the resulting ideal is general, such as “all equilateral triangles.” If a concretely experienceable object is idealized, it is put into ideal terms, such as a concrete drawing of a triangle into “this equilateral triangle with the side length of 5 cm.” In general, we cannot intuitively distinguish the drawing of the 5-centimeter equilateral triangle from a triangle that deviates by 0.0001 degrees in two angles, but, in mathematical terms, the difference can readily be determined. Deriving an ideal object directly from experience or from a generalization is a transformation, for an intuitively experienceable object is transformed into an object that in principle cannot be unequivocally intuited. This can be done via the ingenious method of approximation of “limit-objects” to be explained in the next section.

Ideals are, like general objects, determinate; they concern genera like the set of ideal triangles, or even particular triangles. Formal objects, by contrast, are determinable by any object whatsoever. They are indeterminate in that they are void of all material content. Even a formalization of a triangle, for example by using Euclidian vectors, leads to a formal description that cannot merely be used as a description of a single triangle or a type of triangle, but which could be applied to any material object whatsoever. Since formal objects lack determinate material content, formal descriptions are usually concerned with relations and judgments. Husserl writes with regard to the example of the formal law “ $a + b = b + a$ ” that the sign “+”

is “not the sign of an addition of numbers, but that of any connection whatsoever.”¹³⁴ It doesn’t matter what kinds of material content are finally assigned to the variable. Formalization can thus be applied directly to experience, or to generalizations, or to idealizations. Because of the wide range of possible applications, formalization facilitates the confusion of one kind of meaning with another. For instance, we may erroneously think that the plus sign refers to the addition of numbers only.

The danger of confusion becomes multiplied with symbolization; the assignment of symbols to either morphological essences, idealizations, or formal descriptions. Symbols are physical objects directed at something other than themselves, i.e., their meaning. Formalization tends to rely heavily on the use of symbols, such as in the formal law from above, “ $a + b = b + a$.” But not all symbolic expression is due to formalization. Symbolization can be, for instance, also be applied to general concepts and ideals. In the above formal law, the “+” sign stands for a formal relation, while it can also stand for a relation between ideal objects such as numbers (e.g. “ $1 + 2 = 2 + 1$ ”), or general concepts (e.g. “one apple plus two apples is the same as two apples plus one apple”). It is precisely its wide applicability that makes symbolization so useful.

Their wide applicability, however, also makes it easy to confuse symbols. For instance, nothing in the symbol “+” itself tells us what kind of object is meant. The

¹³⁴ *Logische Untersuchungen* I, 249.

possibility of different syntactically well-formed sentences suggests new combinations of symbols. Some of them are, under their usual meaning, obvious nonsense (e.g. “ $a = +$ ”). But other combinations of symbols merely lead to countersense (*Widersinn*), which is often difficult to reveal. Countersense arises when, in one and the same symbolic expression, incommensurable kinds of objects are put together. This is possible because the only form combinations of symbols must obey is the syntax prescribed by the respective grammar. Yet, the incommensurability usually lies hidden behind the same symbolic form assigned to them. Because symbolization abstracts from all intuitive content, it cannot make use of intuition, which could settle the ambiguities in the meaning a symbol can represent, ambiguities that abet confusion.

In everyday use, generalization, idealization, formalization and symbolization coexist and usually do not harm each other. An example of one can even be used to understand the other. For instance, when we first learn about Pythagoras’s theorem, intuitively graspable drawings are used to make understandable the unintuitive symbolic expression of the ideal law “ $c^2 = a^2 + b^2$.” The ideal law doesn’t depend on any intuitive understanding, but it may be better attainable to the learner if it is put in intuitive terms. Mathematicians and philosophers, however, have to be careful to distinguish the different kinds of meanings. Husserl thinks that their confusion often leads to fundamental misunderstandings. One example—and the example we are primarily concerned with here—are the misunderstandings that, according to Husserl,

are part of the “mathematization of nature.” So let’s come back to the question as to how the confusion is alleged to have happened in modern philosophy.

6 The genesis of the equivocation

This chapter analyzes Husserl's account of the genesis of the equivocation caused by the alleged confusions of meaning in the mathematization of nature. The analysis in this chapter makes use of the latter three ways of constituting meaning distinguished above – idealization, formalization and symbolization. While the analysis concerns Husserl's genealogy in the *Crisis*, it does not follow the plot Husserl presents there, and it leaves aside many of the intricate discussions Husserl presents in the *Crisis* on a huge number of topics. Husserl's own plot will be the topic of Chapter 7.

6.1 First step – idealization: The approximation of ideal limit-objects and the substruction of reality

Ancient mathematics not only supplied the concept of an ideal world standing in relation to the world of experience; it also already contained a model for the method of idealizing objects from experienced objects: the approximation of really intuited objects towards ideal geometrical objects. Ancient geometry was already acquainted with an analogous process of approximation; the “art of measurement.”¹³⁵ The art of measurement is the process of determining the shapes of intuitively experienced objects in geometrical and numerical terms. It was invented long before writing, and

¹³⁵ “Meßkunst” (*Krisis*, 25)

developed alongside applied mathematics. The function of measurement in the mathematization of nature is that, in the art of measurement, the really experienceable qualities of the measured objects are put in the form of the ideal geometrical world.

Husserl thinks that before the mathematization of nature, the art of measurement served mainly practical purposes, and he may have in mind something like following: Since time immemorial, extended objects have been used to measure other extended objects—for example feet to measure the length of a wall—allowing for limited applications such as architecture, which could then can be extended to other applications. The builder of a hut could use her own feet to measure the distance between two edges, and then, by comparison and using the same feet, could measure the length of pieces of wood to be cut. The simple comparison between concrete objects—a foot and a piece of wood—may be objectified with the introduction of an abstract concept of measurement, such as “foot.” Now, “foot” doesn’t mean a concrete object, but a unit that expresses a specific length, which can only be approximated by concrete objects, such as feet or yardsticks.

With the help of abstract concepts of measurement, the masters of the art of measurement discovered that measurements could be related to each other, and that these relations could be used to intersubjectively and unequivocally determine the relations between bodies. For instance, if the height above sea level of a viewing platform was known, and the vertical angle of a ship far away could be measured, then the distance of the ship to the viewing platform could be calculated. The

improvements in calculating with measurements went hand in hand with practical improvements. The development of more precise measurement tools enabled more accurate calculations to be made that allow an increasingly precise measurement of the calculated distances. The precision of the calculation depends only on the precision of the original measurements, and it increases with more precise techniques and technologies.

The dramatic shift of attention to totally different objects made possible by approximations is not readily seen. It seems that the measure used in the measurement is just as real or ideal as the object measured. But precisely here there is the fundamental difference: measured objects are real, but measurements, once they are put into units, are ideal. The fact that often the same name (for example “foot”) is used for both, and the ability to “translate” back and forth between both kinds of concepts through approximation techniques cannot eliminate, but only hide the fact that both kinds of concepts are incommensurable.

The approximated unit may come very close to the measured objects, but every experienced object and every measurement is always vague—even if the measurement very precise and the vagueness is tiny. Even prior to 1928, Husserl wrote about the distinction between ideal and real objects in his essay “Idealization

and the Science of Reality—The Mathematization of Nature.”¹³⁶ In this essay, he explains: “The perceived, the experienced, as such, is thoroughly ‘vague’; it always stands, taken in harmonious experience, under the essential law of a certain gradation of perfection which always exists as an ideal possibility.”¹³⁷ Regardless of how clearly the intuitively experienced quality is perceived, there is always the possibility of further refinement. For instance, normal observers may call a perceived line “straight,” but there is always the possibility that it contains some irregularity that could be seen under better viewing conditions, such as a microscope. A line conceived mathematically, by contrast, is completely straight by definition; there is no possibility of further refinement. The ideal straight line can, in intuitive experience, only be approximated, further approximation pending.

Husserl calls the numerically determinate objects resulting from the approximation, in analogy to the idea of limit-numbers, “limit-shapes.”¹³⁸ This expression should not be taken to suggest that limit-numbers were developed before objects were approximated in measurement; the opposite is the case. Husserl rather means that the approximation of limit-objects is analogous to the “approaching” of

¹³⁶ See *Crisis* 301, “Realitätswissenschaft und Idealisierung.—Die Mathematisierung der Natur” (*Crisis*, 269). According to Biemel’s editorial remark, it was written before 1928, and thus constitutes an earlier attempt to work out the “mathematization of nature.”

¹³⁷ See *Crisis*, 309, “Wahrgenommenes, Erfahrenes als solches ist durchaus ‘vage,’ es steht immer, in einstimmiger Erfahrung genommen, unter dem Wesensgesetz einer gewissen Vollkommenheitssteigerung, die als ideale Möglichkeit immerfort besteht.” (*Crisis*, 287)

¹³⁸ “Limes-Gestalten” (*Crisis*, 23). For the translation of “Gestalt,” cf. footnote 98.

limit-numbers: Even though every measurement is only an approximation, the process of approximation, so to say, “approaches” the approximated object *ad infinitum*. The process of approximation never actually reaches the approximated ideal shape, just as the series never actually reaches its limiting value. The limit-number and the limit-shapes are idealizations abstracted from the really experienced objects. The process of measurement replaces the more or less vague shapes of the concretely experienced objects with approximated limit-shapes. Concretely experienceable objects are replaced with objects that can in principle not be experienced.

One reason why the radical confusion is not immediately realized lies in the arbitrary precision to which the a priori known ideal world approximates the a posteriori known and necessarily vague world of experience. The possibility of approaching the limit-object with arbitrarily high precision makes it look like the approximated object is identical to the intuitive object. It seems like the intuitively experienceable object is identical to the approximated object. In Husserl’s expression, experience is “substructured”¹³⁹ (substruieren) with ideal limit-objects. The point is that the substruction is not reality itself, but the result of the application of a method to our experience of reality.¹⁴⁰ The substruction is not the cause of experience, but the result

¹³⁹ *Crisis*, 38; *Krisis*, 37. Husserl uses the verb in the past tense (“substruiert”), from the noun “Substruktion.”

¹⁴⁰ See section 7.2.

of an idealization applied to experience.

The transformation of measurements to the a priori ideal and back to the experienceable world has become so common that it feels natural to equate the ideal and the experienced object: “So familiar to us is the shift between a priori theory and empirical inquiry in everyday life that we usually tend not to separate the space and the spatial shapes geometry talks about from the space and spatial shapes of experiential actuality, as if they were one and the same.”¹⁴¹ But ideal objects are attainable to theoretical thinking only, not to imagination or worldly experience. If the shift goes unnoticed, a philosophical misunderstanding is imminent: the idealization may be equivocated with empirical reality. The result is that the idealization “buries”¹⁴² the very “reality that is presupposed in all idealization.”¹⁴³ Husserl thinks that the modern concept of the world is not concerned with reality in the first place, but with sedimentations that cover reality.

