

# FOSSILS

A watercolor illustration of a prehistoric landscape. In the foreground, a river flows through a valley. On the right bank, a large, grey, dinosaur-like creature with a small horn-like structure on its head stands next to a smaller, similar creature. In the middle ground, a yellow dinosaur-like creature with a long neck and a small crest on its head stands near the water. In the background, there are rolling hills and a sky with two large, brown, bat-like creatures flying. The overall style is soft and artistic, using a palette of greens, blues, yellows, and browns.

AND  
THE

# FLOOD

**EXPLORING LOST WORLDS WITH  
SCIENCE AND SCRIPTURE**

by the author of *The New Creationism*

# PAUL GARNER

ILLUSTRATIONS BY JEANNE ELIZABETH

foreword by **DR. ANDREW A. SNELLING**, *Answers in Genesis*



## Endorsements for *Fossils and the Flood*

As a child, I used to love poring over books on dinosaurs and fossils, revisiting the photographs and illustrations over and over again. For a long time, I have considered it a shame that no such books exist from a biblical perspective. I am now happy to say that such a work does exist: *Fossils and the Flood* by Paul Garner. I was thrilled to see a clear presentation of a creationist understanding of earth history, and I was perhaps even more thrilled to see depictions of fantastic creatures that never make it into the public eye, from the tiny *Microdictyon* to the bulky *Moschops*. This book is a delight filled with treasures for children, families, and future scientists who want to understand paleontology from a biblical worldview.

DR. MATTHEW MCLAIN,  
Associate Professor of Biology and Geology,  
The Master's University, Santa Clarita, California

*Fossils and the Flood* is a delightful book for the young and the young-at-heart. It reminds me of the field guides and dinosaur books that captivated me as a boy and nourished my fascination with paleontology, and yet surpasses them. For in this richly illustrated and thoughtfully written book, Paul Garner leads us in a more excellent understanding of the fossil record: that it is a testimony to the great Creator and Judge of this world.

Paul Garner possesses a rare skill among scientists: he communicates technical ideas to the general audience with clarity, passion, and great skill. The result is an eminently readable book that brings the reader to a deeper understanding of the history of the world as sketched by the pages of Genesis and enriched in detail from the findings of science.

The written descriptions of the pre-Flood biomes pair with the visual depictions marvelously. There is enough detail to convey a real sense of each environment and the creatures that inhabited them. By weaving all the biomes together, the reader is transported to a world that is richly filled with living beings both familiar and exotic.

*Fossils and the Flood* finds itself equally useful in the field as it does in the library. The section on major fossil groups has so many helpful images of common fossils that the amateur collector should make sure to take this book to the outcrop along with their hammer, goggles, and collection bags.

DR. MARCUS ROSS,  
CEO, Cornerstone Educational Supply;  
Fellow, Center for Creation Studies,  
Liberty University, Lynchburg, Virginia

Books on fossils and geology can sometimes be hard to read but this book is certainly an exception. It is very easy to follow despite being scientifically comprehensive. And the amazing illustrations make it a joy to read. I like the way it has separate sections on historical details and answers to some of the 'big questions' such as the Flood and Noah's ark. Anyone interested in earth history must get this book.

PROFESSOR STUART BURGESS,  
Professor of Engineering Design,  
University of Bristol, UK

Our conception of the past is inevitably shaped by our experience of the present. *Fossils and the Flood* goes a long way in helping us to overcome that limitation, unveiling a lost world. The reconstruction Paul Garner provides is not speculation, but informed by evidence from geology understood within the secure historical framework of scripture. All this is brought to life in a book saturated with stunning and detailed artwork that is scientifically nuanced.

Deceptively easy to read, this book contains a wealth of learning that showcases the best of contemporary creationist research. It cannot fail to excite a new generation with the scientific beauty and power of a creation model—and inspire them to develop it further! If you want to know what a creation model is, and why it is worth pursuing, I can't think of a better place to begin.

DR. STEPHEN LLOYD,  
Pastor, Hope Church, Gravesend, Kent;  
Researcher and Lecturer, Biblical Creation Trust, UK

I am committed to the theology of biblical creationism. This does, however, leave me with lots of questions in the face of the popular flood of evolutionary assumptions. This book introduces plausible explanations for the geology of a young earth. I valued the honesty and integrity of the book. It acknowledges that more research is needed in order to develop our understanding of the fossil record. This book will encourage many and intrigue others. I share the author's hope that it will inspire some to enter the world of geology and other sciences to do the hard work of research with clarity and respect, so that non-scientists like me can be built up in our faith.

PAUL SPEAR,  
Pastoral Dean,  
Union School of Theology, Bridgend, UK

Paul Garner has, again, produced a much welcomed—and needed—work. This time, Garner and (illustrator) Jeanne Elizabeth provide younger readers two books in one: a comprehensive survey of early earth history and an overview of the science of paleontology. *Fossils and the Flood* provides a superbly articulated introduction to the creation model. Readers will find a detailed narrative for creation history that is accurately illustrated at every step.

