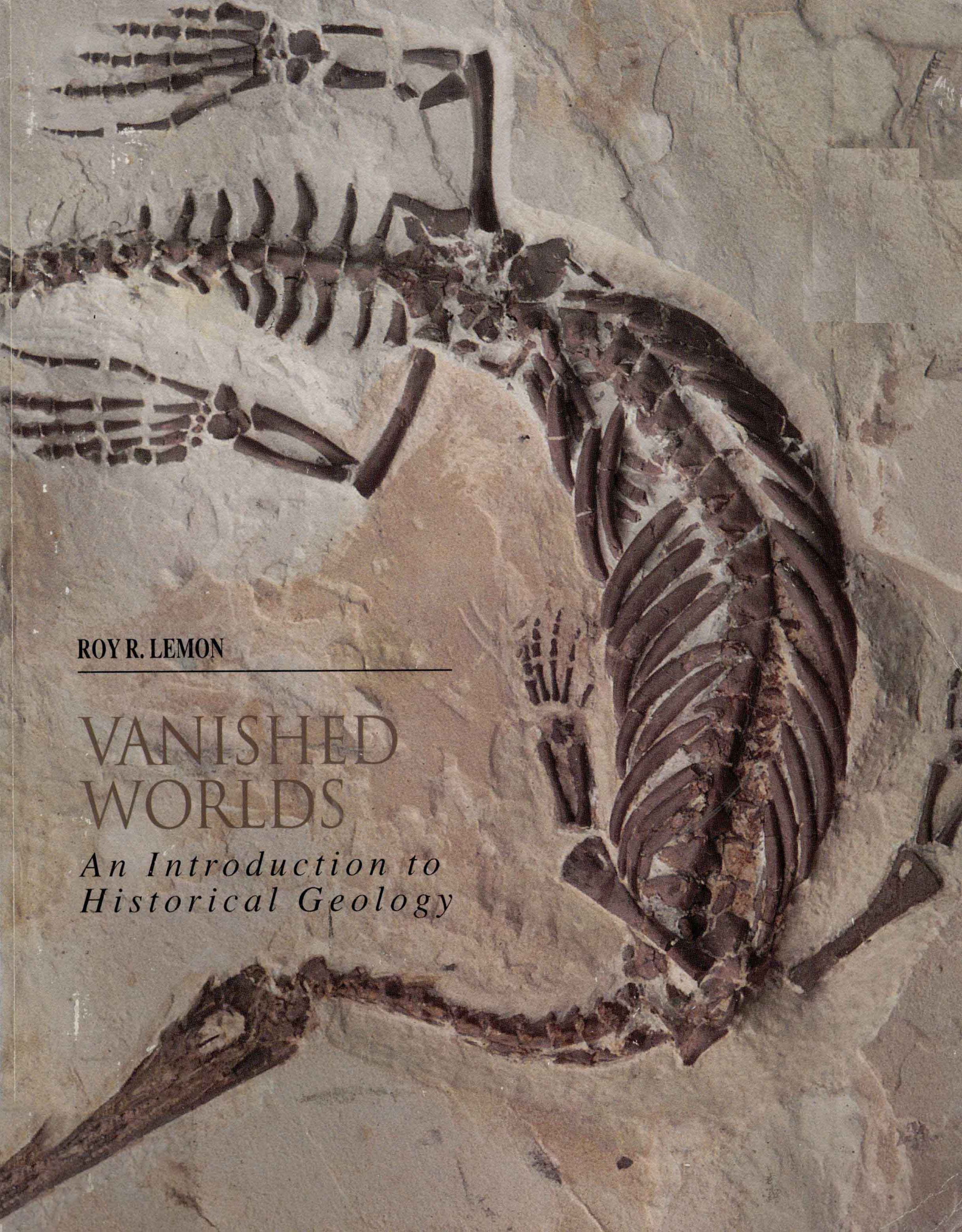

ROY R. LEMON

VANISHED WORLDS

An Introduction to Historical Geology

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ROY R. LEMON
Florida Atlantic University

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Preface

This book is written for both nonscience and science majors as an introduction to historical geology. Although it is likely that many students will have already taken an introductory physical geology or earth science course, this background is not assumed. Accordingly, the book stands on its own and presents a comprehensive picture not only of earth's history but also of the geological forces that have shaped it.