Of course, to the proponents of the modern picture of the world their endeavor looks very different. Every instance of connection between the mathematically conceived objects and the intuitive experiences seems to confirm that the respective experience is caused by the mathematically ideal objects. But, for Husserl, the

¹⁴¹ *Crisis*, §9a, p. 24. “So alltaglich vertraut ist der Wechsel zwischen apriorischer Theorie und Empirie, da wir gewohnlich geneigt sind, Raum und Raumgestalten, uber welche die Geometrie spricht, von Raum und Raumgestalten der Erfahrungswirklichkeit nicht zu scheiden, als ob es einerlei ware.” (*Krisis*, 21)

¹⁴² “verschuttet” (*Krisis*, 51)

¹⁴³ “bei aller Idealisierung vorausgesetzte Wirklichkeit” (*ibid.*)

discovery of empirical correlations of material changes and changes in conscious experience is to be expected for the contrary reason: because every idealization is abstracted from experience in the first place. Husserl seems to have a good point here, but one may counter his claim with the question: could it really escape the attention of such brilliant thinkers as Galileo, Descartes, and Locke that this was a step from intuitively experienceable objects to ideal objects that in principle cannot be intuited? The next section explains that Husserl has an explanation why this step, even if noticed, did not seem hazardous. The next step in the development of mathematics is more prone to lead to apparent contradictions and confusions. Realizing that there are contradictions and confusions doesn't, of course, mean that their source is understood. The next section draws on Husserl's account of formalization, which he had already developed long before the *Crisis*, and which he uses in the *Crisis* to explain the source of what he takes to be a confusion in the application of mathematics to the modern picture of the world.

6.2 Second step—formalization: The development of formal mathematics and its application to the modern picture of the world

The geometry Galileo was acquainted with was still close to intuitive experience. Of course, its idealizations are fundamentally different from our experience, but since Galileo did not work with the formalizations and idealizations that would become commonplace thereafter, the symbolized original intuitive basis for geometrical judgments could readily be reconstructed. Husserl thus calls Galileo merely a “pioneer” of the mathematization of nature, and warns us not to attribute the “matters of course”¹⁴⁴ of our concept of physical science to Galileo. Husserl’s example is that Galileo did not think in terms of a “symbolic that is far from perception.”¹⁴⁵ That would only happen later, and again it has its origin in a new development of mathematics. The development goes towards a formal mathematics, which Husserl describes as the “*arithmetization of geometry*.”¹⁴⁶ This term is shorthand for the long series of mathematical discoveries that gradually replaced operations on ideal geometrical objects, which can easily be brought to intuition, with calculations on formalizations and symbolizations independent of the intuitive figure. The outcome was that geometry became calculable with purely arithmetic operations and ultimately

¹⁴⁴ “Selbstverständlichkeiten” (*Krisis*, 21)

¹⁴⁵ “anschauungsferne Symbolik” (*ibid.*)

¹⁴⁶ “*Arithmetisierung der Geometrie*” (*Krisis*, 44)

became a part of algebra. The arithmetization of geometry is, in contrast to the mathematization of nature, applied to geometry, and not nature. With it, geometry becomes completely embedded in mathematics, and we can truly speak of a mathematization of nature, rather than having to distinguish a “geometrization of nature,” when empirical experiences are put in geometrically-ideal terms.

Husserl mentions in particular Franciscus Vieta, who, even before Galileo, promoted the idea that all mathematical problems could be solved with algebra.¹⁴⁷ The developments of algebra, mathematics of continua, and analytic geometry all continued to elaborate the symbolic formalization Vieta so confidently proposed. When geometry, in the centuries after Galileo, was made a branch of pure mathematics, it could be pursued with purely symbolic operations. Geometry would not have to stay close to the intuitive geometrical objects, but it could rely on calculations of numerical relations. But the formalization can easily reach beyond the reach of intuition.

We may add to Husserl’s reference to Vieta the observation that Democritus, whose atomism preceded fundamental ideas of the modern concept of the world, had already developed some of the calculus ideas, and that he thereby contributed to the concept of limit-numbers.¹⁴⁸ Yet, for most ancient philosophers the idea that some

¹⁴⁷ Cf. *Krisis*, 43. Regarding Vieta, see also Bos, Henk J.M. 2001 *Redefining geometrical exactness: Descartes’ Transformation of the Early Modern Concept of Construction*, 145ff.

¹⁴⁸ See the discussion of Democritus in Section 3.2.

objects of geometry or mathematics could only be approximated seemed far-fetched and perhaps paradoxical.¹⁴⁹ It would need further work of thinkers such as Descartes, Newton, and Leibniz to develop the infinitesimal calculus that made formalization seem so seamless. In spite of thinkers like Vieta, the “arithmetization of geometry” was, in Galileo’s time, still in its fledgling stages. When ideal objects were abstracted from experiences, the formalization rarely went so far that it could not easily be brought back to intuitive experience. Many of the objects of ancient geometry could easily be exemplified, either with intuitively imaginable or with practically drawn geometrical figures, and so could the operations upon them. One may think of the drawings with which Plato’s Socrates helps a slave “recollect” geometric notions; the drawings made Socrates’s point intuitively perceptible, which had, in its ideal form, not been attainable to the slave.

Of course, making ideal forms intuitively experienceable is not always as easy, but, to thinkers like Galileo, it seemed possible. The reason is not that the difference is minutely small, but that the geometry they used remained close enough to intuition to make it seem like the “triangles, circles, and other geometrical figures” of the geometrical language of the world would, in principle, be intuitively experienceable. The step from intuitively experienced objects to objects that in principle cannot be intuited, even if noticed, did not seem hazardous because, even

¹⁴⁹ Compare, for instance, Zeno of Elea’s paradoxes, some of which arise from infinitesimal division.

though the abstracted world is ideal, the objects in it can be relatively easily brought back to their original intuition. Even if Galileo and his followers realized the difference between the approximated ideal and the intuitively experienced object, it would not have struck them as problematic. Galileo thus doesn't address the difference between ideal and experienced geometrical objects, and there is no indication that he thought it may become problematic.

Beyond idealization, formalization is yet a further step in abstraction from intuitive experience, and for that reason alone it exasperates the danger of losing contact to intuitive experience. Furthermore, it may lead to a confusion of different kinds of intuitive experience, thus causing shifts in meaning, the results of which may be felt more readily than those between idealizations and intuitive experience, even though their origin is usually not understood. Their origin lies in the fact that each formal description can have several possible fulfilling intuitions. These are not just different approximations of an ideal object, which, even though they may vary, are usually quite similar intuitions. That there is a detachment doesn't become apparent because some intuitive fulfillment can usually be regained.

Ideal objects are totally different to intuitively experienceable objects, but they have a determinate material content that limits the possible fulfilling intuitions. But formal descriptions, in contrast, do not have to have any determinate material content whatsoever; they can be fulfilled by fundamentally different intuitions, as explained in section 5.3. For instance, a formal description of a triangle can be a

description of a material object of a triangular shape, or a description of an ideal triangle. In fact, it can be applied to a triangular relation between all kinds of things. From the formal description alone we do not know if, for example, a material triangle, or a triangular relation between three things is meant. Since formal descriptions do not have to have any determinate material content that would guide the way to their fulfilling intuitions, however, the relation to intuitive experience more apparently leads to confusion. The original intuitive fulfillment from which the formalized object is abstracted could thus be switched with some other intuitive fulfillment, or it could be eliminated altogether from the “true” account of the world. For instance, if that which causes color experiences is to be described in the terms of formal mathematics, then there is nothing in the formal description that would tell which color sensation it causes under the right conditions, or even that it causes color sensations rather than tones or possibly nothing. There could be “inverted qualia,” or the sensations could completely be eliminated, and the formal description of the world could still be the same. Formal descriptions are thus more prone to causing confusions than idealizations.

6.3 Third step—symbolization: Its contribution to mathematization and confusion

Beyond idealization and formalization, there is yet a third step that leads to the alleged confusion of reality with a method. Along with the work on formal mathematics, figures like Vieta developed a symbolic notation to aid the development of formal mathematics. Symbolization in itself is a useful tool, and its application to idealizations and formalizations is a logical continuation of the mathematization of nature. As early as *Philosophy of Arithmetics*, Husserl distinguishes between symbolic and intuitive understanding of numbers, and claims that the latter is more fundamental. In the *Crisis*, the problem of an unnoticed displacement of meaning to a mere “‘symbolic’ meaning”¹⁵⁰ is not a mere problem of mathematics, but of our understanding of nature itself, in several and rather intricate ways.

Symbolization can come in at any step of the mathematization of nature. It allows for the confusion of different entities, since symbols can stand for any kind of object, regardless of whether they refer to generalizations, ideals, or formal descriptions; for example the word “triangle” can stand for a material object, an idealization, or a formal description, and this makes it seem like “triangle” has in each case the same meaning (cf. 5.3). This can hide the fact that incommensurable objects are put together in the same symbolic form and makes it tempting to jump from one

¹⁵⁰ *Krisis*, 44. Cf. *Crisis*, 45.

meaning to the other while failing to clearly separate the different meanings. Furthermore, the conjunction with the other two steps and the resulting progress in symbolic formalization techniques increasingly augments the difficulties in regaining the original intuition, until, finally, it seems impossible to recover the original intuition.

According to Husserl, symbolization perfects the mathematical substitution of intuitive understanding due the possibility of purely technical transformations of symbols. Once a symbolic description of formalized or idealized nature is achieved, the symbols themselves can be operated upon according to rules. Syntactic operations on symbols can transform them into different symbols without any need to take into account their intuitive meaning. The operations upon symbols do not require any understanding of the intuitively experienceable object that is meant by each symbol. Rather, the rules for the transformation of symbols into different symbols can be purely technical. It is not a coincidence that computers can do this fastest and most accurately, since the processing of symbols is central for computing.

The results of the technical transformations of symbols can be transformed back into intuitive experience, which allows the symbol resulting from the operation to stand for predicted intuitive experiences. This makes it appear as if intuition was a mere imperfect means of the human mind, and as if its essential operations were those of a symbol-processing machine. It is as though the intuitive experiences were only indicators for an underlying mathematical process; as though the intuitive experiences

were themselves symbols that stand for something else. The fact that idealizations, formalizations, and symbolizations seem to be derivable from intuitive experience in such a seamless way therefore suggested to Galileo and his followers a revolutionary turn of perspective. What if rather than the abstractions deriving from experience, experience itself is a mere sign or indicator of some more fundamental mathematical reality? But for Husserl, this would turn the actual dependence upside down.

By alleviating and enabling confusions of meaning, symbolization contributed to the alleged philosophical confusion that is rooted in the mathematization. But the confusion that Husserl diagnoses is not just a mix-up of mathematically ideal entities and experiential bodies. Rather, it is supposed to be a confusion of “*true being*,” with that “what is actually a *method*.”¹⁵¹ This sounds like a mistake nobody would succumb to, but Husserl has an explanation for how such an error becomes tempting by the applicability of the method of purely mechanical operations upon symbols.