Younger aspiring scientists will also find an excellent introduction to the science of paleontology—all framed in terms of creation geology, geography, and biology. The authors include an illustrated survey of every major fossil group.

Beyond this being the most accurate creation model articulation for a younger audience, I would strongly encourage older readers to not underestimate the contents. Garner skillfully weaves together nuanced threads of the creation model that are sometimes misunderstood by even mature creationist audiences. My hope is that *Fossils and the Flood* will reach a wide audience.

DR. NEAL DORAN,  
Professor of Biology and Director,  
Center of Creation Research,  
Bryan College, Dayton, Tennessee

Children and adults alike will spend hours looking at this unique and beautifully illustrated book about earth history and fossils from a biblical perspective. The book stimulates the imagination about what the earth was like before, during, and after the great Flood of Noah. The text of the book includes the most recent and up-to-date ideas of creation scientists but holds to a literal interpretation of scripture and explains it with an enjoyable writing style which the layperson will understand. Everyone needs a copy of this on their coffee table!

DR. JOHN WHITMORE,  
Senior Professor of Geology,  
Cedarville University, Cedarville, Ohio

Paul Garner has done the church a great service. In page after page, he unveils the astonishing beauty and diversity of God's creation from a Christian perspective. The book exudes confidence in scripture and natural science's capacity to glorify God. Accompanying Garner's prose are Jeanne Elizabeth's wonderful illustrations, which offer a feast for the eyes! I highly recommend *Fossils and the Flood* to every young believer. If you are remotely interested in science, you will devour this book—receiving delight, instruction, and encouragement with every page.

DR. HANS MADUEME,  
Associate Professor of Theological Studies,  
Covenant College, Lookout Mountain, Georgia

*Fossils and the Flood* is a magnificent and grand sweep of the wealth of discoveries that have been made in geology which give overwhelming evidence for the worldwide Flood and the rapid burial of plants and creatures across the globe. Paul Garner has made the evidence very accessible, such that the layman without specialized knowledge can understand each section. There are excellent dioramas to summarize the flora and fauna that were in existence prior to the Flood, and Garner has provided further detail of the references to these creatures at the website which accompanies this book ([www.fossilsandtheflood.net](http://www.fossilsandtheflood.net)). He rightly points out that there was a much greater diversity of creatures then than we have today, and that this is apparent in the fossil record.

Garner presents an excellent description of the Flood and the possible mechanics of how it came about, along with the explanation of how zones of different ecosystems of creatures may have been buried. What is especially of interest is the strong evidence of rapid burial, the end of the Flood, and the diversification of the animal kinds that came off the ark of Noah. The explanation of human diversity after the Flood and through the single subsequent ice age is very compelling. His thorough treatment of how to understand the different types of fossils will be, for many readers who are amateurs at this, a source of great inspiration as they read these final pages. This book is a heartening answer to the evolutionary philosophy with which we are so often bombarded. Few books have given the overall picture of geology and how to interpret the rocks and fossils within a biblical context. This book is a milestone that will be referred to for many years to come.

PROFESSOR ANDY MCINTOSH,  
Emeritus Professor of Thermodynamics,  
University of Leeds, UK



# F O S S I L S — AND THE — F L O O D

EXPLORING LOST WORLDS WITH SCIENCE AND SCRIPTURE

by PAUL GARNER

Illustrations by JEANNE ELIZABETH



**Paul Garner** is a full-time researcher and lecturer for Biblical Creation Trust in the United Kingdom. He has a master's degree in geoscience from University College London, where he specialized in paleobiology. He is a fellow of the Geological Society of London and a member of the Geological Society of America, the Palaeontological Association, and the Society of Vertebrate Paleontology. His first book, *The New Creationism: Building Scientific Theories on a Biblical Foundation*, was published by Evangelical Press in 2009.

**Jeanne Elizabeth** studied fine art at Harrow Art College, qualifying for her National Diploma of Design. She has been employed as an illustrator in a London firm, and also accepts private commissions. She is proficient in both illustration and portraiture, using a variety of media.

FOSSILS AND THE FLOOD: EXPLORING LOST WORLDS WITH SCIENCE AND SCRIPTURE  
by Paul Garner. Illustrated by Jeanne Elizabeth.

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F O S S I L S  
— AND THE —  
F L O O D

*EXPLORING LOST WORLDS WITH SCIENCE AND SCRIPTURE*

*by* PAUL GARNER

*Illustrations by* JEANNE ELIZABETH

*Dedicated to my mum, Carolyn Garner.*

*Thank you for everything.*

*“For I the Lord thy God will hold thy right hand, saying unto thee, Fear not; I will help thee.”*

*Isaiah 41:13*

## FOREWORD

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This is a magnificently illustrated book that skillfully and systematically walks through the fossils preserved in the earth's rock record within the biblical framework of earth history centered on the Genesis Flood. Carefully crafted, easily understood descriptions introduce readers to the pre-Flood biological communities that lived in different geographic zones and were thus progressively destroyed as the floodwaters rose and buried them in the sediment layers spread across the continental fragments produced by the erupting of the fountains of the great deep splitting apart the original supercontinent. Next is a primer on fossils and how they form and are preserved, followed by a survey of all the major classified fossil groups.