In studying the broad field of geology at an introductory level, many students are surprised that the basic concepts can be discussed without reference to geologic time. Although students are told that geology is a historical science, a good deal of the subject matter in an introductory text is concerned with "here and now" geology. Although exciting concepts and fascinating new ways of looking at our world are revealed in such courses, it is when we delve into the past and attempt to read the record in the rocks as a sequential account that the subject matter evokes a new fascination. It was the search for answers to questions about the origin and age of the earth, rather than an interest in observed geologic processes, that laid the scientific foundation of geology.

No investigation of any geologic feature, phenomenon, or process can proceed very far without an awareness of the time dimension. That most people are curious about time is evident when we consider that the first question just about everyone asks when looking at a rock or fossil is "How old is it?" It is such a simple but vital question that a book about historical geology sets out to answer.

Although an account of geological processes and change leads to an awareness of time, fossils do much to reinforce that awareness and help make the immensity of geologic time more understandable and even believable. The fossil record and the story it tells of the evolution of life on this planet are surely what a large part of historical geology is all about. This is why a considerable portion of this text is concerned with such topics. There is no question that it is fossils that often draw people to geology. It is a rare person who has not been intrigued by dinosaurs at some point in growing up and acquiring an education. On the other hand, in many ways the humbler fossil remains of the invertebrate hosts play a more important role in fostering interest, for the simple reason that they are more accessible. They can be found almost everywhere and, so, are *collectible.*

The organization of this book is conventional in the sense that the first part is concerned with the fundamental principles that are particularly relevant to historical geology, whereas the remaining 11 chapters deal with earth history. This approach needs no justification because it is the simplest and, therefore, probably the best. The standard geologic time scale is used as the framework for chapter organization, and no attempt has been made to seek other, so-called natural divisions, such as the sequences used by some authors. It is often forgotten that the original systems of the nineteenth-century geologists were established as biostratigraphic units. For all practical purposes, they still are biostratigraphic units and, because the pace of earth history is measured in large part by the fossil record, a calendar of earth history based on evolving life forms is the only truly natural one.

In an account of earth history, there is always the question of how much of the world to cover. Because the book is intended primarily for North American students, this is where the emphasis should be. At the same time, so much is important outside of North America that some excursions farther afield are often called for. For long periods of history, North America did not even exist as a separate continent; in discussing such times, some expansion of our territorial limits is obviously called for. Paleogeographic maps are the key to understanding the world pictures, and this book is generously supplied with such maps. A key to symbols used on each paleogeographic map is supplied below.

Throughout this text, but particularly in the first part, many concepts are discussed as part of the history of the science of geology, and the personalities involved are introduced. It is important that students realize that science is ongoing; thus, the most recent findings are presented not as cut and dried facts but as hypotheses to be tested. Numerous examples are given of studies that can be described as still on the cutting edge of science and that may yet be discarded. This is the way science works and, even at this introductory level, it is an important point to make; particularly is it necessary in the case of nonscience majors.

A textbook of this type does not require detailed reference annotations. Each chapter closes with suggestions for further reading. At the same time, the authors of many of the more important concepts and advances are introduced informally and their professional affiliations mentioned, although it is realized, and has been pointed out by at least one reviewer, that people have a habit of changing affiliations and that such references tend to "date" the book. It is hoped that the reader makes allowances for this. Be that as it may, science is done by real people, and getting this point across is also important.

