

Contents

Foreword	JOHN ANDREWS
Introduction	F. DAVID HOENIGER and JOHN W. SHIRLEY
1 Science and the Arts in the Renaissance: The Search for Truth and Certainty, Old and New	ALISTAIR C. CROMBIE
2 Medicine, Philosophy, and Humanism in Renaissance Italy	JEROME L. BYLEBYL
3 Art and Science: The Paracelsian Vision	P. M. RATTANSI
4 The Science of Sound and Musical Practice	CLAUDE V. PALISCA
5 Science and Navigation in Renaissance England	JOHN W. SHIRLEY
6 The Involvement of Artists in Renaissance Science	JAMES ACKERMAN
7 How Plants and Animals Were Studied in the Mid-Sixteenth Century	F. DAVID HOENIGER
8 The Organism as Symbol: An Innovation in Art	PHILIP C. RITTERBUSH
9 The Renaissance Development of the Scientific Illustration	SAMUEL Y. EDGERTON
10 Diagrams and Dynamics: Mathematical Perspectives on Edgerton's Thesis	MICHAEL S. MAHONEY

Folger Books  
Washington: The Folger Shakespeare Library  
London and Toronto: Associated University Presses

# Science and the Arts in the Renaissance



*Edited by John W. Shirley  
and F. David Hoeniger*

FOLGER INSTITUTE SYMPOSIA

*Compiled by the Folger Institute of Renaissance and Eighteenth-Century Studies and  
Published by the Folger Shakespeare Library*

FOLGER INSTITUTE CENTRAL EXECUTIVE COMMITTEE

John F. Andrews,  
Chairman and Series Editor  
*Folger Shakespeare Library*  
Lena Cowen Orlin,  
Associate Chairman  
*Folger Shakespeare Library*  
J. Leeds Barroll III  
*University of Maryland, Baltimore  
County*  
Carol J. Carlisle  
*University of South Carolina*  
Larry S. Champion  
*North Carolina State University*  
Stuart A. Curran  
*University of Pennsylvania*  
Ellen S. Ginsberg  
*Catholic University of America*  
Thomas M. Greene  
*Yale University*  
S. K. Heninger  
*University of North Carolina*  
Jay L. Halio  
*University of Delaware*  
Elizabeth Hudson  
*West Virginia University*

Shirley Strum Kenny  
*University of Maryland, College Park*  
Mary B. McKinley  
*University of Virginia*  
Eric Molin  
*George Mason University*  
Stephen Orgel  
*Johns Hopkins University*  
Joseph G. Price  
*Pennsylvania State University*  
Dale B. J. Randall  
*Duke University*  
John P. Reesing  
*George Washington University*  
Jeanne Roberts  
*American University*  
Thomas P. Roche  
*Princeton University*  
Jason Rosenblatt  
*Georgetown University*  
Gordon J. Schochet  
*Rutgers University*  
Estelle Taylor  
*Howard University*

An influential collaborative enterprise founded in 1970 and now co-sponsored by twenty-one major universities, the Folger Institute is a rapidly growing center for advanced studies in the humanities. Through support from such agencies as the National Endowment for the Humanities and the Andrew W. Mellon Foundation, the Institute offers a complex interdisciplinary program of seminars, workshops, symposia, colloquia, and lectures. The physical center of the Institute is the Folger Shakespeare Library, an independent research library administered by the Trustees of Amherst College and located on Capitol Hill in Washington.

# Science and the Arts in the Renaissance

*Edited by John W. Shirley and F. David  
Hoeniger*



Folger Books  
Washington: The Folger Shakespeare Library  
London and Toronto: Associated University Presses



Associated University Presses  
440 Forsgate Drive  
Cranbury, NJ 08512

Associated University Presses  
25 Sicilian Avenue  
London WC1A 2QH, England

Associated University Presses  
2133 Royal Windsor Drive  
Unit 1  
Mississauga, Ontario  
Canada L5J 1K5

Library of Congress Cataloging in Publication Data  
Main entry under title:

Science and the arts in the Renaissance.