Throughout, the Bible is handled robustly and the powerful scientific evidence presented that confirms the reliability, truth, and authority of the Bible. I can thus thoroughly and enthusiastically endorse this book and recommend it to children of any school age, budding young paleontologists, parents, and even grandparents. You'll learn so much about this beautifully presented fossil evidence and be superbly equipped to defend God's Word.

DR. ANDREW A. SNELLING,  
Director of Research,  
Answers in Genesis (USA)

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## PREFACE

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This book has its origins in my childhood. As a boy I was fascinated by tomes reconstructing the history of life from the fossil record. The dioramas they contained, depicting past environments populated with long-vanished animals and plants, captivated my interest and even influenced my decision later in life to study geology.

Invariably, these books were written from an evolutionary perspective. Now as an adult and a creationist researcher I wonder, *Where are the books that can inspire similar interest in young people today, but which present the evidence of the fossil record within the biblical framework of earth history?*

There are books written for Christian families that deal with aspects of the Bible's record of early earth history, many focusing on the account of Noah's Flood. But too often they get the biblical and scientific details wrong. One common error is to inaccurately portray the size and likely shape of the ark. Another is to depict modern species on the ark (such as lions and tigers) rather than the ancestral representatives of their kinds, as would have been the case (such as the ancestral cat that, in all probability, gave rise to modern lions and tigers).

Even creationist books that try to rectify these mistakes can still be at odds with the findings of cutting-edge creationist research in other respects. For instance, they may portray Noah and his family as the typical Bible story characters—too modern in physical appearance and dress. Or they may include dinosaurs on the ark but overlook all the other kinds of extinct animals that must have been represented.

So this book is my attempt to present an informed and coherent synthesis of the best biblical and scientific scholarship within creationism on the theme of the fossil record. In my efforts to get the details right, I consulted with several experts. In particular I am grateful to Dr. Kurt Wise

(PhD invertebrate paleontology), Dr. Andrew Snelling (PhD geology), Dr. Todd Wood (PhD biochemistry), and the late and much-missed Dr. Roger Sanders (PhD botany) for their insights, comments, and criticisms while I was preparing this manuscript. I know that the book has benefited enormously from the generous time and effort they expended in helping me, though this should in no way be taken to suggest that they agreed with everything I wrote. Any remaining errors, of course, are my sole responsibility. I am also grateful for the editorial input of Thomas Purifoy, Mike Matthews, and Ben Kelley, whose suggestions greatly improved the finished manuscript. Ben also deserves recognition for his stunning work on the book design.

I am also immensely fortunate to have had the opportunity to work with such a talented illustrator as Jeanne Elizabeth. Though she was unused to taking direction from “difficult” scientists, she threw herself into this project with great enthusiasm and aplomb! I am sure that readers will agree that Jeanne's marvelous paintings are the making of this book and give it tremendous visual appeal. This is her book every bit as much as it is mine, perhaps more so.

Since I intended for this book to be read by lay people and not scholars, I have resisted the temptation to use footnotes in the text. Readers who would like to delve into the evidence (both biblical and scientific) on which the book's claims are based have a resource in the notes and references listed at the back of this book and, even more extensively, on the web page that accompanies this book (see “Recommended resources” and [www.fossilsandtheflood.net](http://www.fossilsandtheflood.net)).

I hope you enjoy what you are about to read—and all the wonderful illustrations. Perhaps there will even be a young reader whose imagination about the past is captured by what they read and see, just as mine was all those years ago. How gratifying it would be to know that a researcher of tomorrow decided to take up the scientific quest because they picked up this book.

*Paul Garner*

**“The works of the LORD are great, sought out of all them that have pleasure therein.”**

*Psalm 111:2*



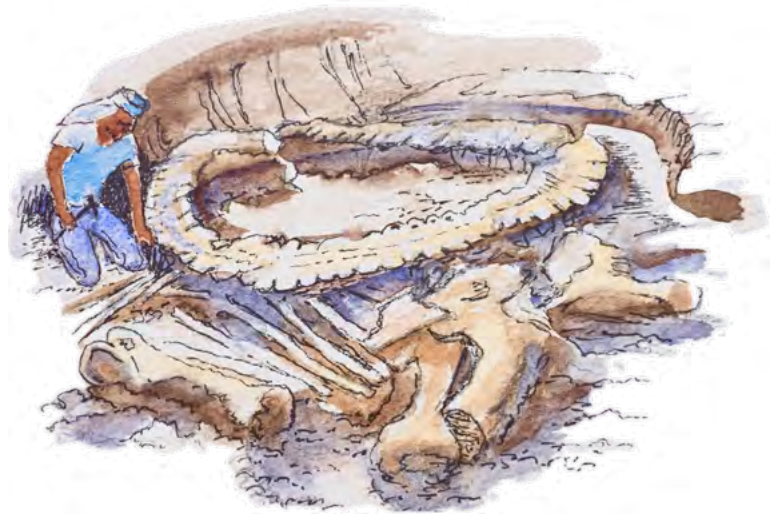
# WHAT THIS BOOK IS ABOUT

This book is about the worldwide Flood that took place in the days of Noah.