¹⁵¹ *Crisis*, 51; “Das Ideenkleid macht es, daß wir für *wahres Sein* nehmen, was eine *Methode* ist.” (*Krisis*, 52)

6.4 The paradox as a result of the confusion of reality with a method

The development and constant improvement of measurement techniques and technologies allows the mapping of primary qualities onto an ideal space in such a perfect manner that it appears as if the measurement itself was already taken in the ideal space. The progress in formalization techniques further contributes to the apparently seamless applicability of the mathematical description. The mathematical structure fits the experienced reality almost perfectly, and, in one of Husserl's metaphors, envelops it like a "garb of ideas"¹⁵² or "garb of symbols."¹⁵³ Because the "garb" fits so neatly, the fact that the mathematized objects are not the directly experienced objects, but the result of a technological method, is easily overlooked.

The garb is the result of a method, but Husserl does not simply write that the confusion consist in confusing reality with the *garb*; he writes that it is *through* the garb that a *method* is taken to be true being.¹⁵⁴ This expression is surprising, for nobody would seem to confuse reality with a *method* applied to reality. But the garb by itself would not be confused with reality either; scientists are in other cases well aware that ideal mathematical objects or symbols are not reality itself; they only refer to reality, or describe it. Husserl's point is that the idealizations, formalizations, and

¹⁵² "Ideenkleid" (*Krisis*, 51)

¹⁵³ "Kleid der Symbole" (*Krisis*, 52)

¹⁵⁴ See end of Section 6.3.

symbolizations are fitted so neatly over reality that it seems like they *are* reality. In this sense we confuse the *results* of the application of a method to reality with reality itself. But in fact the results entail the method of mathematization that allows relating the purely mathematical entities directly to aspects of objects that we experience. The confusion is not a mere confusion of different kinds of entities such as experienced objects and mathematical substructions, but a confusion of reality with a sophisticated technical *method* applied to reality.

The loss of meaning caused by the replacement of intuition with a mere method is of central concern for Husserl's whole phenomenological project, for he needs to understand the connection in his attempt to uncover the original intuition of the "things themselves."¹⁵⁵ Husserl's answer therefore is radical. He calls into question all idealizations, formalizations and symbolizations executed upon intuitive reality that have lost connection to the original intuition: "[O]ne has to question just all epistemological technology that has lost its roots."¹⁵⁶ Husserl doesn't criticize technology per se, nor is he lamenting the unwanted consequences of technological inventions. His point is not that there is "good" and "bad" technology, or that all technology is good or bad. Rather, his problem concerning technology is that a mere technical way of thinking about reality is in danger of losing contact with intuitive

¹⁵⁵ See Section 5.2.

¹⁵⁶ "[I]n Frage gestellt muß eben alle wurzellos gewordene Erkenntnisteknik werden." (H XXIX, p. 153)

empirical reality. If that happens, the connection of the technical way of thinking and the original intuitive experience becomes enigmatic. Since the latter is that which, according to Husserl, allows us to access reality, the resulting concept of the world is not describing reality in the first place, but a mathematical substruction resulting from a technique of dealing with experience.

What does this mean for the distinction between primary and secondary qualities? Husserl thinks that the knowledge of how experiences of primary qualities can be correlated to the respective primary qualities in the mathematically ideal world derives from our ability to apply the technique of mathematization to experiences of primary qualities, with which we map experiences onto the mathematical concept of the world, and not from our knowledge of the structure of reality itself. Likewise, the lack of understanding of how the primary qualities could possibly be the cause of the respective experiences of secondary qualities derives from the inapplicability of the technique of mathematization, not from knowledge that they are secondary and do not belong to reality in itself. Since the applicability of techniques doesn't tell us which qualities belong to reality in itself and which do not, it doesn't lead either to knowledge of the alleged fact that experiences of primary qualities are caused by primary qualities, nor to knowledge of the alleged fact that experiences of secondary qualities are caused by primary qualities.

Part I explained that from Galileo to this day, philosophers vigorously contradict each other on the nature of secondary qualities and their explanation in

terms of primary qualities. The combination of, on the one hand, the inconceivability of the connection, and, on the other, the apparent certainty that the connection holds, remain paradoxical. Husserl doesn't try to offer an explanation for how secondary qualities can be explained in terms of primary qualities because he takes the whole distinction to be confused. For modern philosophers, it appears that the difference in the applicability of a method is the result of an ontological difference between two fundamentally distinct kinds of qualities. But Husserl offers a very different explanation for why they make the distinction.

According to him, all experiences are radically distinct from mathematically ideal or formal objects, regardless of whether they are of primary or of secondary qualities. The problem of disconnectedness from intuitive experience arises for all mathematized qualities, but it doesn't become clearly visible when applied to primary qualities because of the above discussed infinitely precise fit of the "garb of ideas," and the fact that the possibility of recovering the original intuitions was in the beginning relatively straightforward. Experiences of primary qualities can be directly mathematized; we have a technique for approximating ideal and formal mathematical qualities from experiences of primary qualities. Because their mathematization appears seamless, the fundamental difference between experiences of primary qualities and the geometrically ideal world doesn't usually become apparent.

With regard to experiences of secondary qualities, however, there is no method of direct mathematization, and the modern mathematical account of nature

immediately ran into trouble. Their relation to the mathematically conceived reality seems problematic from the beginning, and, as already Descartes and Locke remarked, it seems to be nothing less than inconceivable. So far, Husserl agrees with modern philosophers, and he would also agree that there is a radical ontological difference. In some sense, he even agrees with the conclusion of modern philosophy, according to which the ontological difference has to do something with the difference between fundamental and derived qualities. But for Husserl, intuitive qualities are fundamental, and mathematical qualities derived. Husserl's distinction between fundamental experiential qualities and derived mathematical entities doesn't match with the distinction between primary and secondary qualities, nor is it the same distinction with reversed sides. Under his account, the modern distinction between primary and secondary qualities is confused; primary qualities are taken to be fundamental because they are mathematical, but precisely for that reason they are not fundamental, but only abstractions from intuitive experience.

Husserl's explanation for why there seems to be either a direct relation or a resemblance between ideas of primary qualities and the qualities that cause the resemblance is that the experiences and ideas of primary qualities are directly mathematizable thanks to mathematization techniques. In contrast, no straightforward techniques are available for a direct mathematization of secondary qualities.

Early modern philosophers may respond that there is a reason for the difference in mathematizability. There is something analogous between an imagined

or perceived triangle and a mathematically ideal triangle (for example, both have three corners), and this analogy allows the mathematization of nature to build upon resemblances between ideas of primary qualities and ideal geometrical qualities, and to replace the former with the latter. Between a color and a mathematically ideal object, in contrast, no such analogy can hold. Experiences of secondary qualities cannot have a direct analogy to ideal or formal mathematical terms. Husserl does not deny that there are analogies between imagined or perceived mathematical figures and ideal figures, but he would deny that they could bridge the ontological difference between experience and the mathematical substratum. Analogies can hold between ontologically distinct objects, and in the case of primary qualities and our ideas of them they allow for an apparently seamless transition from intuitive ideas to mathematical entities.

Some may object that Husserl's rejection of an ontological primacy of mathematical abstractions only contradicts a rationalistic conception of reality, but not empiricism. Locke, for instance, affirms that he is making only a hypothesis about the world, the "corpuscularian hypothesis." There is no a priori certainty about its correctness; the corpuscularian hypothesis may only a posteriori turn out to be the "best" possible explanation of secondary qualities. But Husserl's critique is not directed at the problem of supposing that a theory is hypothetical, or thinking that it is a priori justified. Rather, he rejects an assumption common to rationalists and empiricists, namely that the mathematical description approximates the world in

itself, even when the subtraction is a “hypothetical subtraction.”¹⁵⁷

Husserl doesn't think that secondary qualities are the fundament for primary qualities; that would ignore the fundamentally important experiences such as those of forms and space. In early modern terminology, we may say that Husserl thinks that both primary and secondary qualities are founded in our ideas of them. But that would not do justice to Husserl's much more elaborated account. There is not enough space to describe it extensively, but I hope that the following rudimentary description elucidates what kind of notion of experience Husserl is after in his attempt to overcome the misunderstandings he diagnoses in the early modern concept of the world.

¹⁵⁷ See section 7.2.

7 The overlooked life-world and the resulting crisis

The first part of the current work showed that modern philosophers tried to conceive of nature itself in mathematical terms. The second part so far showed how Husserl's concept of the mathematization of nature explains why the same nature that is the cause of our experiences seems to be mathematical in its inner structure: because mathematization techniques allow an apparently seamless transition from intuitive experience to mathematically ideal and formal entities. The current chapter is concerned with what Husserl thinks has been forgotten in mathematization and needs to be recovered—the life-world—, and with what he takes to be the consequences of the forgetfulness.

With his concept of the life-world, Husserl picks up and elaborates earlier concepts. The “natural attitude” (*natürliche Einstellung*) in *LI* was the ordinary mode of consciousness, according to which the world exists in exactly the way it appears. Husserl believes that phenomenology needs to overcome the natural attitude (*natürliche Einstellung*) and, instead of considering the *things* experienced, it should investigate *how* they are given to experience. In *Ideas*, Husserl uses the term “imaginatio,” qualified by the adjectives “Cartesian” or “sensual,” to refer to the experience of the world that is “subtracted”¹⁵⁸ by physical theory. Because all

¹⁵⁸ “substruieren” (*Ideas* I, p. 114)

physical truth is an explication of the same things that are experienced in the *imaginatio*, the physical world depends on the *imaginatio*, while the *imaginatio* would exist in the same way even if there were different laws in the physical world, or if there would be no physical world at all.

Husserl's concept of the life-world develops these thoughts. Husserl believes that the mathematized world is conceived of in ideal terms, and that it is therefore radically different from intuitive experience. Since the mathematized world is derived from the life-world, it is absurd to expect that it can explain the totality of our experience. Rather, the life-world contains the experience that is presupposed in the distinction between primary and secondary qualities and the underlying mathematized concept of nature. With the concept of the life-world, Husserl does not only attempt to find the development of mathematization and the confusions that developed in it. The description of the importance he ascribes to experience in section 5.2 already suggested that one of Husserl's aims is a new account of experience itself. Husserl believes that the result of mathematization is a crippled notion of intuitive experience, and he attempts to show a different way of understanding it, a way that opens up the whole realm of subjectivity that is the foundation of all science. Let's first consider the reason why, according to Husserl, the mathematization prevented an understanding of intuitive experience, and then turn to Husserl's own concept of intuitive experience.

7.1 Husserl's call for a new concept of experience reconsidered

The modern concept of the world permits only certain types of experiences to represent real qualities in an unmediated way, namely ideas of primary qualities. The existence of ideas of secondary qualities is not denied; even eliminativists usually recognize that they exist, and dispositionalists even consider them to be a necessary part of the definition of secondary qualities. Those who think that there is something coherent about our ideas of secondary qualities usually agree to a notion of experience alike that expressed in the concept of “qualia,” which alleges that there is a “what it’s like” to ideas of secondary qualities. Normally, the point of contention comes down to whether the notion of a “what it’s like” should or should not be an essential part of scientific explanation. But, setting aside this question, what is important for us here is that even if the notion of qualia were an established part of scientific explanation, under Husserl’s account that notion would still cripple the concept of intuitive experience.

