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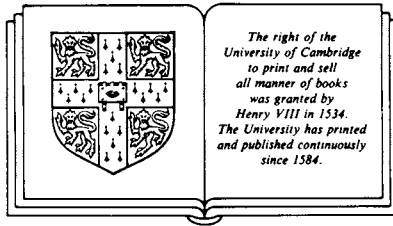
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# GOETHE CONTRA NEWTON

*Polemics and the project  
for a new science of color*

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To my family

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Have thought about fiction and science. The disaster they cause comes from the need of reflective reason, which creates for its own use a sort of image, but thereafter sets it up as true and concrete.

– Goethe

To explain all nature is too difficult a task for any one man or even for any one age.

– Newton

Men who like him had taken up the entire abundance of the elements of their age's culture without being constricted in the natural independence of their sensibility, who as ethically free individuals in the noblest sense of the word needed only to follow their fervent, inborn sympathy for all stirrings of the human spirit in order to find the right way amidst the cliffs of life, already in our times have become very rare and will likely become rarer.

– Helmholtz

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## Preface

People say: between two opposed opinions the truth lies in the middle.  
Not at all! Between them lies the problem, what is unseeable, eternally  
active life, contemplated [*gedacht*] in repose.

– Goethe (*MR*, no. 616)

Johann Wolfgang von Goethe's *Farbenlehre*<sup>1</sup> has produced bitter controversy for almost two centuries. Consequently, a work that presumes to illuminate its most controversial aspect, the polemic against Sir Isaac Newton's theory of white light and colors, should indicate at the outset its position with respect to the controversy. The first and most important point is that there is no simple answer to what seems the basic question, "Who is right, Newton or Goethe?" Attempts to answer the question involve more than sorting out the details. The different fundamental aspects under which the question must be posed – phenomenal, theoretical, methodological, historical, and philosophical – must also be clarified.

Common opinion, including the consensus of the physical literature, holds that the Goethe–Newton conflict can be resolved by simple fact. It is interesting that even many of the partisans of Goethe's science have agreed, but they think the facts speak for Goethe rather than Newton! This circumstance made me realize that the issue of fact itself had to be raised, because the question of what factuality is lies at the heart of Goethe's color science and his repudiation of Newton. Goethe charged that Newton had portrayed as fact – or, to use terms preferred by Goethe, phenomenon or appearance – what was hypothesis, and thus that Newton had injected a fundamental epistemological confusion into the very core of the science of colors. Goethe's first intention, then, was to pay the most careful attention to the phenomena of color and to be scrupulously untendentious in presenting them publicly; his second intention was to unravel the complex relationship between these phenomena and the ways in which we speak and speculate about them.

Three centuries ago, Newton established the foundation of modern optics and revolutionized the study of color. These have been lasting achievements, and I have every reason to expect them to endure even as



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they continue to be modified through the progress of research. Nevertheless, we must realize that the enduring substance of Newton's discovery is not identical with Newton's presentation of his experiments and theory; the former is the result of three hundred years of critical revision, the latter is fixed in Newton's writings and in the particulars – not always unassailable – of his approach and goals. To us, Newton's basic theory of light and colors is a good hypothesis, but to Newton it was much more: a fixed and foundational truth that might perhaps be more exactly specified but never refuted. Moreover, we must realize that Newton did not always distinguish carefully what we might call the "physics" underlying color, which is a physical optics of radiation, from the "psychophysics" of color, which tries to correlate the kind and amount of radiation with what is seen and which therefore inevitably draws into the ambit of color science matters of psychology, physiology, and perception. Insofar as he even raised the question, Newton for the most part tried to give the psychophysics of color a purely physical basis, and thus he really did not provide a comprehensive foundation for the science of color qua color. Newton's partial success, compounded by subsequent deformations of his theories in the course of eighteenth-century optics, created a situation that justified Goethe's criticisms and his attempts to lay a new foundation grounded upon a more scrupulous regard for articulating the proper approaches to the phenomena of color.

Yet to argue that Goethe's *Farbenlehre* and his polemics have been largely misunderstood is not to argue that they are unproblematic or simply right. I have come to believe that Goethe has an ampler conception of science than Newton, that he has a sounder notion of what an empirical methodology requires and a firmer grasp on the epistemological and philosophical issues involved; however, in the competition for scientific achievement Newton must take the palm of victory. (I do not, by the way, expect that everyone who reads this book will agree with my assessment of Goethe, but I do think most will understand that these claims are not groundless.) Although Goethe is not as amathematical as people think, he nevertheless did not resolve the question of how mathematical conception and calculation are to be reconciled with seeing and experiencing the appearances, and thus despite his intention to present an all-encompassing science of color – and not a merely qualitative science (whatever that might be), as some enthusiasts have claimed – we must conclude that, even on his own terms, he failed to realize this project.