We know quite a lot about the Flood because it was recorded for us in the book of Genesis, the first book of the Bible. We can trust this written record because, as 2 Timothy 3:16 tells us, “All scripture is given by inspiration of God,” and we know that God is always truthful. Numbers 23:19 says, “God is not a man, that he should lie” (see also 1 Samuel 15:29; Romans 3:4; Titus 1:2).

But the Bible does not answer all of our questions. The Flood also left evidence that can be collected and studied by scientists. This scientific evidence gives us additional information about how the Flood happened. We can even begin to work out what the world was like before the Flood. Much of this evidence comes from the study of fossils.

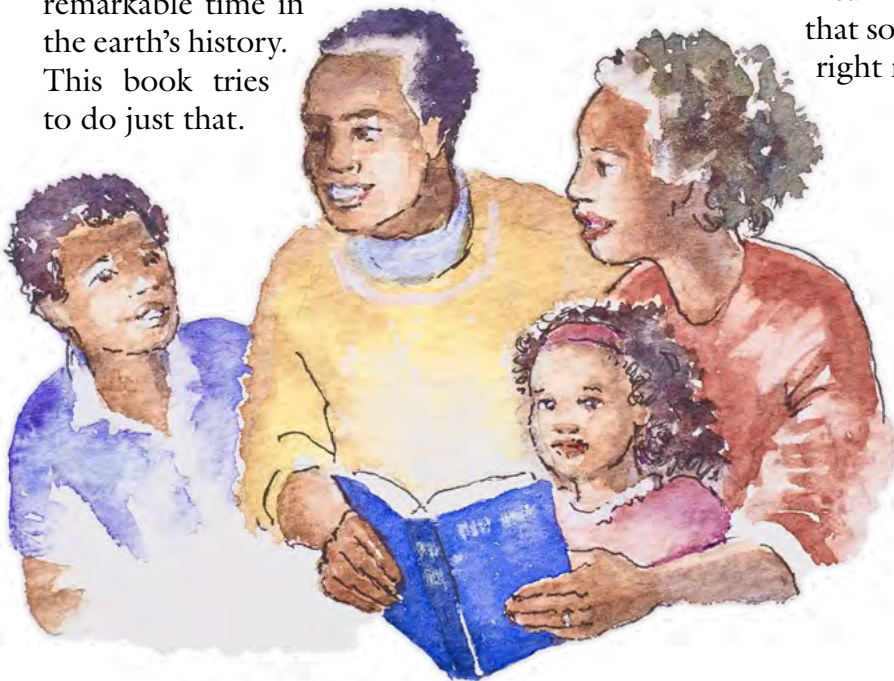
With the help of God’s Word and clues from our scientific studies we can piece together a fuller picture of this remarkable time in the earth’s history. This book tries to do just that.



God has given us the tools of scientific investigation so that we can discover things not directly revealed in the Bible, but this information is never as reliable as the Bible itself.

Of course, scientific answers are never final. Scientific ideas change as new evidence comes to light and some may turn out to be completely wrong. But the Bible’s historical record of the Flood is true and will never change.

This book is our attempt to take the puzzle pieces before us and put them together into a meaningful picture. But you should remember that some of the details are simply our best guess right now.



The Bible is our most important source of information about the Flood because it was inspired by God and is therefore completely reliable.



## HOW THIS BOOK IS ORGANIZED

This book is divided into six main sections.

The first section considers what the Bible tells us about *the early history of the earth* as well as the kinds of insights that we can glean from scientific investigation.

The second section looks in detail at the old world—*the world before Noah's Flood*. It seeks to reconstruct from the biblical and scientific clues the major communities of plants and animals that existed on the earth at that time.

That world was destroyed by the Flood, however, and the third section of the book describes *how the Flood unfolded*, transporting and burying those created biomes to produce the fossil record.