The crippling element is that ideas of secondary qualities are conceived of as being purely subjective. Their “what it’s like” is claimed to be intimately known to the respective perceiver, but it could be different for different perceivers (“inverted qualia”), or even nonexistent (“zombies”). The word “qualia” was not a buzzword in Husserl’s time, but the notion that ideas of secondary qualities have a subjective character that is in the observer and not in the world has been around since Galileo.

Husserl speaks of “Galileo’s famous doctrine of the merely subjective character of the specific sense-qualities,”¹⁵⁹ which is the other side of “Galileo’s mathematization of nature.”¹⁶⁰ Mathematization is a guide for dividing primary and secondary qualities, so that the ideas of primary qualities become elevated to a level of true representations, while secondary qualities are reduced to a level of relativity to a subject.

Husserl’s attempt to undermine the apparently self-evident notion that ideas of secondary qualities must be caused by configurations and movements of primary qualities is only the negative side of his account of experience. There is as well a positive side: Husserl tries to establish a view of intuitive experience that doesn’t reduce it to a merely subjective character. The citation from the beginning of Chapter 5, in which Husserl declares that “we cannot have an a priori insight that every change of specific qualities of intuited bodies which can be experienced, or is conceivable in every actual and possible experience, is causally dependent on occurrences in the abstract shape-stratum of the world” comes directly after a short discussion of those general features of the world of experience that can be known a priori. Husserl writes that intuitive experience follows an “a priori anticipation”¹⁶¹ of the “invariant, general style of being to which the intuited world, in its unending

¹⁵⁹ *Crisis*, 54, *Krisis*, 54.

¹⁶⁰ *Krisis*, 20.

¹⁶¹ *Krisis*, 34.

change, adheres.”¹⁶²

Husserl lists several examples, starting with the “form of space-time,”¹⁶³ by which he means space and time in the way it is experienced, in contrast to a mathematically ideal or formal concept of space and time. Husserl also thinks that every concrete experience of a real body entails the a priori anticipation that forms and fillings require each other; they are different aspects of the same “concretum” of which the aspects of form or filling can be abstracted after the concretum is experienced as a whole. According to Husserl, there is a “universal concrete causality” in the intuitive world. This causality is not the particular causality of some science, or the “universal idealized causality”¹⁶⁴ of physical science, but the causation that can appear to us in concrete experience. The a priori anticipation is that “*every change*, whether it involves aspects of shape or of plenum, occurs according to certain causalities, immediate or mediate, which make it necessary.”¹⁶⁵

The universality of the a priori anticipations points towards Husserl’s claim that experience is always embedded in a whole of possible experiences. Every concrete experience stands in the context of an infinite number of other possible experiences that connect anything that can be experienced. Every concrete experience is embedded in other possible experiences; it stands in the “endlessly open

¹⁶² *Crisis*, 35; *Krisis*, 34.

¹⁶³ *Crisis*, 35; *Krisis*, 34.

¹⁶⁴ *Krisis*, 38.

¹⁶⁵ *Crisis*, 35-6; *Krisis*, 34.

horizon”¹⁶⁶ of other experiences that form the world. The world is that which can be intuitively experienced. Husserl is thus not only concerned with the intentional correlates of individual experiences, but with the whole world of human experience. It is this world of concrete and implicitly anticipated intuitive experience that Husserl calls the “life-world.”

The life-world is the world of intuitive experience, but in contrast to modern notions of intuitive experience, such as those expressed in the concept of qualia, Husserl thinks that intuitive experience is not simply a “what it is like” that could be different for each observer. Instead, he thinks of intuitive experience as structured by a priori anticipations such as those of the intersubjective world. Husserl claims that the concept of the life-world has a foundational role for all possible science. That claim stands in stark opposition to the concept of subjectivity as being caused in the more fundamental world of science.

¹⁶⁶ *Krisis*, 38.

7.2 The origin of all abstraction: the life-world

Husserl's idea of the relation between ordinary experience and science is diametrically opposed to the modern picture of the world. Modern philosophers think that the mathematically structured world that is investigated in science is the world that exists regardless if there is intuitive experience or not, and that it is that what precedes and causes intuitive experience. Husserl, in contrast, conceives of the world of science as an abstraction from the world given in intuitive experience. According to him, particular causalities, such as the idealized causalities investigated in physical science, are founded in the very world that concretely appears to us. Julian Nida-Rümelin expresses Husserl's idea pointedly when he writes that "realism and objectivity enter the scientific models in the extent in which they are connected to the life-world, and only in this extent."¹⁶⁷ According to Husserl, even a priori truth has a "necessary reference back to a corresponding a priori of the life-world. This reference-back is one of a founding of validity."¹⁶⁸ Without the reference back to the life-world, all truth, even a priori truth, has no validity.

Husserl believes that the concrete manifestations of the life-world are relative to culture, and he is very aware of the question whether this means that the alleged

¹⁶⁷ "Realismus und Objektivität kommen in die wissenschaftlichen Modelle in dem Maße, in dem sie eine Anbindung haben an die Lebenswelt, und nur in diesem Maße." (Julian Nida-Rümelin *Philosophie und Lebensform* (Frankfurt: Suhrkamp, 2009): 72)

¹⁶⁸ *Crisis*, 140. "[A]lles objektive Apriori, in seiner notwendigen Rückbezogenheit auf ein entsprechendes lebensweltliches Apriori. Diese Rückbezogenheit ist die einer Geltungsfundierung." (*Krisis*, 143)

foundation is in fact a shaky ground. Husserl writes that the life-world “is the spatiotemporal world of things as we experience them in our pre- and extrascientific life and as we know them to be experienceable beyond what is [actually] experienced,”¹⁶⁹ but he concedes that things are relative to their use and meaning in a culture, and that the truths of one culture are not necessarily the same for other cultures. But trying to list truths that are shared by all cultures is not an option either, for this would mean to go beyond the limits of the “pure life-world,”¹⁷⁰ and it would at best lead to the same kind of truths that are the aim of “objective” science. The goal of Husserl’s investigation of the life-world is, in contrast, to reveal its “*general structure*,”¹⁷¹ which is the same structure of space, time, and causality that is investigated in science. In difference to those of science, such structures are given in the life-world in the way in which they are intuitively experienced; they are not mathematically exact and ideal, and they are not part of the world “in itself.” Husserl states that the “categorical features of the life-world have the same names but are not concerned, so to speak, with the theoretical idealizations and the hypothetical substructions of the geometrician and the physicist.”¹⁷²

¹⁶⁹ *Crisis*, 138. “ist die raumzeitliche Welt der Dinge, so wie wir sie in unserem vor- und außerwissenschaftlichen Leben erfahren und über die erfahrenen [Dinge] hinaus als erfahrbar wissen” (*Krisis*, 141)

¹⁷⁰ *Crisis* 139. “reine Lebenswelt” (*Krisis*, 142)

¹⁷¹ *Crisis*, 139. “allgemeine Struktur” (*Krisis*, 142)

¹⁷² *Crisis*, 140. “Das Kategoriale der Lebenswelt hat die gleichen Namen, aber kümmert sich sozusagen nicht um die theoretischen Idealisierungen und hypothetischen Substruktionen der Geometer und Physiker.” (*Krisis*, 142-3)

According to Husserl, the world of intuitive experience is the world we experience in everyday life, before and after all theorizing, and it is not changed by whatever theories we apply to it. It is given independent of all theory, even though Husserl admits that theory frequently changes the life-world, for example by technical machines used in the life-world, and by concepts that become assimilated in the life-world from scientific theories.¹⁷³ Most modern philosophers would agree that the world is given before all theorizing, but they think that scientific theory explains precisely the world that is given. For them, the world in itself is mathematically structured and intuitive experience is one way of relating to the world in itself, while Husserl thinks that mathematical structuring presupposes the world of intuitive experience. For him, modern science explains a world that is already mathematized, and erroneously thinks that it is the world in itself. For most modern philosophers, intuitive experience of secondary qualities stands between the world, and us, while mathematical sciences can directly relate to the world. For Husserl, intuitive experience can directly relate to the world, while the mathematical sciences are built upon the intuitively experienced life-world.

Husserl agrees with most modern philosophers that it would not make sense to assume that the world investigated in science is without relation to the world of intuitive experience; these are not two hermetically enclosed worlds. But Husserl and

¹⁷³ Cf. e.g. *Krisis*, 142-3.

most early modern philosophers disagree over the direction of dependence. The primary-secondary quality distinction presupposes that the world as it is intuitively experienced is dependent on the world as it is explained in science, while Husserl conversely maintains that the mathematized world of science is dependent on the intuitively experienced world. The modern picture of the world entails that intuitive experience is at best supervenient, i.e., that any change of intuitive experience is dependent on changes of primary qualities. Husserl, in contrast, maintains that primary qualities are idealizations and formalizations from intuitive experience, and as such are inapt to completely explain intuitive experience.

According to the primary-secondary quality distinction, everything in the world is determined in itself. For Husserl, everything in the world is the result of determinations executed upon intuitive experience. The objects of the world are not given as things that are independent of our experience. Rather than being a mere cause of the manifold of actual and possible intuitive experiences, the manifold of actual and possible intuitive experiences constitutes all objects. Husserl calls the total of all possible intuitive experience, regardless of whether it is veridical or not, simply “subjectivity”¹⁷⁴ (*Subjektivität*). In contrast to the position he calls “objectivism” (*Objektivismus*),¹⁷⁵ he holds: “what is primary in itself is subjectivity.”¹⁷⁶ Husserl’s

¹⁷⁴ *Krisis*, 70.

¹⁷⁵ *Krisis*, 71.

¹⁷⁶ “das an sich Erste ist die Subjektivität” (*Krisis*, 70). Cf. *Crisis*, 69.

concept of the life-world is his late attempt to understand the structures of intuitive experience overlooked by objectivism.