If Goethe were alive to see the sciences of color today, he would approve of the vast cooperative effort, the manifold approaches, the theoretical variety, the exact specification of experiments, the refinement of instruments, and the vigor of scientific communication and debate. In short, he is not the proponent of antimodern science he is often portrayed as;

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in fact, I believe that the natural sciences have in some respects been reorganized in ways that he hoped would come about (most important, perhaps, being the intensive cooperation of communities of researchers). But it is clear, too, that Goethe, looking upon present-day work, would remind us not to let theories obscure what we actually see or forget that our ultimate goal is comprehensive fidelity to nature.

Scholars interested in Goethe and cultural history may miss in this book a sustained effort to explain the relationship between Goethe's science and his literary works, or between his science and broad cultural currents, such as Neoplatonism and Spinozism. My apology is that to begin to do justice to the Goethe–Newton controversy it is necessary to delve into textual, experimental, historical, and philosophical issues; this seemed work enough (and even this only begins to scratch the surface of the positive teachings of the *Farbenlehre*, the elucidation of which would seem to be the next order of business). Although I have not ignored such issues as philosophical connections and cultural influences, I have for the most part followed the principle that one must initially avoid explaining Goethe's scientific work according to what historians of science call externalist categories in order to provide a good internalist account of it. At any rate, I believe I have followed a thoroughly Goethean method in imposing on myself the primary obligation of securing a basis that might ultimately lead to a more speculative sequel.

While taking into account historical factors, I treat Goethe and Newton in some sense as contemporaries, trying to come to terms with a common object of investigation. I do this by carefully examining in context what Goethe and Newton wrote, and also by elaborating from this examination some notion of their characteristic ways of conceiving the phenomena (*Vorstellungsarten*, a term that will become thematic at the end of Chapter 2). Although we may not achieve complete commensurability between their different ways of conceiving things, we can establish a common ground that presupposes not consensus but rather the ability of human beings to talk with and learn from one another. I emphasize this common ground because it is something that the opposing sides in the controversy have rarely, if ever, achieved. Indeed, one might reasonably argue that the eclipse of the *Farbenlehre* was assured by Goethe's failure to establish a common ground on which both Goetheans and Newtonians could stand, and that the polemic served to obscure what was at issue rather than illuminate the differences between the two approaches to color. The polemic was not only a strategic blunder for Goethe personally, it was also a calamity for his scientific project.

To understand this project, it is essential to see how and where Goethe differed with Newton and to make clear that Goethe was fully aware of the character and bearing of the differences. To shed light on these matters

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and the reasons for them, I have scrutinized in Chapter 3 the letter in which Newton announced his theory to the Royal Society of London. To those who might object that in virtually dissecting this work I am unfair to Newton, I say that the classics of science are at least as much a part of our heritage as the *Iliad*, *Hamlet*, or *Faust*. Meticulousness is perhaps not necessary for a first appreciation of classic works, nor is it sufficient for pronouncing the last word on them; but at some point we must approach them with the presumption that their authors wrote precisely what they did for precise reasons. Moreover, I have tried to be scrupulous with Goethe's writings as well. If at times I seem to treat Goethe more indulgently, it is because this book is chiefly about a scientific work that has been subject to a more persistent neglect and misapprehension than Newton's and that is therefore in need of an at least provisionally sympathetic reading; moreover, Newton made the more extreme claims of truth, so it is perhaps just to hold him to a very strict accounting. But I do not spare Goethe when evaluating his accomplishments and failures; least of all do I approve of his having initiated the polemics and partisanship that have marred the controversy from the beginning and, even worse, have obscured the questions of science and truth. I have tried to avoid partisanship myself, but undoubtedly have not fully succeeded; yet I can still hope that the defects of my work are not so severe as to prevent readers from seeing what needs to be seen in the affair of Goethe against Newton.

As I conclude this preface, I realize that there is no way of adequately expressing my gratitude to the scores of those who have helped me bring this work to fruition. Not least do I owe thanks to the librarians who have so ably and readily given their assistance: I should like especially to thank the staffs of the Bayerische Staatsbibliothek, the Deutsches Museum, and the Ludwig-Maximilians-Universität in Munich; and the library staffs of the University of Chicago, Stanford University, and the University of Dallas, in particular Mrs. Alice Puro. The Deutscher Akademischer Austauschdienst (DAAD) generously supported me during my year-and-a-half-long stay in Germany, and Frau Margret Kassian and her family sheltered me from the worries of everyday living so that I could devote myself to "meta-worries" instead.