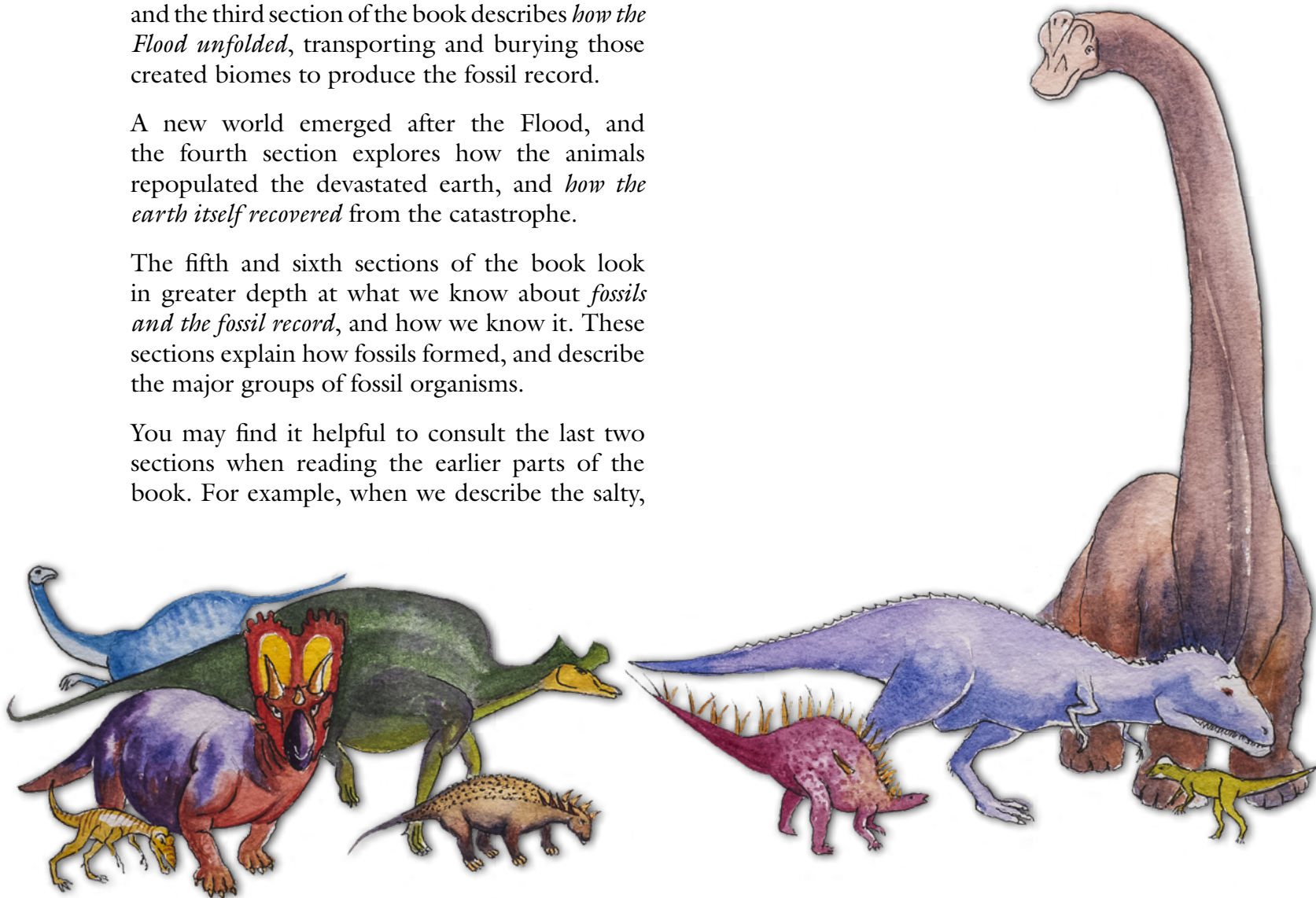
A new world emerged after the Flood, and the fourth section explores how the animals repopulated the devastated earth, and *how the earth itself recovered* from the catastrophe.

The fifth and sixth sections of the book look in greater depth at what we know about *fossils and the fossil record*, and how we know it. These sections explain how fossils formed, and describe the major groups of fossil organisms.

You may find it helpful to consult the last two sections when reading the earlier parts of the book. For example, when we describe the salty,

hot-water reefs of the old world, you may want to turn to the pages on microfossils to find out more about stromatolites.

The book concludes with some *recommendations for further study*, including books, DVDs, periodicals, and websites, and a *glossary* of significant terms, which appear in bold at key places in the text.





# THE EARLY HISTORY OF THE EARTH

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The Bible gives us a clear, historical framework for the early history of the earth, while science is a God-given tool that allows us to work out many of the details of these historical events. By studying both the Bible and science, we can gain a more complete picture of the earth's early history, including Creation and the Flood.

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A watercolor illustration of Noah's Ark. The ark is a large, yellow, multi-story building with a ramp leading to a blue entrance. A large crowd of people and animals is gathered on a green hillside leading up to the ramp. The sky is a mix of blue and white, suggesting a bright day. The style is soft and artistic, with visible brushstrokes and blended colors.

## WHAT DOES THE BIBLE TELL US?

The Bible gives us a clear outline of the early history of the earth.

It tells us that God made all things in six days only thousands of years ago (**Creation**). But this was soon followed by the fall into sin of the first man, Adam, which brought death and corruption into the world (**Fall**).

By the time of Noah, the world had become so corrupt and full of violence that God judged it with a worldwide deluge (**Flood**). During the Flood, humans, birds, and land animals were preserved on the ark.

After the Flood, human languages were confused at Babel, causing the people to scatter across the face of the earth (**Babel**). Also, human lifespans rapidly declined.

We will consider each of these events in more detail later. This God-given outline of the earth's history is important because it guides the way we think about the scientific evidence throughout this book.