1. Science and the arts—Addresses, essays, lectures.
  2. Arts, Renaissance—Addresses, essays, lectures.
  3. Science, Renaissance—Addresses, essays, lectures.
  - I. Shirley, John William, 1908— II. Hoeniger, F. David.
- NX180.S3535 1985 700'.1'05 82-49312  
ISBN 0-918016-69-X

Printed in the United States of America

## Contents

Foreword	JOHN ANDREWS, The Folger Institute	7
Introduction	F. DAVID HOENIGER and JOHN W. SHIRLEY	9
1 Science and the Arts in the Renaissance: The Search for Truth and Certainty, Old and New	ALISTAIR C. CROMBIE	15
2 Medicine, Philosophy, and Humanism in Renaissance Italy	JEROME L. BYLEBYL	27
3 Art and Science: The Paracelsian Vision	P. M. RATTANSI	50
4 The Science of Sound and Musical Practice	CLAUDE V. PALISCA	59
5 Science and Navigation in Renaissance England	JOHN W. SHIRLEY	74
6 The Involvement of Artists in Renaissance Science	JAMES ACKERMAN	94
7 How Plants and Animals Were Studied in the Mid-Sixteenth Century	F. DAVID HOENIGER	130
8 The Organism as Symbol: An Innovation in Art	PHILIP C. RITTERBUSH	149
9 The Renaissance Development of the Scientific Illustration	SAMUEL Y. EDGERTON, JR.	168
10 Diagrams and Dynamics: Mathematical Perspectives on Edgerton's Thesis	MICHAEL S. MAHONEY	198

## Foreword

*Science and the Arts in the Renaissance* originated as a two-day symposium initiated by the Folger Institute of Renaissance and Eighteenth-Century Studies, co-sponsored by the Smithsonian Institution's National Museum of History and Technology, and supported by a grant to the Folger Institute from the Education Programs division of the National Endowment for the Humanities.

The first day's sessions took place on Friday, October 27, 1978, in the Theatre of the Folger Shakespeare Library. After listening to and discussing three papers on "Rationalizing the Order of Things" and three more papers on "Expanding the World in Time and Space," participants took a break for dinner and then reconvened in the Hall of Musical Instruments at the Museum of History and Technology for a concert by the Library's early music ensemble, the Folger Consort. The evening concluded with an elegant reception in the Hall of Ceramics and Glass.

The second day's sessions took place on Saturday, October 28, in the Carmichael Auditorium of the Museum of History and Technology. Three papers in the morning on "Measurement and the Arts" were followed by a lunch break, a guided tour of the Smithsonian's collections of early scientific instruments, and an opportunity to view a special exhibit of rare books (some from the Folger, some from the Smithsonian) in the Dibner Library of the History of Science and Technology. Then everyone reconvened for a roundtable discussion moderated by Otto Mayr, Acting Director of the National Museum of History and Technology, and yet another lovely reception, this time in the Flag Hall of the Museum.

Thanks in large measure to the conscientious efforts of Mary Rosenfeld, Curator of the Dibner Library (who supervised the assembly of the exhibit of "Rare Scientific Books and Instruments"), Silvio Bedini, Deputy Director of the National Museum of History and Technology (who introduced the guided tour on the second day of the symposium), and Otto Mayr (who committed the Museum's resources to the symposium, commissioned a handsome commemorative poster for the occasion, and participated in the planning of the



event from its inception), "Science and the Arts in the Renaissance" was a pleasant and enriching program—and one that the editors and most of the participants in this volume still recall with delight. Its special ambience is one, alas, that can never be recaptured. But, thanks to the editorial labors of David Hoeniger and John Shirley and the hard work of those who have been so gracious as to contribute to the present volume (including two scholars who were unable to attend the meetings back in 1978), we are now pleased to offer a legacy that may be of equal value: a book that records, in a more enduring form, something of the essence of the occasion.

I speak not only for the editors but also for the Folger Institute when I lament the unavoidable delays that have caused so much time to elapse between the conclusion of the symposium and the publication of the volume proceeding from it. One measure of the change that has occurred in the meantime is to be found in the difference between the brochure announcing the symposium and the page listing the current membership of the Central Executive Committee of the Folger Institute: in 1978 there were thirteen universities co-sponsoring the Institute's various activities, whereas now there are twenty-one. An even more dramatic measure of the elapsed time may be found on the Mall of the Smithsonian. Over the entrance to what in 1978 was known as the National Museum of History and Technology is a banner proclaiming the new name of that splendid building and collection: the National Museum of American History. One thing that hasn't changed, paradoxically, is the Foucault Pendulum. It still swings the way it used to, facing Horatio Greenough's statue of George Washington across the Hall of Flags. And whether thereby hangs a tale I suppose only Shakespeare knows for certain.