Understanding the structures of intuitive experience is, of course, not a new project for Husserl. The *LI* are such an attempt, and its apparent shortcomings led Husserl, in *Ideas*, to advocate the same project in the new form of “transcendental idealism.” In *Ideas*, Husserl supports the opposition of transcendentalism to objectivism, which he alleges to have existed since the beginning of modern philosophy and the rise of epistemological investigations into the conditions of subjective experience. But after *Ideas*, Husserl came to believe that transcendentalism itself is plagued by an apparent emptiness of central concepts, such as the transcendental ego, if they are not sufficiently related to the life-world. Husserl puts forward such a critique not only against other transcendental philosophers, but also against his earlier approach to transcendental philosophy in *Ideas*:

I note in passing that the much shorter way to the transcendental *ἐποχή* in my *Ideas toward a Pure Phenomenology and Phenomenological Philosophy*, which I call the “Cartesian way” (since it is thought of as being attained merely by reflectively engrossing oneself in the Cartesian *ἐποχή* of the *Meditations* while critically purifying it of Descartes’s prejudices and confusions), has a great shortcoming: while it leads to the transcendental ego in one leap, as it were, it brings this ego into view as apparently empty of content, since there can be no preparatory explication; so one is at a loss, at first, to know what has been gained by it, much less how, starting with this, a completely new sort of fundamental science, decisive for philosophy, has been attained. Hence also, as the reception of my *Ideas* showed, it is all too easy

right at the very beginning to fall back into the naïve-natural attitude—something that is very tempting in any case.”¹⁷⁷

Here, Husserl doesn't declare that the approach he pursued in the *Ideas I* and his *Cartesian Meditations*¹⁷⁸ is false. But he thinks that it made it easy to misinterpret him and that it has prevented his recipients from overcoming the “naïve-natural” attitude. He thinks that the fault lies in his insufficient explication of how the “transcendental ego” can be reached in an investigation that ultimately needs to start from the “natural world-life.”¹⁷⁹ This resulted in an “apparent lack of content,” which is supposed to explain why many of his readers were clueless as to how this could lead to a completely new and, for philosophy, foundational science. Husserl introduces the concept of the life-world not only not only to clarify the meaning of concepts that had become enigmatic because of the objectivistic forgetfulness of life-worldly experience, but also to elucidate and make understandable the meaning of the

¹⁷⁷ *Crisis*, 155. “Ich bemerke nebenbei, daß der viel kürzere Weg zur transzendentalen Epochē in meinen ‘Ideen zu einer reinen Phänomenologie und phänomenologischen Philosophie,’ den ich den ‘cartesianischen’ nenne (nämlich als gewonnen gedacht durch bloße besinnliche Vertiefung in die Cartesianische Epochē der ‘Meditationes’ und durch kritische Reinigung derselben von den Vorurteilen und Verirrungen Descartes’s) den großen Nachteil hat, daß er zwar wie in einem Sprunge schon zum transzendentalen ego führt, dieses aber, da jede vorgängige Explikation fehlen muß, in einer scheinbaren Inhaltsleere zur Sicht bringt, in der man zunächst ratlos ist, was damit gewonnen sein soll, und gar, wie von da aus eine neue und für eine Philosophie entscheidende, völlig neuartige Grundwissenschaft gewonnen sein soll. Daher erliegt man auch, wie die Aufnahme meiner ‘Ideen’ gezeigt hat, allzuleicht, und gleich bei den ersten Anfängen, den ohnehin sehr versucherischen Rückfällen in die naiv-natürliche Einstellung.” (*Crisis*, 157-8)

¹⁷⁸ Edmund Husserl, *Cartesianische Meditationen und Pariser Vorträge*, ed. S. Strasser (Den Haag: Martinus Nijhoff, 1950). He might not mention them in the above passage because, at the time of his writing on the *Crisis*, they had not been published in German.

¹⁷⁹ “natürliches Weltleben” (*Crisis*, 156)

concepts he uses in his phenomenological form of “transcendental subjectivism” (*transzendentaler Subjektivismus*), which he claims to be the “*final form* of transcendental philosophy.”¹⁸⁰

Husserl’s concept of the life-world has, of course, predecessors in Husserl’s earlier philosophy. In *Ideas I*, for instance, Husserl doesn’t use the term ‘life-world,’ but he does speak of “natural world,” and “natural life,” and it is not far-fetched to collocate both terms into ‘natural life-world,’ or just ‘life-world.’ Husserl starts the investigations in *Ideas I* with the “natural attitude” and the corresponding “natural world,” which he also simply calls “world.” In *Ideas I*, too, Husserl’s concept of the “natural world” is directed against the early modern concept of the world; one example is his detailed discussion of the primary-secondary quality distinction.

It would go to far to discuss in sufficient detail either Husserl’s notion of transcendental philosophy before the *Crisis*, or the later variant of transcendental philosophy that entails an investigation of the concept of the life-world.¹⁸¹ But the investigation into Husserl’s account of mathematization and experience in his *Crisis* still needs to be related to Husserl’s notion of science and what he calls the “crisis of

¹⁸⁰ *Crisis*, 70; “*Endform* der Transzendentalphilosophie” (*Krisis*, 71)

¹⁸¹ The objective stated in the introduction was merely to show that Husserl’s attempt to find a new framework of experience in *Crisis* is motivated by his critique of the reduced concept of subjective experience in the mathematization of nature. For an in-depth study of Husserl’s notion of the transcendent world and the transcendental ego in his *Ideas I*, see Abe Stone “On Husserl and Cavellian Skepticism, With Reference to the Thomistic Theory of Creation” (PhD diss., Harvard University, 2000).

the European sciences.” The life-world is supposed to be subjective-relative, and, nevertheless, it is alleged to have a universal structure. The concept of the life-world is Husserl’s late attempt to find a place for subjectivism beyond the two extremes, which together seem to fill the whole space of logical possibilities. On the one side, there is the already mentioned objectivism,¹⁸² and on the other there is relativism, according to which there is no way to transcend relative positions beyond that what is common to the respective positions. But, according to Husserl, objectivism and relativism are like two sides of the same coin. The next section shows that Husserl promoted the idea that they are expressions of the same fundamental concept of science well before the *Crisis*, and even before he turned towards transcendental philosophy.

¹⁸² In contemporary philosophy, the related concept of ‘naturalism’ is more commonly used, and Husserl’s concept of the life-world is frequently used to reject naturalism; see e.g. Julian Nida-Rümelin “Reasons Against Naturalizing Epistemic Reasons: Normativity, Objectivity, Non-computability,” ed. A. Carsetti *Causality, Meaningful Complexity and Embodied Cognition* (Dordrecht: Springer, 2010): 203-210.

7.3 Philosophy as rigorous science between “positivism” and “historicism”

Husserl developed the idea that the contradicting positions of objectivism and relativism are expressions of the same fundamental notion long before *Crisis*, most prominently in his 1911 article *Philosophy as Rigorous Science*, but also in his *Kaizo-paper* and *Fichte’s ideal of humanity*.¹⁸³ He there deems philosophy to have an obligation to respond to a fundamental need of human life, and that the two opposite attempts of finding an answer in fact exclude the possibility of any answer. In *Philosophy as Rigorous Science*, he writes:

Far more than this, it is the most radical vital need that afflicts us, a need that leaves no point of our lives untouched. All life is taking a position. ... Naturalists and historicists fight about *Weltanschauung*, and yet both are at work on different sides to misinterpret ideas as facts and to transform all reality, all life, into an incomprehensible, idealess confusion of “facts.” The superstition of the fact is common to them all.¹⁸⁴

Husserl doesn’t use the term “crisis” in *Philosophy as Rigorous Science*, but his

¹⁸³ Husserl, Edmund 1989 Kaizo-Artikel, in Thomas Nenon und Hans Rainer Sepp (eds.) *Aufsätze und Vorträge (1922-1937)*. Husserliana XXVII, Dordrecht: Kluwer, 3-94. *Fichte’s ideal of humanity*: Husserl, Edmund 1987 “Fichtes Menschheitsideal,” in Thomas Nenon & Hans Rainer Sepp (eds.) *Aufsätze und Vorträge (1911-1921)*. Husserliana XXV. Dordrecht: Kluwer, 267-293.

¹⁸⁴ Translation by Quentin Lauer in Husserl, Edmund *Phenomenology and the Crisis of Philosophy*, trans. Quentin Lauer. New York: Harper & Row, 1965. Original text: “Es ist vielmehr die radikalste Lebensnot, an der wir leiden, eine Not, die an keinem Punkte unseres Lebens haltmacht. Alles Leben ist Stellungnehmen. ... Naturalisten und Historizisten kämpfen um die Weltanschauung, und doch sind beide von verschiedenen Seiten am Werk, Ideen in Tatsachen umzudeuten und alle Wirklichkeit, alles Leben in ein unverständliches ideenloses Gemenge von ‘Tatsachen’ zu verwandeln. Der Aberglaube der Tatsache ist ihnen allen gemein.” (*Philosophy as Rigorous Science*, 56)

diagnosis of the time he lives in resembles very much that of *Crisis*. He believes that Western societies are in need of scientific orientation, but that the modern concept of science excludes the possibility of genuinely addressing that need. “Positivism” and “historicism” seem to stand on opposite grounds: positivists claim that we should not try to find reason beyond the positive facts investigated in science, and historicists counter that because science is limited to positive facts, it cannot say anything about the most important questions of life, which are relative to history and culture. But, according to Husserl, positivism and historicism are just different responses to the same basic idea that objective science can investigate only positive facts.

Besides “positivism,” Husserl uses the concepts “naturalism“ and “objectivism” in *Philosophy as a Rigorous Science*, although not in the same meaning as he uses them later. Their protagonists are *not* scientists when engaging in their specific scientific research. Rather, they are people—sometimes the very same scientists—who philosophize about ontological and metaphysical questions and take them to be reducible to the methodological logic and empirical data of positive science. Husserl objects that nevertheless that “the naturalist teaches, preaches, moralizes, reforms,”¹⁸⁵ and it is indeed not difficult to see such tendency in popular naturalists such as Ernst Haeckel and Wilhelm Ostwald.¹⁸⁶ Husserl objects that this

¹⁸⁵ “der Naturalist lehrt, predigt, moralisiert, reformiert” (*Philosophy as Rigorous Science*, 296)

¹⁸⁶ Both were renowned scientists who, in addition to their scientific worldview, propagated the replacement of religion with a form of materialistic monism. Besides in numerous publications their

contradicts the original idea of “naturalism” and maintains that “naturalistic” moralizing is self-defeating.

The other side Husserl is opposed to in *Philosophy as a Rigorous Science* is populated by adherents of “relativism,” “skepticism,” “historicism” and “Weltanschauungsphilosophie.” They oppose naturalism, but, according to Husserl, they share with naturalism the belief that philosophical questions that go beyond scientific facts are a matter of opinion of individual subjects or groups. They agree with objectivists in that science is applicable to positive facts only, but their conclusion is not that everything else should be excluded from philosophy. On the contrary, Husserl criticizes them for trying to make philosophy altogether a matter of subjective conviction. He laments that they do not allow for objective truth in philosophy, and make it a matter of taste, personal preference, or opinion. The problems naturalists run into when explaining anything beyond positive facts caused the historicists not to a reform of the quest for objective truth, but to an dismissal of the “methodological aim”¹⁸⁷ of a scientific philosophy altogether. Husserl believes that they throw out the baby with the bath: the desired scientific rigor together with the undesired reductionism. The result is that science is a “residual concept”¹⁸⁸ of

public engagement expressed for example in the *Deutsche Monistenbund*, which Haeckel founded in 1906 and Ostwald led 1911-1915. This movement may be compared to the current “New Atheism” of people like Daniel Dennett or Richard Dawkins.

¹⁸⁷ “methodisches Ziel” (*Philosophy as Rigorous Science*, 295)

¹⁸⁸ “Restbegriff” (*Krisis*, 7)

what was once an “all-entailing science.”¹⁸⁹

For Husserl, both answers to the apparent difference in progress between natural science and others are premature. In contrast to the “historicists,” he believes that questions of the meaning of life should not be excluded from scientific investigation. In contrast to the “positivists,” he believes that questions of meaning for life should not be reduced to positive science. Husserl states that, as a whole, science is a realization of reason and would ultimately be reason itself:

In the whole life of modernity there is perhaps is no idea that is more powerfully advancing than that of science. Nothing will inhibit its run of victory. In ideal completion it would be reason itself, which could have no authority above itself.¹⁹⁰

Husserl doesn't want to reduce philosophy to science, but to extend science into philosophy: The method of scientific reasoning should not be limited to positive science, but used for all questions of self-determination of humanity, be it in the descriptive or in the normative sense. For Husserl, the purpose of philosophy is to guide humans through their life. This is not meant in an individualistic manner, but with the help of generally obligating principles and norms. Philosophy should “enable

¹⁸⁹ “allumfassende Wissenschaft” (ibid.)