## WHAT CAN WE LEARN FROM SCIENTIFIC RESEARCH?

The Bible gives us a true and reliable outline of the earth's early history. But God gives us the exciting task of using scientific research to find out many of the details of these events.

We can discover some things about the history of our world by studying living creatures (the science of **biology**).



Biology is the study of living organisms.

Other clues come from investigating rocks, minerals, and the structure of the earth (the science of **geology**).



Geology is the study of the earth.

Still more can be learned by studying creatures that lived in the past, now preserved as **fossils** in the earth's rocks (the science of **paleontology**).



Paleontology is the study of fossilized organisms.

Bible-believing scientists carry out field research, conduct laboratory experiments, and develop scientific theories in each of these areas, guided by the framework of Creation, Fall, Flood, and Babel given in scripture.

## SOME BIBLE BELIEVING SCIENTISTS OF TODAY

### Biologist Dr. Gordon Wilson

- PhD in environmental science
- Senior fellow of natural history, New Saint Andrews College, Idaho

Dr. Wilson says: “We are studying the direct handiwork of God, and it gives us insight into His creative and artistic character, so biology is part of theology.”



### Geologist Dr. Steven Austin

- PhD in sedimentary geology
- President of the Creation Geology Society

Dr. Austin says: “The fact is that geologic features form rapidly and not over millions of years. The geologic evidence is entirely consistent with the biblical timescale.”



### Paleontologist Dr. Matthew McLain

- PhD in earth sciences
- Associate professor of biology and geology, The Master’s University, California

Dr. McLain says: “From the tiniest, ornately-crafted diatom to 80-ton, 100-foot-long sauropod dinosaurs, the fossil record puts God’s glory on display in a magnificent way.”



## PUTTING THE PUZZLE PIECES TOGETHER

The goal of Bible-believing scientists is to reconstruct the early history of the earth in a manner that is consistent with both the historical framework in the Bible and the scientific evidence.

That task is like assembling a complex jigsaw puzzle. Scripture provides the edge pieces that set the boundaries, as well as some crucial inside pieces. Science provides many additional pieces. But, unlike a jigsaw puzzle, we will never have all the pieces and there is no box to show us what the completed picture should look like. Despite these challenges, a coherent picture is emerging from this research effort.

The most significant geological event recorded in the Bible is the Flood of Noah—an event that must have left evidence in the rock record, as we will explain later in the book. This suggests that we can divide the earth’s rock layers, and the fossils they contain, into those that were deposited before the Flood, those that were deposited during the Flood, and those that were deposited after the Flood.

In this book we refer to the world before the Flood as *the old world*, and the world after the Flood as *the new world*. In the next section, we will explore the old world, and seek to reconstruct it from the biblical and scientific clues available to us—with particular reference to its origins, its age, its physical features, and its animals and plants.





# THE OLD WORLD

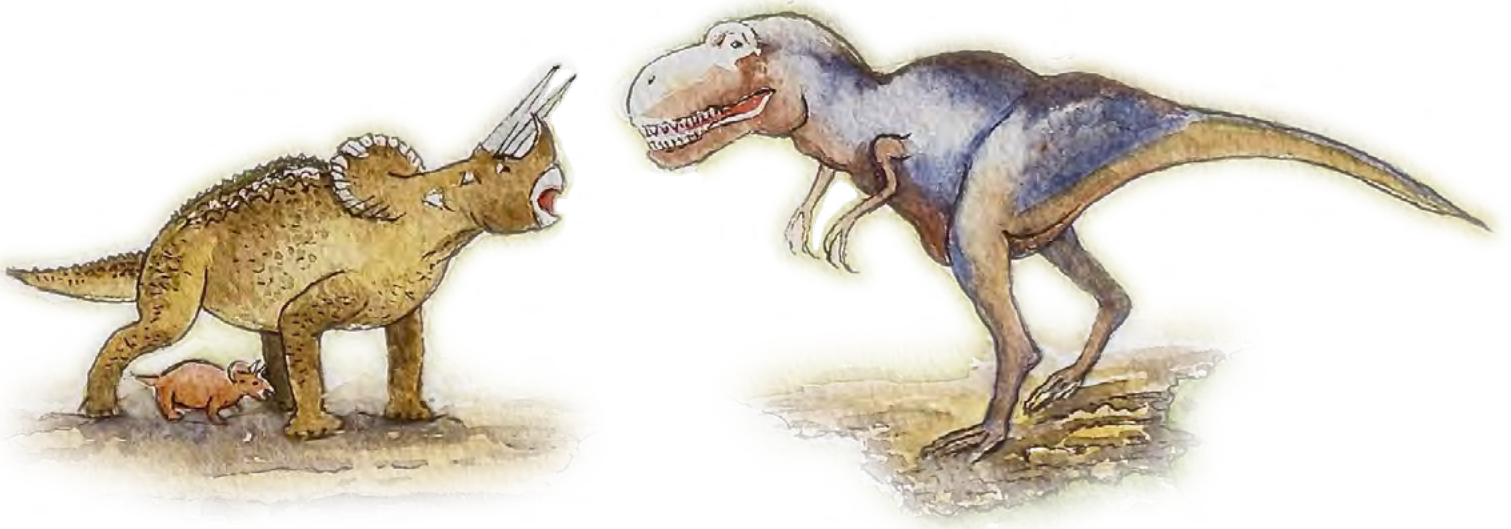
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Clues from the Bible and science allow us to reconstruct the world before Noah's Flood—its continents and oceans and its communities of plants and animals. Many of these communities are now extinct, but we can find out about them by studying their remains in the fossil record.