Ancillary Materials

Vanished Worlds is accompanied by an instructor's manual, a test item file, a testpak, and a transparency set. The instructor's manual was written to assist the instructor in lecture preparation. It includes instructor's notes to highlight key ideas and themes and answers to the end-of-chapter questions. The test item file is bound with the instructor's manual and includes approximately 500 multiple-choice and true/false questions. The test item file is also available on Testpak, a computerized test bank. Testpak is available for IBM, Macintosh, and Apple computers. There are 40 transparency acetates of selected paleogeographic maps, charts, schematic drawings, and conceptual diagrams.

Acknowledgments

This book owes much to the input of its reviewers; their guidance and many helpful comments and suggestions have contributed a great deal. I sincerely appreciate their help and I extend my thanks to Allen H. Johnson, West Chester University; John R. Huntsman, UNC–Wilmington; John Howe, Bowling Green University; Richard A. Laws, UNC–Wilmington; Gene Robinson, James Madison University; and Mark Camp, University of Toledo.

The manuscript was typed by Cynthia Mischler and without her hard work, enormous patience, and neverfailing cheerfulness the project would not have been possible. To her go my most grateful thanks and appreciation.

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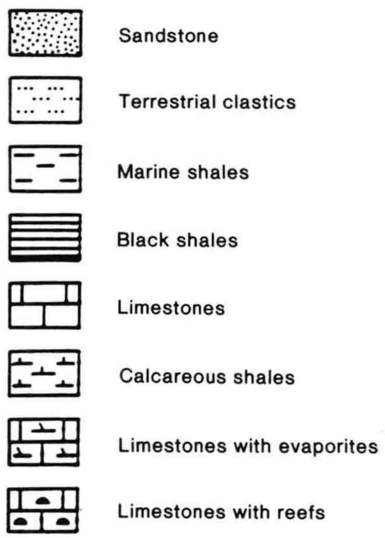
Key to Symbols on Paleogeographic maps



VANISHED WORLDS

An Introduction to Historical Geology

Contents

6

REAL-TIME DATING IN GEOLOGY 99

7

ORIGINS—THE EARTH AND LIFE 113

8

PLATE TECTONICS 129

9

THE NEW UNIFORMITARIANISM 149

10

THE ARCHEAN 165

11

THE PROTEROZOIC 183

12

THE CAMBRIAN WORLD AND AN EVOLUTIONARY EXPLOSION 209

13

THE ORDOVICIAN-SILURIAN: THE WATER PLANET 229

14

THE DEVONIAN: THE GREAT INVASION 257

15

THE CARBONIFEROUS: AN END AND A BEGINNING 279

16

THE PERMIAN 303

17

THE TRIASSIC AND JURASSIC 321

18

THE CRETACEOUS 349

19

THE PALEOGENE 377

20

THE NEOGENE 401

1

A MATTER OF TIME

Outline

Key Terms

actualism 15
bedding plane 6
biostratigraphic calendar 9
catastrophism 11
field relationships 5
formation 6
fossils 9
geologic map 5
law of superposition 5
marine regression 7
marine transgression 7
Neptunist 12
Plutonist 12
sedimentary rock 5
stratigraphic sections 5
stratigraphy 4
uniformitarianism 4
Vulcanist 12

Introduction

When Neil Armstrong first set foot on the moon on 21 July 1969 and astronauts later began exploring the lunar surface and sampling rocks, they had, in effect, traveled back in time. As pictured in Figure 1.1, the landscape over which they walked had remained virtually unchanged for more than 3 billion years. Moreover, their footprints on the moon probably will still be discernible millions of years into the future!

Such vast periods of time are almost beyond comprehension, but geologists and astronomers deal with them routinely in their study of the earth, the solar system, and our galaxy. By contrast with the moon, landscapes on the earth are often altered beyond recognition in only a few million years, sometimes even in a few hours (Figure 1.2). Our home in space is a planet where, in the cosmic scheme of things, change is very rapid. On the other hand, in human terms, changes that take place over millions of years are hardly rapid. Even time spans of hundreds of years seem long. Thus, dealing with time is a question of scale, and some adjustment in ordinary thinking is necessary when we consider geologic processes.