¹⁹⁰ “Vielleicht gibt es im ganzen neuzeitlichen Leben keine mächtiger vordringende Idee als die der Wissenschaft. Ihren Siegeslauf wird nichts hemmen. In idealer Vollendung wäre sie die Vernunft selbst, die neben und über sich keine Autorität mehr haben könnte.” (*Philosophy as Rigorous Science*, 269)

a life that is regulated by norms of pure reason in an ethical-religious respect.”¹⁹¹

Husserl’s phenomenology is usually thought to be purely theoretical and descriptive, rather than normative. But he is not only in his lectures on ethics concerned with ethical questions,¹⁹² he also thinks of philosophy itself as a project necessary for human self-understanding and self-determination. Much of his writing is not directly concerned with answers to ethical problems, but rather with the confusions that have made it impossible to treat ethical problems in philosophy, and with recovering a way to make them treatable. In the *Crisis*, he claims that philosophy is the form of reason needed for human self-determination: “the ‘philosophical’ form of being: the free self-determination of oneself, one’s life, one’s rule from pure reason, from philosophy.”¹⁹³ Philosophy can become “pure reason” only if it becomes a rigorous science, and that means to overcome the apparent dichotomy between objectivism and relativism.

In the *Crisis*, however, Husserl seems to question the project of philosophy as rigorous science when he, in a frequently quoted statement, writes that “[p]hilosophy as science, as seriously rigorous, indeed apodictic rigorous science—this dream is

¹⁹¹ “in ethisch-religiöser Hinsicht ein von reinen Vernunftnormen geregeltes Leben ermöglichen” (*Philosophy as Rigorous Science*, 289)

¹⁹² Cf. e.g. Edmund Husserl *Einleitung in die Ethik*. Vorlesungen Sommersemester 1920 and 1924, ed. Henning Peucker (Dordrecht, Boston, London: Kluwer, 2004). (Husserliana XXXVII)

¹⁹³ “[D]ie ‘philosophische’ Daseinsform: das frei sich selbst, seinem ganzen Leben, seine Regel aus reiner Vernunft, aus der Philosophie Geben.” (*Crisis*, 5)

over.”¹⁹⁴ This exclamation is often interpreted to show Husserl’s resignation, for example by Wilhelm Szilasi in his postscript to a new edition of *Philosophy as Rigorous Science*.¹⁹⁵ Subsequently, there developed a discussion on the question of whether or not Husserl’s alleged resignation was justified,¹⁹⁶ or not.¹⁹⁷

But the above citation is more likely to be interpreted not as Husserl’s own opinion, but as a mocking of the position of his critics, as pointed out by Janssen¹⁹⁸ and others. The latter interpretation stands in accordance with Husserl’s remarks in the beginning of the *Crisis*, where he still wants philosophy to be a rigorous science. He claims that the apparent failure is not essential to rationalism, but that it is due to the reductive concept of rationalism. In fact, the crisis itself is a symptom of the apparent failure, as Husserl claims in his Vienna lecture “Philosophy in the Crisis of European Humanity”¹⁹⁹:

The “crisis” could then become distinguishable as the apparent failure of rationalism. The reason for the failure of a rational culture, however, as we

¹⁹⁴ “*Philosophie als Wissenschaft*, als ernstliche strenge, ja apodiktisch strenge Wissenschaft—*der Traum ist ausgeträumt*” (*Krisis*, 508)

¹⁹⁵ Wilhelm Szilasi “Nachwort,” in Edmund Husserl *Philosophie als Strenge Wissenschaft*. ed. Wilhelm Szilasi (Frankfurt: Klostermann, 1965).

¹⁹⁶ Thomas Friedrich *Bewusstseinsleistung und Struktur: Aspekte einer phänomenologisch-strukturalistischen Theorie des Erlebens* (Würzburg: Königshausen & Neumann, 1999), 22.

¹⁹⁷ Szilasi “Nachwort,” 101.

¹⁹⁸ Paul Janssen, *Geschichte und Lebenswelt: Ein Beitrag zur Diskussion der Husserlschen Spätphilosophie* (Köln: Gouder and Hansen, 1964), 96.

¹⁹⁹ German title: “Die Philosophie in der Krisis der Europäischen Menschheit.” The lecture was a first version of the Prague lectures, presented six months later, which Husserl in turn worked into the beginning of the *Krisis*. According to Biemel’s introduction, Husserl held the Vienna lecture twice, on the May, 7 and 10, 1935, and the first of four Prague lectures on November 14.

said, lies not in the essence of rationalism itself but solely in its being rendered superficial, in its entanglement in “naturalism” and “objectivism.”²⁰⁰

Husserl affirms the idea that rationalism should guide human life, but he turns against its reduction to the superficiality that stems from its “entanglement” in “naturalism” and “objectivism.” Here, Husserl follows up on the notion of *Philosophy as Rigorous Science*, according to which positivism applies reason only to the world of one special science (physics), and forgets about other problems of human self-determination. In the *Crisis*, Husserl develops this thought further, and puts it in a new framework of historical development.

²⁰⁰ *Crisis*, 299. “Die ‘Krise’ konnte dann deutlich werden als das *scheinbare Scheitern des Rationalismus*. Der Grund des Versagens einer rationalen Kultur liegt aber—wie gesagt—nicht im Wesen des Rationalismus selbst sondern allein in seiner *Veräußerlichung*, in seiner Versponnenheit in ‘Naturalismus’ und ‘Objektivismus.’” (*Krisis*, 347)

7.4 The concept of “crisis” and Husserl’s “historical a priori”

This section argues that Husserl’s notion of “crisis” is an expression of his later historical framework of philosophical study. For the contemporary reader, the thesis that the concept of “crisis” is historical may seem strange. Is not a crisis a state; is not “to be in a crisis” synonymous with “to be in a state of crisis”? But a state of crisis is not a mere state. Rather, it is a state that is what it is only by its relation to its past and its future. A crisis is a state in the development of a history, and it presupposes a specific idea of the history of what is in a state of crisis, or so I argue in this section.

In contemporary usage, neither the notion of history that underlies the term “crisis,” nor that term itself are likely to appear important. The term is so widely and frequently used that it seems like virtually any noun can denominate something that can fall into a state of crisis. To name only a few examples from a random selection of online news headlines: Euro crisis, Midlife crisis, Oil Crisis, Climate crisis, Asian turtle crisis. Umberto Eco summarizes the inflationary use of this term in an essay from 1980 in three words: “Crisis sells well.”²⁰¹ It would go too far to suggest that this is the very reason why the title of his essay itself implies that beyond all other talk of crisis there has to be added yet another crisis, a meta-crisis: “On the Crisis of the Crisis of reason.” But the doubling of crisis in the title bears an irony, for Eco himself acknowledges that already the meaning of the first crisis (the crisis of reason)

²⁰¹ Umberto Eco, “On the Crisis of the Crisis of reason,” id. *Travels Into Hyper-Reality* (1986): 126.

is unclear when he states: “even admitting the considerable age of the crisis, I still don’t understand what the hell it means.”²⁰²

While the alleged “Crisis of reason” may be old, the cornucopian use of the concept of “crisis” is not. The German, French, and English uses derive from Latin “crisis,” which itself goes back to the Ancient Greek *κρίσις*. This noun is, like “critique,” a derivation of the Ancient Greek verb *κρίνειν*, which signifies to tell, distinguish, judge, or to decide a case.²⁰³ The first widespread use of “crisis” was to denote a critical medical condition. Physicians believed that when the fever had risen to a certain point the patient was in an unstable state that would necessarily result in one out of two possible outcomes. Either, due to the intervention of a doctor, the fever could be lowered, and the patient would recover. Or, the fever would continue to rise and the patient would soon die. “Crisis” in the medical sense thus denoted a short but decisive time span that determined recovery or death. According to Reinhart Koselleck in *Critik und Crisis*,²⁰⁴ it was Jean-Jacques Rousseau who, in *Émile, Or*

²⁰² Ibid., 127

²⁰³ Most etymological dictionaries trace the German concept “Krisis,” or, in the today’s more common spelling, “Krise,” back to the sixteenth century. The latter term is probably derived from the French “crise.” There is no plural for the German “Krisis,” but we can use the more recent term “Krise” in the plural form (“Krisen”), which coincides with today’s extensive applicability of the term. Husserl uses both “Krisis” and “Krise” interchangeably, and uses the plural form of “Krisen” only on three instances (*Crisis*, 207, 216, and 356). At each instance, the word “Krisen” is used in connection with the science of Psychology.

²⁰⁴ Koselleck, Reinhart. *Kritik und Krise: Eine Studie zur Pathogenese der bürgerlichen Welt*. Freiburg, München: Karl Alber, 1959, 133.

Treatise on Education,²⁰⁵ first uses “crisis” in a political, historic, philosophic, and prognostic sense. Koselleck notes that in Rousseau on the concept of “crisis” became an essential part of bourgeois conceptions of history. Koselleck concludes that the concept of crisis is a concept that implies a history:

It is part of the essence of a crisis that a decision is due, but not yet determined. ... The possible solution is uncertain, but the humans know for certain that there is end, a transformation of the existing state of affairs—threatening and feared, or hopefully wished. The crisis evokes the question to the historical future.²⁰⁶

Koselleck describes the historical implications of “crisis,” which were only in rudimentary form implied in the medical sense, but which became amplified in the later political, historic, philosophic, and prognostic sense. More than a hundred years after *Émile*, the medical use continued to be prevalent, and the *Brockhaus* from 1866 still refers to the medical meaning only.²⁰⁷ But the concept of “crisis” in the political, historic, philosophic, and prognostic sense fits well to a prevalent mood in the early 20th century. An elucidating study on the different facets of the feeling of “crisis” and its underlying conception of history in the early twentieth century can be found in

²⁰⁵ Rousseau, Jacques. *Émile, ou De l'éducation*, 1782, http://fr.wikisource.org/wiki/Émile,_ou_De_l'éducation.

²⁰⁶ “Es liegt im Wesen einer Krise, daß eine Entscheidung fällig ist, aber noch nicht gefallen. ... Die mögliche Lösung bleibt ungewiß, das Ende selbst aber, ein Umschlag der bestehenden Verhältnisse—drohend und befürchtet oder hoffnungsfroh herbeigewünscht—ist den Menschen gewiß. Die Krise beschwört die Frage an die geschichtliche Zukunft.” (Koselleck, *Kritik und Krise*, 105)

²⁰⁷ Cf. Reinhart Koselleck, “Krise,” in *Geschichtliche Grundbegriffe: Historisches Lexikon zur politisch-sozialen Sprache in Deutschland*. 8 vol., ed. Brunner, Otto & Conze, Werner & Koselleck, Reinhart (Stuttgart: Klett-Cotta, 1972–1997), 628.