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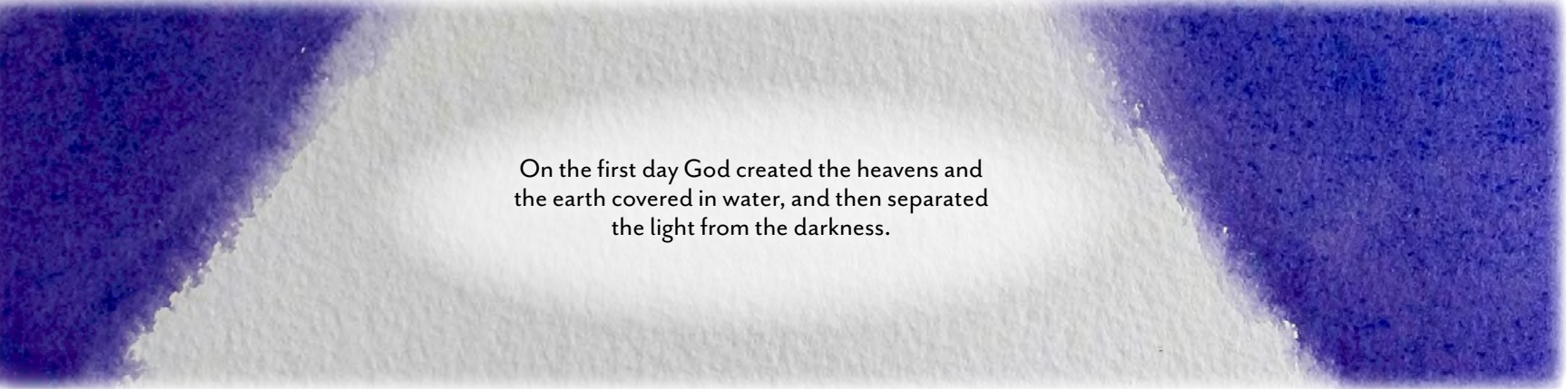


## CREATION WEEK

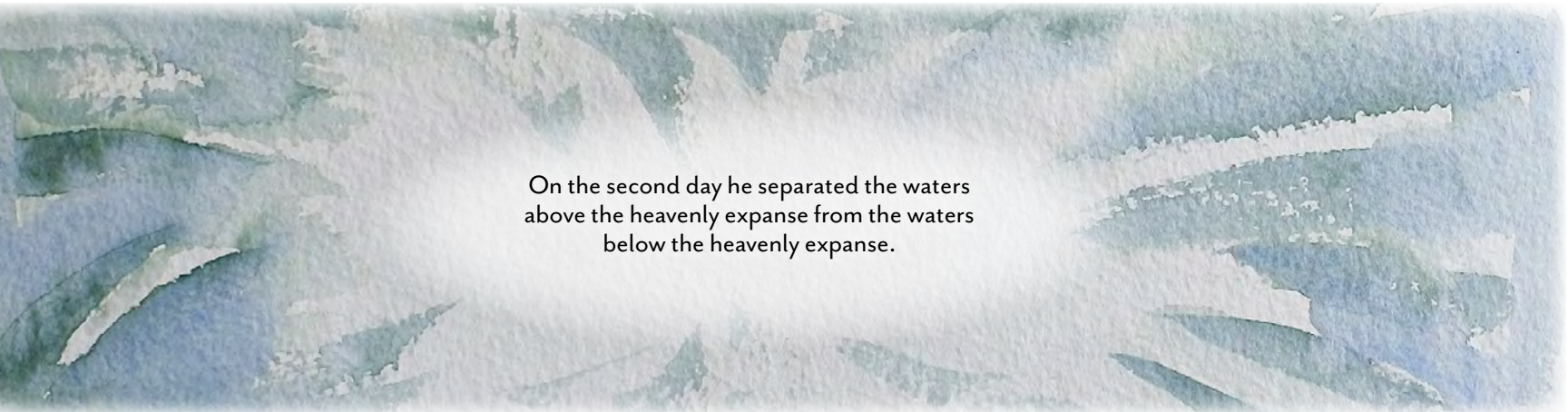
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We begin our **reconstruction** of the earth's history by considering what the Bible says about the earth's origins. It is important to start with the Bible because God the Creator inspired its human authors to write down exactly what he wanted them to, without any mistakes or errors.