John F. Andrews

## Introduction

The idea of this book was conceived during the planning of an interdisciplinary conference, "Science and the Arts in the Renaissance," initiated by the Folger Institute of Renaissance and Eighteenth-Century Studies in the summer of 1977. A two-day symposium was presented in October 1978 under the joint sponsorship of the Folger Shakespeare Library and the National Museum of History and Technology of the Smithsonian Institution. Supported in part by a grant from the National Endowment for the Humanities, the symposium attracted a gratifyingly large number of scholars and other participants interested in the Renaissance. The papers presented during the sessions spurred heated discussion, both among the contributors and between them and the audience. This lively response reinforced the idea of the organizers that the symposium should be followed by a more permanent record. It also convinced them that this volume should not simply record the papers as presented, but rather should reflect the second thoughts of the contributors. Two of the participants of the conference were entrusted with the task of compiling and editing such a volume for the Folger Institute, and the fruits of their labor are offered in the pages that follow.

The original purpose for the symposium was expressed as follows:

Between 1450 and 1700, a revolution in astronomy and physics, associated with the names of Copernicus, Kepler, Galileo, and Newton, transformed Western cosmology and laid the groundwork for the development of modern science. This revolution was a strikingly successful part of a larger movement in the Renaissance, a movement characterized both by the vigorous pursuit of fact in the world of phenomena and by the attempt to bring the resulting wealth of new information under the rule of rational principles and ordering. Mathematics and geometry were developed and applied to the rational ordering. Measurement, observation, experiment, and classification were extended to a variety of new areas, including the fine arts and the practical arts. Although less dramatic in its consequences than the revolution in astronomy and physics, the resulting revolution in the arts had a transforming effect on the understanding of the world of nature and the world of the arts.

Alistair C. Crombie of Trinity College, Oxford, was involved in the planning for the symposium from the beginning, and he prepared a paper to provide the broad philosophical basis for the ensuing discussions. A summary of Dr. Crombie's paper was sent to all prospective lecturers in advance to give the symposium a sense of direction and unity. This paper opened the symposium and it naturally begins this volume.

Although Dr. Crombie's paper was retained in close to its original form, the editors urged other contributors to revise their papers (some of them drastically) to incorporate some of the substance of the symposium discussions and to give the essays greater appeal for the general reader. The editors also took the liberty of omitting some of the papers given at the symposium which were too specialized for a reasonably unified book and of adding two additional papers on subjects not covered at the symposium but believed to be essential parts of the interaction between the sciences and the arts during the Renaissance.

Since the whole experience of the symposium proved highly stimulating for both participants and auditors, the Institute and editors hope that the resulting book—though in some ways quite different from the symposium—will be attractive to an even wider audience of those generally curious about the role of science and the arts in a period when each underwent explosive development. After all, the Renaissance does represent both a high point in Western culture and the beginning of the modern era. In exploring this phenomenon, the present volume is designed to be somewhat more comprehensive than the symposium was. It would be idle to claim that any tight unity has been achieved in this attempt, for any such unity would have had to come at the sacrifice of some diversity in the areas covered as well as in the approaches to them. Yet the reader of this book, we feel confident, will find frequently as he reads one essay that his thoughts are wandering back to passages in another; for instance, when Professor Mahoney is debating a thesis by Professor Edgerton (though not necessarily that of his revised essay in this volume) or when Professors Ackerman, Hoeniger, and Ritterbush each feels the need, though in different contexts and as parts of different arguments, to refer to Hans Weiditz's extraordinarily artistic and realistic botanical illustrations of Brunfels's herbal.

The reader is free, of course, to approach the individual contributions in any order that appeals to his interest, but it might be helpful for the editors to indicate why the essays are arranged as they are in this volume. Alistair Crombie's paper, placed first, provides essential background on the philosophical outlook of the period from Alberti in the mid-fifteenth century to Galileo in the early seventeenth, with a basic thesis showing—in their analytical, rational, and creative approach—how much the great artists and scientists had in common. While most of the following essays develop arguments on more specific subjects or disciplines, most of them involve the context of ideas and happenings of the time. J. L. Bylebyl describes the development in Italy of the learned medical profession over the course of three centuries from ca. 1300 to 1600,

showing how leading physicians were affected first by medieval Aristotelianism and then by Renaissance humanism before they asserted more and more their bold independence from the philosophers in both their medical teaching and their practice. In the third essay P. M. Rattansi gives a lucid account of some of the chief tenets of Paracelsus's Neoplatonic and highly peculiar medical philosophy, which for a while was to challenge all orthodox medical tradition. Rattansi shows how Paracelsus's vitalism and emphasis on the power of the imaginative faculty, dismissed by the mechanical philosophy of the seventeenth and eighteenth centuries, once again exercised a strong attraction for such Romantic poets as Blake, Coleridge, and Wordsworth.

