Prologue

Arrangement of Topics in Historical Geology

> Not *how* the world is, is the mystical, but *that* it is. —Wittgenstein.[1]
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> But what she was writing wasn't science at all. It was history. The past. Why would that matter, when there was so much to do and discover in the present? —Orson Scott Card, *Ender in Exile*.[2]

Historical geology is the study of Earth's prehistory; the time before human hands kept written records. The time before the Beginning. The time before Time.[3]

How can we delve into that past? There are, we find, records. These are rocks. Their layers are the "pages" of the story. Most of the pages are missing. However, scattered books of these pages can be found and are datable. Not surprisingly, the older the book, the rarer and less complete it is. Books of the same age show a consistency of content and style. A remarkable discovery is that even the oldest books are written in essentially the same language that continues today. But the older a book, the more unfamiliar is the world it describes.

How can we arrange the tales we find in these books? We can place them in historical order. But the world is vast, and, no matter their interest, old tales from different places do not necessarily help us understand more recent ones. If that were so, the story of the Aztecs would, for example, help us understand Medieval Europe. And that would help us piece together the story of the living !Kung of Africa. Obviously not. What we can do successfully with the stories that we find is to place them in chronological order going back from the present. Then, as recent tales accustom us to variety, the world of older times becomes less surprising and so less incomprehensible as insights are gained that ease understanding. What could have bewildered by its strangeness now delights. Surprises are everywhere. We are encouraged to explore.

The portal to prehistory was opened two hundred years ago when James Hutton realized that geological processes which can be seen operating today were also operating in prehistory. That is the key! We must work back in time as in an archaeological dig.

History tries to make sense of the present in terms of human-produced documents. Historical geology tries to discover the facts of prehistory in terms of the rock record. It does so as follows: We can know by direct observation and written accounts what geological processes during historical times have caused change. And we can also identify what products remain that record their operation. Any of these same products that survive from prehistorical times are understood, most simply, to record the operation of familiar geological processes. Physical geology, not the subject of this book, is devoted to describing these geological processes and the products that they bring into being. In historical geology we accept the findings of physical geologists as we do the findings of physicists, chemists, and biologists, and apply these where they can help us read the rock record of prehistory.

Our frame-story, to which we can forever add, organizes topics so that we are taken back in time in steps. On each step we dwell awhile so that the vista becomes familiar. From our findings we piece together stories. Some survey the scene and document past contingencies. Some wrap about the arrow of time and are ramps that can lead us back. Our experience is that our tales can have good middles but often vague, incomplete, lost, or abrupt are their beginnings and endings. Here, gathering and hunting can be done. Most trails become many in their ascent. Which would we have followed had we not descended? No signposts point out the way we came. To either side are labyrinths. For these we find clews (balls of thread) and could venture therein. But on this trip we hurry on. Sometimes on the way, tools need to be fashioned to bring into focus ancient scenes. This is the way the pioneers of our science traveled.

Causality and contingency in historical geology, like nature and nurture in behavioral science, need to be assessed for their contributions to what we find. A tale told of Earth's history and the evolution of life running forward in time implies causality. This may be true for runs of time but the lie to it is when the reader starts to realize that nothing laboriously learned about the 160 million years of the dinosaurs existence in the Mesozoic world has much bearing on the tale of the Cenozoic mammals to which a fish-amphibians-reptiles-mammals song would segue. Nor is the geology of the Cenozoic America relatable in straightforward way to the world of Pangea and before. A tale told of Earth's history and the evolution of life stepping back in time enforces an appreciation of contingency. Yes, the dinosaurs are a valid focus of interest in that they did exist. The world of Pangea can be reconstructed, as can different worlds and lives before. To each, we bring our fascination. ❑

Figure a1.1 **Archbishop James Ussher** (1581-1656)

Ussher, Archbishop of Armaugh (Ireland), is best remembered for his calculation of Earth's age using chronologies found in the Old Testament of when who was begat in terms of the Julian calendar winding back though the astoundingly long lives of Noah, Lamech, Methuselah, Enoch, Jared, and Seth, born in the image of Adam who was created in the image of God. A long tradition (begun in the 4th century AD by such as Eusebius of Caesarea and Eusebius Hieronymus since Augustine (354-430) had cried "there is no time before the World") of totting these up and arriving at about 6000 years for Earth's age was stunningly concluded when Ussher (innocently unaware of the reality of time zones) pegged in his *Annales*, 1650 [2] (translated from Latin into English in 1658)[3] the beginning of time fell upon the entrance of the night preceding Sunday 23 October 4004 BC. On this first full day, God created the angels.[4] A quibble was that John Lightfoot (1602-1675), Vice-Chancellor of Cambridge, England, had determined in 1642 that (as translated by Andrew D. White)[5] "heaven and earth, centre and circumference, were created [12 September 3927 BC he confides in 1644][6] all together, in the same instant, and clouds full of water," and "this work took place and man was created by the Trinity at nine o'clock in the morning" (a gentlemanly hour to set about business).

Both can be excused for the confusing detail respectively of evening and 9 a.m. because when they worked the concept of time, which is natures "way of making sure that everything doesn't happen at once,"[7] being different at different longitudes as well was not known. Only on 11 December 1847 was a standard time first imposed in Britain based on the equation of time for noon at the prime meridian through the Royal Observatory in Greenwich. Thereafter, in Canada, Sandford Fleming, in the 1870s, could devise world time zones bounded by degrees of longitude. Time before had been a local matter. Towns kept the hours by counting from solar noon as revealed on a sundial. Neighbors may then have lived with different hours and minutes, but in the pre-industrial world, as Clark Blaise points out in *Time Lord*, 2001, "no one could go far enough or fast enough in an hour, let alone in a day, to run into confusion."[8]

Isaac Newton's 17th century cabalistic findings (revealed in 1936) put civilization's beginning at around 980 BC (before Christ) and the end of the world, as we know it, to be the Battle of Armageddon, A (*anno*, in the year of) D (*Domini*, our Lord) 2060.[9] Recently, a like quest has been elaborately repeated with less satisfactory (being anachronistic for our age) results: The Old Testament includes detailed genealogies and lengths of time that certain persons lived and certain kings reigned, and the durations of other historical events such as the Exodus. Harold Camping, beginning in 1972, linked these together as a continuous chain that starts with the first six days of the creation. In this duration, he identified astronomical phenomena as time markers. For these, Gregorian calendar dates can be given. A scaling of the whole assemblage is then possible, such as the birth of Jesus at 7 BCE, standing for *before the Common era* (as first used by Lady Katie Magnus), and his crucifixion at 33 CE (Common era).[10] Camping's book *1994* gives his hypothesis that the many time markers that allow for the beginning of time to be known are also there to foretell of the end. The evident year of Creation is 11,033 BCE. The last possible day for the world was 2 October 1994.[11]