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0521524814 - Unrolling Time: Christiaan Huygens and the Mathematization of Nature
Joella G. Yoder
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This case study examines the interrelationship between mathematics and physics in the work of one of the major figures of the Scientific Revolution: the Dutch mathematician, physicist, and astronomer, Christiaan Huygens (1629–1695). Joella Yoder details the creative interaction that led Huygens to invent a pendulum clock that theoretically beat absolutely uniform time, to measure the constant of gravitational acceleration, to analyze centrifugal force, and to create the mathematical theory of evolutes.

In the second half of the book, Dr. Yoder places Huygens's work in the context of his time by examining his relationship with other scientists and the priority disputes that sometimes motivated his research. The role of evolutes in the history of mathematics is analyzed; the reception of Huygens's masterpiece, the *Horologium Oscillatorium* of 1673, is described; and finally, the part that Christiaan Huygens played in the rise of applied mathematics is addressed.

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UNROLLING TIME

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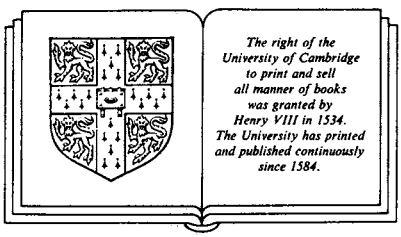

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With great affection and appreciation
I dedicate this book to my mother, Vera W. Lane,
for whom the education of her daughter
was always first priority

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Preface

Any attempt to reconstruct the process by which a great mind discovered an important concept becomes itself a process of discovery, and the recounting of the reconstruction becomes a mystery tale twice told. The detritus of the subject's activities – the calculations in the margins, the remains of former values poking out from behind ink blotches – these are the clues left to the historical detective. Shall I tell you of the manuscript that had to exist, although there was no trace of it in the collected works, simply because the derivation it contained was the "logical" next step? Eureka, I found it – or rather he did.

It is incumbent upon me to explain the way that I present the evidence gathered during my pursuit of the elusive Chr. Huygens. For obvious reasons I have adhered as much as possible to his original derivations and avoided the finished propositions. I have rarely presented his arguments verbatim, however, and this raises the possibility that I have misinterpreted what is on the page. In particular, for the sake of rendering the arguments more accessible, I have made some concessions to readability. Modern notation for such entities as pi and the equal sign are introduced, except in one case where I wish to make a point regarding the notation. A potentially more serious substitution is my use of algebraic notation in geometric arguments. Huygens stated everything verbally when he was in his "geometric mode" and used symbols such as the radical sign only when he switched to his "algebraic mode." Facile mathematician that he was, he switched back and forth between the two modes as his needs changed within the same problem, a procedure that even the most devout purist would not duplicate. Hence, you will find the verbal arguments presented in an algebraic form never used by him; for example, "the subduplicate proportion of AB to CD" is rendered as $\sqrt{AB}/\sqrt{CD}$. What you will not find is an integral

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sign or an infinite sum sign or any other symbol that embodies concepts developed in more modern times. One word that does appear often and needs some justification is "infinitesimal," which I use as a shorthand expression for an arbitrarily small length. Huygens did use equivalents such as *particula* or, in the case of an infinite sum, *infinita considerata multitudine,* so that I do not feel that I am violating the spirit of his work or that of his contemporaries by using the word.

Fewer compromises have been made regarding the figures, only because the originals for each derivation have been included, even in cases where a redrawn version is provided for clarity's sake. However, note that, in order to maintain the configuration of the figures as drawn by Huygens and yet translate his mathematics into recognizable formulas in the notes, I have taken the vertical axis as the x axis in most cases.

Because the intent of this book is to show a master of the Scientific Revolution at work, as many manuscripts have been reproduced as cost and legibility have allowed. Since so much of the material is drawn from the working papers, including manuscripts not reproduced by the editors of the *Oeuvres complètes,* I have decided for consistency to provide my own translations of all passages from Huygens's work, even in those few cases where published translations exist, particularly including the recent English translation of the *Horologium Oscillatorium* done by Richard Blackwell. Finally, on the level of real minutia, all dates are given according to the Gregorian calendar already adopted on the Continent during Huygens's time, unless specifically noted as old style (o/s).

This book would not exist had it not been for the help of two venerable Dutch institutions. The University of Leiden has been the keeper of Huygens's manuscripts for nearly three centuries, and I thank Dr. P. F. J. Obbema and his excellent staff of the Department of Western Manuscripts for their assistance. All photographic reproductions of the manuscripts contained herein were provided courtesy of the library at Leiden. Equally essential to Huygens scholarship is the *Oeuvres complètes de Christiaan Huygens* (1888–1950) published by the Hollandsche Maatschappij der Wetenschappen (Holland Society of Sciences). Although I may sometimes disagree with the editors, for example, regarding a specific manuscript's date, I do not wish to denigrate their very substantial achievement.

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I offer many thanks to the members of the society not only for their support of the original publication of the works but also for their continuing encouragement of research on Huygens. As I have already intimated, quotations are taken from the *Oeuvres* when possible; likewise reproduced from the collection are those figures belonging to the published treatises (Figs. 1.1, 8.1, and 8.4). I also thank the libraries and staffs of the University of Washington, the University of Wisconsin, Schaumburg (Illinois) Township, and Northwestern University for all the many services rendered over the course of my research.

This book has had many readers who encountered it in its various forms as it progressed from dissertation to printed treatise. Their discerning eyes and questioning minds righted egregious errors and prompted reassessments. Somehow a mere thank you seems meager recompense but will have to do. I gratefully acknowledge the help of Floris Cohen, Donald Crowe, James Evans, Mordechai Feingold, Thomas Hankins, David Lindberg, Daniel Siegel, and William Yoder. Additional thanks are owed to those who provided encouraging words from the sidelines – the members of the Seminar in History of Science at the University of Washington, as well as Rima Apple, Mary Robertson, and, once again, my supportive husband, Bill.

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