In the fourth and fifth essays we move from abstract and philosophical overviews to exploration of more practical and applied arts. C. V. Palisca examines the revolution that was occurring in music. Following discussion of the acoustical theories devised by philosophers and scientists for both musical theory and practice, he shows how toward the end of the Renaissance musical theorists found such speculations increasingly unsatisfactory and tended to dismiss them, stressing instead the need for independent, empirical investigation. Next J. W. Shirley emphasizes the crucial role that the burgeoning sciences of astronomy, mathematics, and physics were beginning to have on the practical art of navigation. He shows how the theorists of the universities became involved and how the most advanced mathematical innovator of the age, Thomas Harriot, employed his new theories in the solution of some vexing practical problems of his time.

The final five essays concentrate more specifically on the interrelation of the new science and the fine arts. J. Ackerman, an art historian, shows how fifteenth-century painters conceived their art scientifically and attained their fresh goals with the aid of mathematics and optics. He also considers the later contributions of artists to the teaching of anatomy and botany, as well as to the more limited technological developments in architecture and architectural drawing. Similarly, the role of both artistic and realistic illustration of plants and animals is part of the next essay by F. D. Hoeniger. But in addition to showing the contribution that illustrators made, Hoeniger also points out the danger that the sheer appeal of pictures distracts readers of botanical and zoological books from their real content—the text. He describes how, after long delay, the mid-sixteenth century saw a remarkable upsurge in the study of plants and animals by naturalists, and how in Gesner at least we find indications of an interest in morphology and in other aspects of the science of biology. The eighth essay, by P. C. Ritterbush, also involves art and living creatures but from quite a different angle. Taking his initial clue from seventeenth-century collectors' cabinets whose drawer fronts are resplendent with naturalistic paintings of insects and small plants, Ritterbush argues that at this time artists and scientists were still thinking alike in that they shared the habit of viewing organisms as symbols, though in ways that refined the allegorical imagery of the Middle Ages.

In the ninth essay S. Y. Edgerton reverses the coin; he asserts that it was art



which contributed to science. Scientific illustrations, he contends, represent a totally new development and a new form of "visual language." Had Galileo not been educated in this language, Edgerton argues, he could not have made the scientific discoveries he did. It was science which followed the new art and not the reverse. To bolster this thesis, Edgerton contrasts the incongruous use of "scientific illustrations" in non-scientific Chinese books after they had been introduced from the West. The final essay, that of M. S. Mahoney, takes violent issue in a provocative and dramatic opposition to the thinking of more than one of the book's other authors. Mahoney completely rejects the thesis that technical innovations by such fifteenth-century artists as Alberti laid any essential background for the scientific revolution. Scientists, even in the seventeenth century, he insists, dependent as they were on geometrical explanations, were able to communicate visually not the manner of a machine's operation but only what it looked like. No clear communication of the laws of dynamics was possible, Mahoney contends, until there was more mature development of algebra; only then could the scientific revolution be complete. In summary, though the contributors to this book show in many ways the interaction between the sciences and the arts in the Renaissance, the final essay once again stresses the crucial role of invention in mathematical thought in the development of what we call the modern world.

As editors of this book, we wish to express to the Folger Shakespeare Library our gratitude and delight both for inviting us to participate in this symposium and for entrusting us with the shaping of the resulting book. These editorial duties enabled us to continue a happy and fruitful dialogue with those who stimulated our thinking during the symposium. At the same time, we welcome the fresh contributions of two distinguished historians of medicine. Not only have we learned much from our colleagues, expert in disciplines other than our own, but we also have been pleased to find that as Renaissance scholars they were delightfully broad and human as well. Particular gratitude must be expressed to John Andrews, Chairman of the Folger Institute, without whom neither the symposium nor this volume would have happened, and to his former Associate Chairman, Susan Zimmerman, with whom we had many day-to-day contacts during our wrestling with the text. Both have been understanding of our frailties, physical and intellectual, and have given us support in every instance. We pay them our respect and remain in their debt.

F. David Hoeniger  
John W. Shirley

## Science and the Arts in the Renaissance