Although I never had the opportunity to meet or speak with him before his death, I wish to express my gratitude to Rupprecht Matthaei, the principal editor of the volumes on color science in the Leopoldina-Ausgabe of Goethe's scientific writings and a color scientist in his own right, for doing more than anyone in this century to bring Goethe's *Farbenlehre* to the public in a full and comprehensive way, and for helping guide readers to an understanding of it.

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The original insights that led to this book first glimmered in University of Chicago seminars on Goethe conducted by Manfred Hoppe, at whose instigation I first read the *Farbenlehre*; a more challenging teacher I have not met. Although I did not meet Erich Heller until the dissertation underlying this book was well advanced, his essays on Goethe inspired me to pursue my insights. When I finally met him in person I profited from his generous comments and his kindly admonitions not to be carried away by enthusiasm. In Germany Reinhard Löw and Ivo Schneider gave me encouragement and sound advice, and were always a responsive audience. Among those who have read and commented on my manuscript I give special thanks to John Cornell, whose conversations have been a constant source of intellectual stimulation.

I want also to thank the University of Chicago's Committee on Social Thought, which encourages risky ventures where more orthodox academic departments might not let their students tread, and especially Stephen Toulmin, whose continued support and uncanny ability to find the proper word of encouragement and to point out where things are going astray helped turn an idea and a hope into reality.

Jonathan Sinclair-Wilson at Cambridge University Press has been every bit the professional that those who know him told me he is; I offer a special thank you for his assistance in bringing this book to the public. Thanks also to Helen Wheeler, Janis Bolster, and Rhona Johnson for their aid; and I especially thank Brian MacDonald for his fine editing, which helped this book find a more consistent tone. The defects that remain are doubtless the result of resisting his advice or the counsel of others. Let them be held blameless.

I could hardly list the names of all those who have labored over my manuscripts, but I must not omit thanking publicly at least Gloria Valentine, Vicky Boubelik, Tina Lemon, Mary Jensen, Joanne Baird, Laura Braith, Regina Gomez, and Liota Odom.

I especially thank my parents, Joseph and Marge Sepper, for the help and support they have given over the years.

To Kathleen Wellman I owe not just the thanks of husband to wife for her love and encouragement, but also the gratitude of philosopher to historian. Finally, I cannot say that Elizabeth Wellman Sepper and Matthew Wellman Sepper have offered criticism or advice, but they have been encouraging in their very own way, and they, and their mother, have made the whole process more humanly bearable. May they someday read this and understand.

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## Abbreviations

The following abbreviations are used in text and note references for works I cite frequently. Unless otherwise noted, citations are by page numbers. Author-date citations refer to the reference list at the end of this volume.

### *Works by Goethe*

- BzO** *Beiträge zur Optik*, part 1 (1791) and part 2 (1792); found in *LA* I, 3:6–53. Cited by standard paragraph numbers.
- FL-D** The first, didactic part of *Zur Farbenlehre* (1810); found in *LA* I, 4. Cited by standard paragraph numbers.
- FL-P** The second, polemical part of *Zur Farbenlehre*; found in *LA* I, 5. Cited by standard paragraph numbers.
- HA** Hamburger-Ausgabe (*Goethes Werke*) = Goethe 1948–60. Cited by volume and page.
- LA** Leopoldina-Ausgabe (*Die Schriften zur Naturwissenschaft*) = Goethe 1947–. Cited by division, volume, and page.
- MR** *Maximen und Reflexionen*, ed. Max Hecker = Goethe 1907. Cited by aphorism number.
- WA** Weimarer-Ausgabe (*Goethes Werke*) = Goethe 1887–1919. Cited by division, volume, and page.

### *Works by Newton*

- Corresp.** *The correspondence of Isaac Newton* = Newton 1959–76. Cited by volume and page.
- LO** *Lectiones opticae* = Newton 1729.
- OL** *Optical lectures* = Newton 1728.

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ABBREVIATIONS

*Opticks* = Newton 1952.

Shap. Alan E. Shapiro, ed., *The optical papers of Isaac Newton*,  
vol. 1 = Newton 1984.

*Other works*

Eck. Johann Peter Eckermann, *Gespräche mit Goethe in den  
letzten Jahren seines Lebens* = Eckermann 1949. Cited by  
date of conversation.