Hans Sluga's book *Heidegger's Crisis*.²⁰⁸ Sluga singles out "three historical preconditions for the emergence of a modern sense of crisis."²⁰⁹ Its possibility is conditioned by the first precondition, the invariant "present-directedness of human experience,"²¹⁰ which can become realized at any time in any culture, but is "activated only at those times and in those cultures that schematize their grasp of the world according to subjective experience."²¹¹

Sluga's second precondition for "crisis" is the idea of a disconnectedness between past and future, "that the heroized present comes to be seen as discontinuous, as sharply separated from the past as well as the future, and that time as a whole is conceived as a sequence of moments in which past and future appear over and over again as disconnected."²¹²

The third precondition Sluga describes is anxiety in a culture about the feeling of instability and the loss of confidence in its own powers. He points out that the concept of crisis "meant nothing to the thinkers of the Enlightenment"²¹³; they had too much trust in the powers of progress to develop a feeling of crisis. "Crisis" gained its political meaning only when doubts about its achievements became more

²⁰⁸ Hans Sluga *Heidegger's Crisis: Philosophy and Politics in Nazi Germany* (London: Harvard University Press, 1993).

²⁰⁹ *Op. cit.*, 67.

²¹⁰ *Ibid.*

²¹¹ *Ibid.*

²¹² Sluga, *Heidegger's Crisis*, 68.

²¹³ *Ibid.*, 69.

prominent. It is no coincidence that Rousseau, the great critic of Enlightenment, coined the political and social use of the term “crisis.” Germany, which was after the defeat of WWI in a virulent “identity crisis,” provided an especially fertile breeding ground for all kinds of sociopolitical and cultural crisis-talk. These three “historical preconditions”; the present-directedness of human experience (1), the concept of time as a sequence of moments in each of which past and future is disconnected (2), and a cultural anxiety (3), were surely part of the feeling of crisis in Husserl’s time.

By using the concept of “crisis,” Husserl does not only introduce a more explicit notion of history, but also a specific notion of history that implies a specific idea of past, present, and future. With regard to the past, there once was an apparently “healthy” state of science. The present is thought of as an unhealthy, unstable, and yet all-decisive state. There are allegedly only two possible outcomes for the European sciences in the future: demise or radical retransformation. By applying the concept of “crisis” to what Husserl calls “science,” his notion of science inherits a very special sense of history. The special sense is that the genesis of the scientific concept of the world (and the unintelligibility of subjective experience) can be analyzed in terms of an idealized past, a problematic and all-decisive present, and a future that has only two possible states. The analysis of the genealogy of the mathematization of nature in Chapter 5 and 6 is a study of Husserl’s detailed explanation of how the original meaning of the project of understanding the world by reason allegedly became entangled in confusions and is covered by new layers of interpretation. The genealogy

of the mathematization of nature unveils how a confused understanding of what constitutes the being of the things in the world distorts the project of a scientific understanding of the world and our relation to it. Due to the sedimentations, the full extend of the original project gets out of sight, and science becomes reduced to a technique of applying mathematics to experience. Husserl's message is that it is possible to recover the full extend of science, but that this requires intellectual work and there is an ominous risk of failure. With the birth of philosophy, so Husserl, an "entelechy" was inherited that already entails the "telos" (*Telos*; *τέλος*) of human self-determination. The present is the state in which either the old *telos* can be reawakened, or the project of human self-determination fails. Husserl is serious about the historical sense of the crisis of science, and he thinks it has serious implications for the future of humanity.

The fact that Husserl thinks that philosophy as a whole—not only "practical" but also "theoretical" philosophy—has a responsibility beyond the Ivory Tower of academia, is something appreciable. Yet, his formulation of the "crisis of the European sciences" today sounds rather pathetic and like a vast overestimation of the role of philosophy for human identity and self-determination. We are used to perpetual crises, including in mathematics, science, and society, and—for the better or worse—are less prone to be perturbed by foundational problems. Moreover, there are many questions concerning the notion of history that is suggested by it. Was there ever a healthy state of science? Is the present really the last chance to rescue the

meaning of science? What makes this crisis unique, or are there other similar states of crisis at different points of time? Some of the dramatic urgency conveyed by Husserl has to be understood in the context of his time, even though his answer is particular Husserlian.

Beyond the described general idea of history that is part of every conception of history in terms of “crisis,” in Husserl’s time this concept was charged with a more specific sense. Husserl acknowledges the latter when he declares that he is concerned with the “often treated topic of the European crisis.”²¹⁴ That topic was not necessarily discussed under the header of “crisis,” but the connotations of that term were all already given: the apocalyptic visions of the imminent end of the current order, the need for radical change, the need for an extreme reaction, and the idea of an all-or-nothing decision. In the description of the “crisis,” Husserl relates to the common feeling of crisis; his term “crisis” is a pithy name for a widespread notion of the state of society, culture, and science. Yet, his search for the causes of the crisis leads to a field very different from that of the usual advocates of crisis, and Husserl admits that from his initial remarks alone it is not clear how the development of philosophy had lead to the crisis:

I have advanced too quickly, in order to make felt the incomparable significance attaching to the clarification of the deepest motives of this

²¹⁴ “viel verhandelte Thema der europäischen Krise” (*Krisis*, 314)

crisis—a crisis which developed very early in modern philosophy and science and which extends with increasing intensity to our own day.”²¹⁵

This passage from page 14 is the last time Husserl uses the word “crisis” in the continuous text of the *Crisis*, apart from one instance in which he says that there are “always new crises” of natural sciences, and a “crisis of psychology.”²¹⁶ The crisis talk is restricted to the Vienna and Prague lectures and the very beginning of the *Crisis*, and it serves as an introduction to the problem that unfolds thereafter, namely the development that led to the state of science and philosophy of his time. Husserl dedicates hundreds of pages to the description of this development, and here he is very much concerned with details. While it is good to keep in mind that the development of philosophical problems is supposed to lead to the “crisis,” we do not have to follow Husserl’s specifically charged connotations of the concept of “crisis” to make sense of his account of the development and the misunderstandings that arise from it.

We should not overlook the fact that there was already another ongoing talk about a “crisis” on a topic Husserl was particularly interested in, namely the “foundational crisis of mathematics.” For instance, Hermann Weyl held talks at the

²¹⁵ *Crisis*, 16. “[I]ch bin schnell vorausgeeilt, um die unvergleichliche Bedeutung empfindlich zu machen, die einer Aufklärung der tiefsten Motive der Krisis zukommt, in welche die neuzeitliche Philosophie und Wissenschaft schon sehr früh hineingeraten ist und die sich in gewaltiger Steigerung bis in unsere Gegenwart forterstreckt.” (*Krisis*, 14)

²¹⁶ *Krisis*, 216. Cf. *Crisis*, 212.

“Mathematical Colloquium” in Zurich that were published in 1921 under the title “On the new foundational crisis of mathematics,”²¹⁷ and Husserl had surely heard the expression “foundational crisis of mathematics” from Weyl or others. Since the development of mathematics was an important part of the account of the “mathematization of nature,” which in turn allegedly leads to the misunderstanding of crucial philosophical concepts, the “foundational crisis of mathematics” may well have suggested to Husserl the term “crisis” for the alleged foundational crisis of science.

Possibly the most important point of Husserl’s application of the concept of crisis is that the “entanglement” of the modern concept of the world is part of the development of the very science and philosophy of our time. The entanglement is not something that could easily be avoided: neither by avoiding the topic, nor by avoiding it altogether to make assumptions. In *Philosophy as Rigorous Science*, Husserl mostly argues against positivism and historicism by pointing out that they go back to the same unwarranted thought that science is limited to positive explanation. In *Crisis*, Husserl shows much more empathy with the philosophical positions he criticizes. He still believes that such a limitation of science is wrong, but he argues in detail why the dichotomy between objective world and subjective-relative experience seems unavoidable. The problem he sees is not the application of mathematics in particular

²¹⁷ Weyl, Hermann “Über die neue Grundlagenkrise der Mathematik,” *Mathematische Zeitschrift* 10 (1921) 39-79.

science; mathematics can be a very useful tool for science, but it also can lead to fundamental misunderstandings. Husserl's aim is not to undo mathematization, but to show what it presupposes, and to reveal the hidden meaning of the terms that are misunderstood.

Husserl not only thinks that there are good reasons for taking either of the positions he tries to overcome, he also thinks that they cannot simply be overcome by presenting better reasons for his own position. The reason is that Husserl's and our own science and philosophy entails "sedimentations" (cf. e.g. *Crisis*, 73) of past thought. Because we, when we try to analyze the entanglement, stand ourselves on the modern understanding of science, we cannot take a view from the outside, and rather stand in a hermeneutical circle:

Thus we find ourselves in a sort of *circle*. The understanding of the beginnings is to be gained fully only by starting with science as given in its present-day form, looking back at its development. But in the absence of an understanding of the *beginnings* this development is mute as a *development of meaning*. Thus we have no other choice than to proceed forward and backward in a zigzag pattern; one has to help the other in an interplay.²¹⁸

Husserl's investigation of the historical roots of thinking is thus not a mere historical investigation, but an epistemological investigation into the meaning of the concepts

²¹⁸ *Crisis*, 58. Original: "Wir stehen also in einer Art *Zirkel*. Das Verständnis der Anfänge ist voll nur zu gewinnen von der gegebenen Wissenschaft in ihrer heutigen Gestalt aus, in der Rückschau auf ihre Entwicklung. Aber ohne ein Verständnis der *Anfänge* ist diese Entwicklung als *Sinnesentwicklung* stumm. Es bleibt uns nichts anderes übrig: wir müssen *im 'Zickzack'* vor- und zurückgehen; im Wechselspiel muß eins dem andern helfen." (*Krisis*, 59)

we are trying to understand, such as experience, the world, mathematics, logic, or philosophy itself. Husserl is interested in the genesis of such concepts; he is pursuing a genealogy in which the logical and historical meanings of such terms go together. In *The Origin of Geometry*, Husserl thus writes that “[t]he problem of genuine historical explanation comes together, in the case of the sciences, with ‘epistemological’ grounding or clarification.”²¹⁹ Husserl writes that he investigates the “historical apriori” (*historisches Apriori*).²²⁰

Luckily, we do not have to leave the interpretation of what Husserl means by terms such as “historical apriori” to further meta-philosophical consideration. Husserl himself shows what he means in the concrete instance of the mathematization of nature and the developments originating from it. The above interpretation of Husserl’s genealogy of the mathematization and my analysis of the different steps involved in it are intended to show that Husserl indeed puts his finger on a hidden but crucial part of the development of early modern thought that continues to shape philosophical discussions today, even when they appear to be purely systematic, such as those around dispositionalism, physicalism, projectivism, and eliminativism. I think that the details of Husserl’s account of the development of the mathematization of nature are also the best guide for further study of the mathematization, or

²¹⁹ *Crisis*, 373. “Das Problem der echten historischen Erklärung fällt bei den Wissenschaften mit der ‘erkenntnistheoretischen’ Begründung oder Aufklärung zusammen.” (*Krisis* 381)

²²⁰ *Krisis*, 381.

genealogical investigations into other domains.

