Preface

Of all the great themes in astronomy, one of the most profound and provocative has been the discovery of galaxies and of man's place in the cosmic order. Although this story stretches over millennia, the most revolutionary findings have come during the twentieth century. The efforts of the people who made these discoveries—including their thoughts, their methods, and their instruments—comprise the subject matter of this book. Man's developing understanding of the galaxian universe has been characterized by sudden, unexpected discoveries; by long, tedious work; and, sometimes, by false, misleading results. Although the subject matter of astronomy may be impersonal and inanimate, the process of scientific inquiry is a thoroughly human enterprise, and this book stresses the role of people, with all of their strengths and imperfections.

We hope this book will be of interest and use to any reader with an interest in galactic astronomy. The largest group of such individuals probably will be college-level students taking introductory astronomy courses for non-science majors. The book, nonetheless, should also be of use in courses such as physical science for non-scientists, basic astronomy for scientists, physics for both scientists and non-scientists, and the history of science. Likewise, we hope it would be of value in certain teacher training programs for both pre-service and in-service teachers. And we also hope it will be of interest and value to lay readers.

The approach in this book differs from that of conventional textbooks in several respects: This volume does not presume to be comprehensive, surveying all facets of astronomy; rather, it concentrates on a single, highly significant episode in the development of modern science. In addition, it makes extensive use of original, archival information, much of which has never before been published. This information makes it possible to describe with unusually good documentation the events surrounding certain traumatic scientific discoveries, the influences of personalities on scientific research, and the difference between public and private science. A primary aim of this book is to involve the student to some depth in a single, highly important, and unusually exciting problem as it developed in the history of science, and thereby to convey an understanding of both science and scientists.

An asset of the approach used in this book is its inherent flexibility. By including or omitting technical sections, problems, and so on, the subject matter can be adapted for either science or non-science students at various academic levels; moreover, the chapters can be used over a time span ranging from a single lecture to many weeks. Thus, this book is designed primarily to be used in conjunction with a normal college curriculum, not in place of it.

The preparation of this book began in the late 1960's with the support of a grant from the National Science Foundation. The program was then officially entitled "The Case

Studies Project on the Development of Modern Astronomy" and the Principal Investigator was Richard Berendzen. The Project ultimately led not only to this book but also to several papers published in scientific and educational journals, lectures at professional society meetings, and an international conference on education in and history of modern astronomy. The Project originated when all three of the authors were at Boston University. The early drafts of the materials comprising this book were developed there and were tested there as well as at a number of other colleges and universities in the United States and in Canada.

Because this book rests fundamentally upon archival and unpublished sources, it has been especially necessary for us to receive the assistance and goodwill of numerous individuals and institutions. It is impossible to acknowledge all of those who have assisted us over the years, but we should like to mention the following institutions that were especially helpful: The National Science Foundation; American Astronomical Society; American Institute of Physics; The American University; Boston University; California Institute of Technology; University of California at Berkeley; University of Groningen; Dominion Astrophysical Observatory; Harvard University; Hale Observatories; Huntington Library; Lick Observatory; University of Leiden; University of Pittsburgh; Lund University; Princeton University; Lowell Observatory; the U.S. National Academy of Sciences; the U.S. Naval Observatory Library; the U.S. Library of Congress; and the numerous literary and photographic sources listed in the back of this book. And we would especially like to thank Owen Gingerich of Harvard University and Michael Hoskin of the University of Cambridge, both of whom read early drafts of this manuscript and provided us with many helpful suggestions. We alone, however, take full responsibility for the final version of the manuscript.