THE DEVELOPMENT OF MATHEMATICS THROUGHOUT THE CENTURIES

A Brief History in a Cultural Context

BRIAN R. EVANS

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Pace University
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INTRODUCTION

There have been numerous books written about the history of mathematics, ranging from very brief introductions to extensive in-depth textbooks. This book is intended to provide a brief overview of the history of mathematics in a straightforward and understandable manner. By no means will this book cover the history of mathematics exhaustively or every mathematician whose work contributed to the evolution of mathematics. However, it will address major findings that influenced the development of mathematics as a coherent discipline.

Many books focus heavily on complicated mathematics, which is not easy to understand by many readers outside the discipline. The intention of this book is to present considerable mathematical content in an easy-to-digest manner. Moreover, this book will emphasize the historical foundations and background of the history of mathematics in order to provide context. There will be more mathematics content presented regarding the earlier historical periods because the mathematics discussed will be easier to understand for most readers, as opposed to its later developments. The mathematics presented in recent history would require advanced knowledge in the subject. Occasionally, however, this book will address mathematics that may assume prerequisite knowledge that may not be possessed by all readers. It is the author's belief that such an instance will rarely be encountered by most readers who have a high school background in mathematics and perhaps some college mathematics background as well. Readers who have been exposed to some calculus will have little to no trouble understanding the mathematics

in this book. Hence, this book is written for a wide audience of readers. Readers with a range of basic high school or college mathematics backgrounds as well as students majoring in mathematics and high school mathematics teachers will find most of this book interesting and enjoyable. This book can be used as a textbook in a history of mathematics college class or even for pleasure reading and intellectual curiosity. Even a doctorate in the field may want to keep this book on hand as a quick reference guide. Middle school, high school, and college professors, and even elementary school teachers, may find this book useful in motivating their students to learn mathematics content through the use of mathematics history in their teaching. In order to be an effective teacher, it is important to engage students in the material. Introducing the history of mathematics can make the study of mathematics more enjoyable and help students see how mathematics developed throughout the centuries because it gives mathematics a human face. This book integrates formal history with anecdotes and legends, where appropriate, in order to make the reading more interesting. Even for the mathematical legends unlikely to be true, they have been constructed around significant historical figures and will be of interest to the reader. The reader will be notified when an anecdote or legend is merely speculative.

Another purpose of this book is to highlight the contributions made by various world cultures. The most recent books about the history of mathematics certainly have gone in this direction, but this book is intended to help the reader understand developments of mathematics around the world. Specifically, there are chapters presented on African, Egyptian, Babylonian, Chinese, Indian, Islamic, and Pre-Columbian American mathematics. It is important that students understand that mathematics has developed throughout the world and that no single culture has a monopoly on the subject. While there were remarkable mathematical developments in ancient Greece and throughout Europe in the Modern Era, these accomplishments would not have been possible without the contributions from various cultures such as Babylonian, Indian, and Islamic cultures. At the time Europe was in the "Dark Ages," particularly in

mathematics and science, great accomplishments were being made in China, India, and later the Middle East. It is commonly believed that much of modern mathematics was exclusively developed in Europe, but that is not the case. As addressed in this book, many of the concepts discovered by Europeans in the 17th to 19th centuries were discovered in some form, although often but not always more limited, much earlier in China, India, and the Middle East. Rich mathematical knowledge was also produced in parts of the Pre-Columbian Americas. This book will demonstrate that Indian and Islamic mathematics were highly influential on European mathematics, which began to more fully develop in the European Renaissance and would climb to remarkable heights throughout the 17th to 19th centuries.

Students from diverse cultures and backgrounds who believe that mathematics is an exclusively white male endeavor are less likely to be engaged in mathematics class. In fact, in a study in which children were asked to draw a mathematician, many children drew the stereotypical mathematician as an older white male. Nevertheless, after bringing diverse mathematicians into the classroom to speak with the children, many children drew diverse mathematicians of different backgrounds when asked to complete the task again.

While it is important for students to perform well in mathematics for its own sake, it is essential that students perform well because it serves as the "gatekeeper" for entrance to quality colleges and high paying careers. Success in mathematics is one of the strongest variables in predicting success in life. High paying careers such as those of mathematician, actuary, statistician, and engineer all require high levels of mathematics knowledge. Strong mathematics knowledge is also necessary for personal success and in making informed life decisions, including important economic, social, and political choices. Mathematics knowledge is a necessary component of financial literacy and economic well-being, and quantitative reasoning is needed for citizens to make informed decisions in a healthy democracy. Engagement in mathematics will lead to greater learning in mathematics, and teaching students by using mathematics history as a framework can

also help facilitate the necessary student motivation needed for academic success.

The history of mathematics is intriguing because it gives us a perspective of the long development of mathematical ideas throughout the ages. It allows us to glimpse into the ancient cultures and place mathematics in the context of human history and development. It helps us realize that mathematics was discovered by real people, but simultaneously mathematics reveals universal truths. Unlike other subjects that depend on subjective information, mathematics objectively tells us about the world and the universe. Once a mathematical theorem is proved correctly, it is proved for the ages. People who enjoy history can gain a positive disposition toward mathematics if the subject is presented in its historical context. Mathematics is developed and interpreted by humans throughout the ages, which makes the study of its development a worthy goal.

Mathematics can be defined as the study of patterns in the context of quantity, structure, and dimension. Throughout this book, we shall take a journey throughout time and observe how people around the world have understood these patterns of quantity, structure, and dimension around them. We shall explore mathematics in the wider historical context. This book is set up in chronological order, for the most part, beginning with the earliest known records of human mathematics in Africa. It continues with ancient Egypt and Babylon, and then covers ancient Greece to the fall of the Roman Empire. We then turn to historical developments of mathematics in ancient to medieval China and India, and on to the Islamic world. Next, the mathematics of the Pre-Columbian Americas is explored. We then go into the dark period of mathematics in Europe after the fall of the Roman Empire until the influence of Islamic mathematics on European thinking. We next visit the European Renaissance and work our way through the 17th to 19th centuries in Europe. The 20th century takes us through Europe and to North America, which took the lead in mathematics after World War II. We shall then work our way to the early 21st century. Finally, we shall explore the history of mathematics educa-

tion and its development in the United States during the 20th and 21st centuries.

A final note should be made regarding the source of the information in this book. This book was written from the class notes used in a mathematics history class taught by the author. This work is considered to be a textbook of information and not an original work of historical or mathematical research. The facts have been gathered from many other sources, and none of the information presented will be an original discovery by the author, besides the occasional author speculation. Facts found in one source were checked against the same facts in other sources, when available. As a textbook written for informative purposes, references are not cited throughout the book. The Resources and Recommended Readings section at the end of this book lists all of the sources in which information was gathered. In particular, a special note should be made about the University of St. Andrew's MacTutor History of Mathematics website. This website has proven to be an invaluable source of information on the backgrounds of the numerous mathematicians found in this book. For more details than this book can provide, it is recommended that the reader explore the MacTutor website for more information. As noted throughout the text, the Internet will continue to change how we live, work, and study. Now, more than any time in the past, the reader has access to an unlimited amount of information through simply having a computer and access to the Internet. This brief book should serve as a guide through mathematics history. It places the history in context and allows the reader to have a starting point for further exploration.

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PART 1

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