Literature

All translations are mine except where otherwise noted. Spaced out print is replaced with *italics* in all citations.

- Aristotle. *Aristotle's Metaphysics*, ed. W.D. Ross. Oxford: Clarendon Press, 1953.
- Becker, Oskar. *Grundlagen der Mathematik in geschichtlicher Entwicklung*. Freiburg: Alber, 1954.
- Becker, Oskar. *Größe und Grenze der Mathematischen Denkweise*. Freiburg: Alber, 1959.
- Bennett, Jonathan. "Substance, Reality, and Primary Qualities." *American Philosophical Quarterly* 2 (1965): 1-17.
- Bennett, Jonathan. *Locke, Berkeley, Hume*. Oxford: Clarendon Press, 1971.
- Boghossian, Paul A. & Vellman, J. David. "Colour as a Secondary Quality." *Mind*, New Series, Vol. 98, No. 389 (Jan., 1989): 81-103.
- Bos, Henk J.M. *Redefining geometrical exactness: Descartes' Transformation of the Early Modern Concept of Construction*. New York: Springer, 2001.
- Boyle, Robert "The Origin of Forms and Qualities, According to Corpuscularian Philosophy," *The Works of the Honourable Robert Boyle in Six Volumes*, Vol. III. London: J. and F. Rivington, 1772.
- Brunner, Otto, Conze, Werner, and Koselleck, Reinhart (eds.). *Geschichtliche Grundbegriffe: Historisches Lexikon zur politisch-sozialen Sprache in Deutschland*. 8 vol., Stuttgart: Klett-Cotta, 1972–1997.
- Burt, Edwin. *The Metaphysical Foundations of Modern Physical Science*. London: Paul, Trench, Trubner, 1925.
- Byrne, Alex and David R. Hilbert. *Readings on Color. Vol. I: The Philosophy of Color*. Cambridge, Mass.: MIT Press, 1997.
- Cairns, Dorion *Guide for translating Husserl*. The Hague, M. Nijhoff, 1973.
- Campbell, Keith. "Primary and Secondary Qualities." *Canadian Journal of Philosophy* 2 (1972): 219-32.
- Democritus. "Fragments," ed. Hermann Diels *Die Fragmente der Vorsokratiker: Griechisch und Deutsch*, 1952.
- Descartes, René. *Œuvres de Descartes*, 11 vols., revised edition, eds. Charles Adam and Paul Tannery. Paris: Léopold Cerf, 1904-10.
- Descartes, René. "Dioptrics," transl. Paul Olscamp, *Discourse on Method, Optics, Geometry and Meteorology*. New York: Bobbs-Merrill, 1965. (AT VI)

- Diels, Hermann. *Die Fragmente der Vorsokratiker: Griechisch und Deutsch*. Berlin: Weidmann, 1952.
- Drake, Stillman. *Discoveries and Opinions of Galileo*, New York: Random House, 1957.
- Eco, Umberto. "On the Crisis of the Crisis of reason." *Id.*, *Travels Into Hyper-Reality*. (1986): 125-132.
- Friedrich, Thomas. *Bewusstseinsleistung und Struktur: Aspekte einer phänomenologisch-strukturalistischen Theorie des Erlebens*. Würzburg: Königshausen & Neumann, 1999.
- Galilei, Galileo. *Il Saggiatore*. Rome, 1623. http://it.wikisource.org/wiki/Il_Saggiatore.
- Grunwaldt, Hans Heinrich. *Ueber die Phänomenologie Husserls, mit besonderer Berücksichtigung der Wesensschau und der Forschungsmethode des Galileo Galilei*. Berlin: E. Ebering, 1927.
- Gurwitsch, Aron. "Husserlian Perspectives on Galilean Physics." *Phenomenology and the Theory of Science*. Evanston: Northwestern University Press (1974): 33-59. The chapter is a synthesis of "Comment on the Paper by H. Marcuse 'On Science and Phenomenology,'" in *Boston Studies in the Philosophy of Science*, Vol. II, ed. Robert S. Cohen and Marx W. Wartofsky, New York: Humanities Press, 1965, and "Galilean Physics in the Light of Husserl's Phenomenology," *Galileo, Man of Science*, ed. Ernan McMullin, New York: Basic Books, 1967.
- Hatfield, Gary. "The Cognitive Faculties." *Cambridge History of Seventeenth Century Philosophy*, ed. by M. Ayers & D. Garber, 953-1002. Cambridge: Cambridge University Press, (1998): 953-1002.
- Held, Klaus. "Husserl's These von der Europäisierung der Menschheit." Ed. Christoph Jamme & Otto Pöggeler *Phänomenologie im Widerstreit*. Frankfurt a. M.: Suhrkamp (1989): 13-39.
- Hilbert, David R. *Color and Color Perception*. Stanford: Centre for the Study of Language and Information, 1987.
- Hopkins, Burt C. *The Origin of the Logic of Symbolic Mathematics: Edmund Husserl and Jacob Klein*. Bloomington and Indianapolis: Indiana University Press, 2011.
- Hoy, David & Durt, Christoph. "What Subjectivity isn't." Ed. Jeff Malpas *The Hermeneutic Davidson*. MIT Press, 2011.
- Husserl, Edmund. *Cartesianische Meditationen und Pariser Vorträge*. Ed. S. Strasser. Den Haag: Martinus Nijhoff, 1950. (Husserliana I)
- Husserl, Edmund. *Die Krisis der europäischen Wissenschaften und die*

- transzendente Phänomenologie*. Edited by Walter Biemel. Den Haag: Martinus Nijhoff, 1962. (Husserliana VI)
- Husserl, Edmund. *Die Krisis der Europäischen Wissenschaften und die transzendente Phänomenologie: Ergänzungsband: Texte aus dem Nachlass 1934-1937*. Edited by Reinhold N. Smid. The Hague: Kluwer Academic Publishers, 1992. Husserliana XXIX.
- Husserl, Edmund. *Philosophie als strenge Wissenschaft*. Ed. and postscript by Wilhelm Szilasi. Frankfurt a.M.: Klostermann, 1965.
- Husserl, Edmund. *Ideas pertaining to a Pure Phenomenology and to a Phenomenological Philosophy: First Book*. Translated by F. Kersten. Hague: Martinus Nijhoff, 1983.
- Husserl, Edmund (ed.) *Jahrbuch für Philosophie und phänomenologische Forschung* 8, Halle a. S.: Niemeyer, 1927.
- Husserl, Edmund. *Logische Untersuchungen I: Prolegomena zur Reinen Logik*. Halle: Niemeyer, 1900.
- Husserl, Edmund. *Logische Untersuchungen II: Untersuchungen zur Phänomenologie und Theorie der Erkenntnis*. Halle: Niemeyer, 1901.
- Husserl, Edmund. *Phenomenology and the Crisis of Philosophy*. Translated by Quentin Lauer. New York: Harper & Row, 1965.
- Husserl, Edmund. *Einleitung in die Ethik: Vorlesungen Sommersemester 1920 and 1924*. Ed. by Henning Peucker. Dordrecht, Boston, London: Kluwer, 2004. (Husserliana XXXVII)
- Husserl, Edmund. *Philosophie der Arithmetik. Logische und psychologische Untersuchungen*. Halle-Saale: C.E.M. Pfeffer, 1891.
- Janssen, Paul. *Geschichte und Lebenswelt: Ein Beitrag zur Diskussion der Husserlschen Spätphilosophie*. Köln: Gouder and Hansen, 1964.
- Johnston, Mark. "How to Speak of the Colors," *Philosophical Studies* 68: 221-63. Reprinted with added postscript in Byrne and Hilbert (1997): 137-76.
- Klein, Jacob. *Die griechische Logistik und die Entstehung der Algebra* in: *Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik*, Abteilung B: Studien, Band 3, Erstes Heft, Berlin 1934, p. 18-105 und Zweites Heft, Berlin 1936, p. 122-235. Revised English edition: *Greek Mathematical Thought and the Origin of Algebra*. Cambridge, Mass. 1968.
- Koselleck, Reinhart. *Kritik und Krise. Eine Studie zur Pathogenese der bürgerlichen Welt*. Freiburg, München: Karl Alber, 1959.
- Koyré, Alexandre. *From the closed world to the infinite universe*. New York: Harper and Row, 1958.
- Locke, John. *An Essay concerning Human Understanding*. London: Tegg, 1836.

- Macintosh, J. J. "Primary and Secondary Qualities." *Studia Leibnitiana* 8 (1976): 88-104.
- Mackie, John Leslie. *Problems from Locke*. Oxford: Oxford University Press, 1976.
- Nida-Rümelin, Julian. *Philosophie und Lebensform*. Frankfurt: Suhrkamp, 2009.
- Nida-Rümelin, Julian "Reasons Against Naturalizing Epistemic Reasons: Normativity, Objectivity, Non-computability," ed. A. Carsetti *Causality, Meaningful Complexity and Embodied Cognition*. Dordrecht: Springer, 2010.
- Nolan, Lawrence. "Descartes on What We Call Colour." ed. id. *Primary and Secondary Qualities*. Oxford: Oxford University Press, printed from Oxford Scholarship Online, 2011.
- Pasnau, Robert "A Theory of Secondary Qualities." *Philosophy and Phenomenological Research* LXXIII 3 (2006): 568–591.
- Pitcher, George. *A Theory of Perception*. Princeton: Princeton University Press, 1971.
- Sluga, Hans. *Heidegger's Crisis: Philosophy and Politics in Nazi Germany*. London: Harvard University Press, 1993.
- Smith, A.D. "Of Primary and Secondary Qualities." *Philosophical Review* Vol. XCIX, No. 2 (April 1990): 221-54.
- Stone, Abraham "On Husserl and Cavellian Skepticism, With Reference to the Thomistic Theory of Creation." PhD diss., Harvard University, 2000.
- Stroud, Barry *The Quest for Reality: Subjectivism and the Metaphysics of Colour*. Oxford: Oxford University press, 2000.
- Szilasi, Wilhelm. "Nachwort." In Edmund Husserl *Philosophie als Strenge Wissenschaft*. Ed. by Wilhelm Szilasi. Frankfurt: Klostermann, 1965.
- Villemaire, Diane Elizabeth Davis. *E.A. Burt, historian and philosopher: A study of the author of The metaphysical foundations of modern physical science*. Dordrecht: Kluwer Academic, 2002.
- Weyl, Hermann. "Über die neue Grundlagenkrise der Mathematik," *Mathematische Zeitschrift* 10 (1921): 39-79.
- Wilson, Margaret. "History of Philosophy in Philosophy Today; and the Case of the Sensible Qualities." *The Philosophical Review* 101 (1992): 191–243.
- Wolf-Devine, Celia. *Descartes on Seeing: Epistemology and Visual Perception*. Carbondale: Southern Illinois University Press, 1993.