During the formative years of geology as a science, the great time intervals involved was one of the most difficult concepts to grasp, and it is still a difficult concept for beginning students today. We will discuss the numerous ways of measuring time in later chapters; however, none is of much concern to us unless there is some kind of record in the rocks.

Historical geology is that vital aspect of geology that considers geological phenomena in the time context and attempts to assemble an account of what has gone before. Drawing upon data from every branch of geology, and also from fields outside of geology, historical geology endeavors to restore vanished worlds (Figure 1.3) and to visit landscapes that have long since disappeared in the mists of time (Figure 1.4). Initially, at least, historical geology is concerned with extrapolation from the present into the past. It is only logical to attempt a reconstruction of the past in terms of what can be seen at the present day.

Many geologic features and processes can be described under the heading of what might be called "here-and-now" geology, usually termed physical geology. Indeed, we can learn a great deal about the basics of geology with little need to refer to the time frame in which

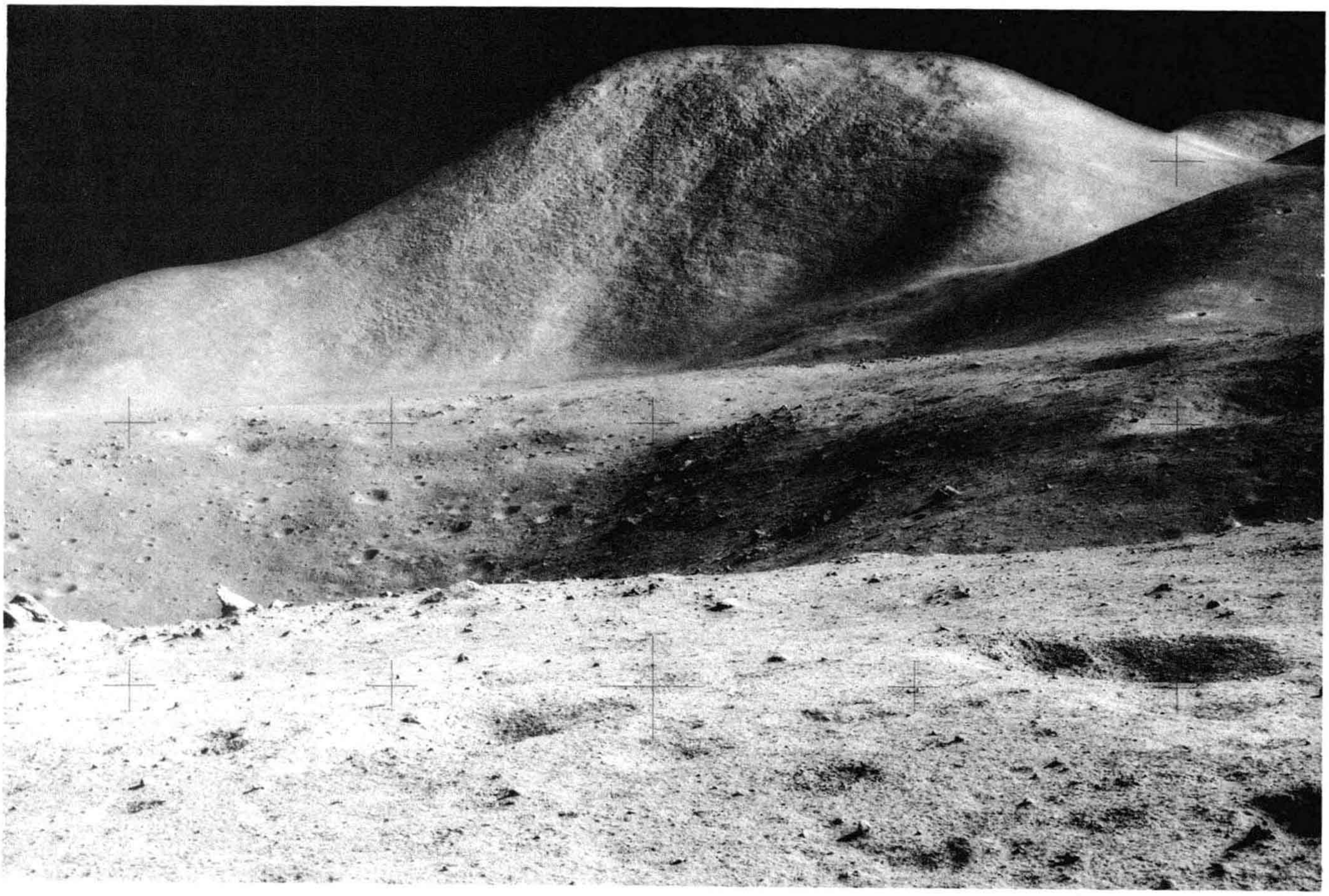


FIGURE 1.1
The lunar surface near the landing site of *Apollo 15*. *(NASA Photograph.)*

FIGURE 1.2
The Po Shan road landslide, Hong Kong, 18 April 1972.
(Photo courtesy Hong Kong Government, Geotechnical Control Office.)

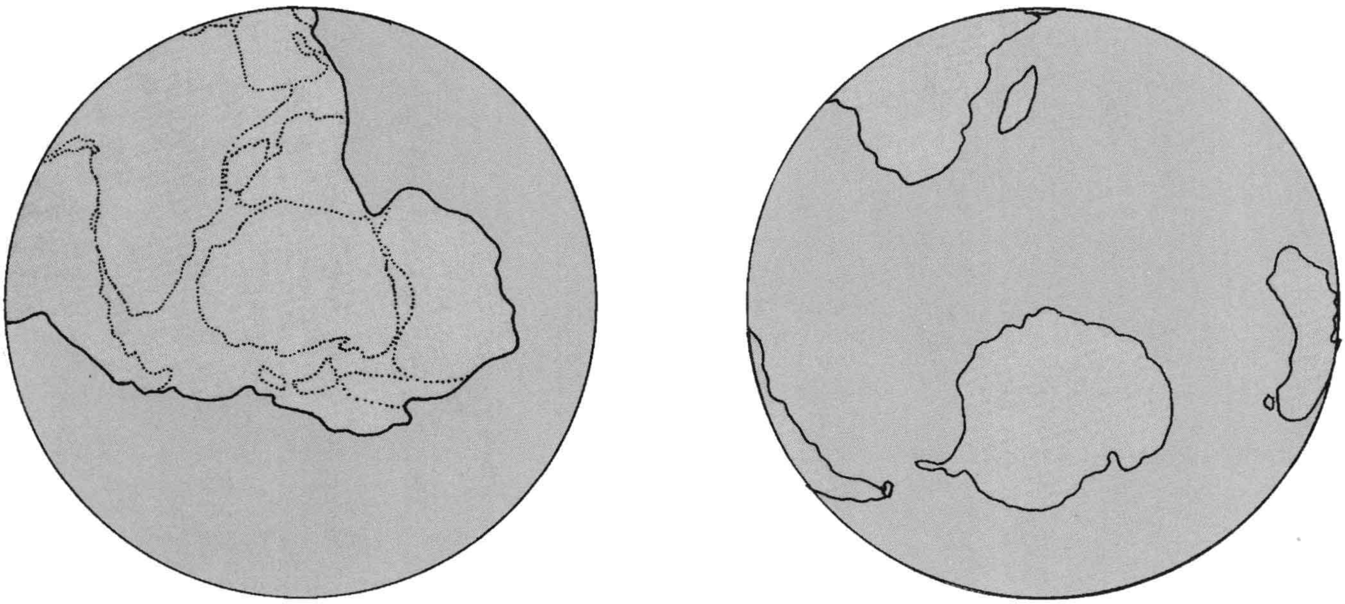


FIGURE 1.3
(a) The ancient continent of Gondwana, a vanished world, viewed from a point over the South Pole. (b) The earth today from the same point in space.