The Bible's account of Creation (Genesis 1:1–2:4) tells us that God made the heavens, the earth, and everything in them in just six days:



On the first day God created the heavens and the earth covered in water, and then separated the light from the darkness.



On the second day he separated the waters above the heavenly expanse from the waters below the heavenly expanse.

▼ On the third day he separated the dry land from the seas and made the plants.





▲ On the fourth day he created the sun, moon, and stars.



▲ On the fifth day he created the flying creatures and the swimming creatures.



▲ On the sixth day he created the land animals and the first people—Adam (from the dust) and Eve (from Adam's side).

▼ By the end of the sixth day, Creation was finished. And so on the seventh day God rested from all that he had done.



# HOW LONG AGO DID CREATION TAKE PLACE?

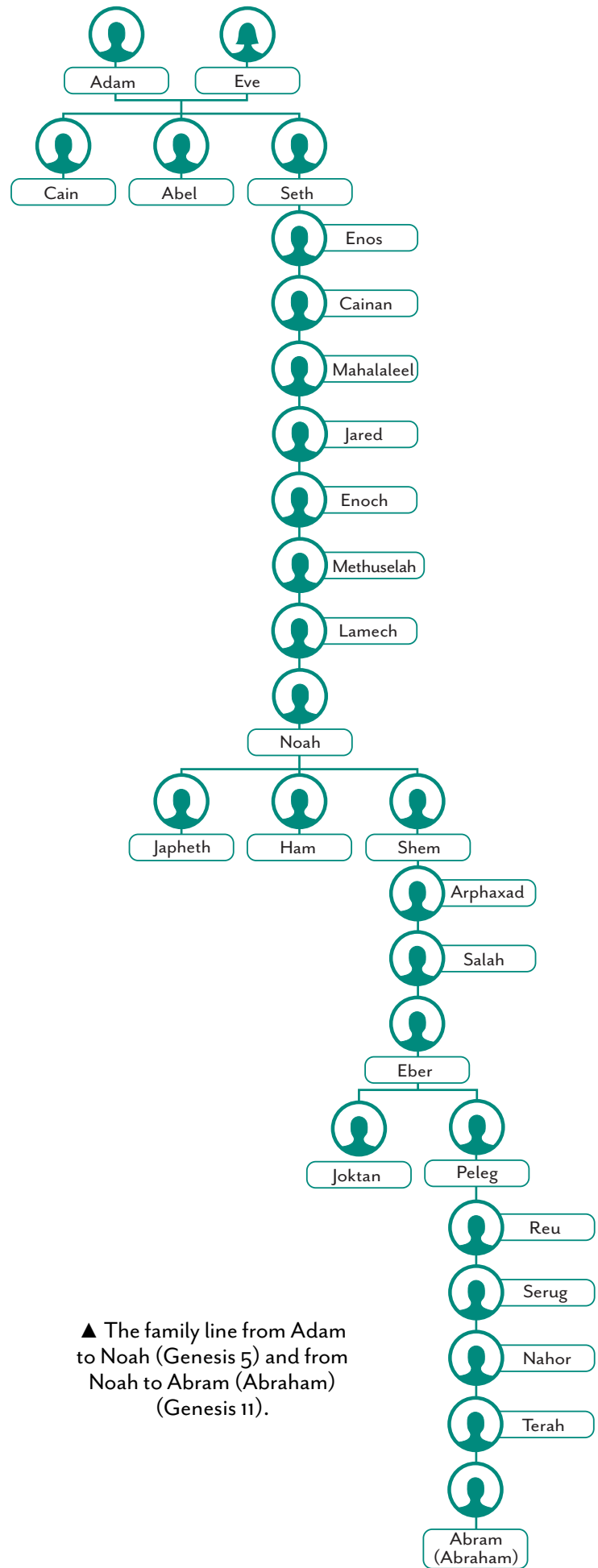
The Bible also gives us information that allows us to work out how long ago Creation took place.

Two chapters in Genesis provide important clues: Genesis 5, which traces the family line from Adam to Noah, and Genesis 11, which traces the family line from Noah to Abraham. By adding up the ages in these family lines we can in principle work out when Adam was created.

## WERE THE CREATION DAYS ORDINARY DAYS?

There are many reasons to think that the days of Creation were ordinary days, each about twenty-four hours long:

1. Genesis 1:5 uses the Hebrew word *day* to describe the daylight portion of a day and the entire light/dark cycle—in other words a normal day.
2. Each day of Creation is given a number. Elsewhere in the Old Testament this always means a normal day.
3. Each day consists of an evening and a morning. Again, this always refers to a normal day elsewhere in the Old Testament.
4. Genesis 1 does not use other Hebrew words for time (e.g. *olam*—meaning *antiquity* or *eon*), which could have more clearly conveyed the idea of long or indefinite creation-days.
5. Exodus 20:8-11 draws a parallel between the Creation week and our week. We are to remember the Sabbath day and keep it holy because God created in six days and rested on the seventh.



▲ The family line from Adam to Noah (Genesis 5) and from Noah to Abram (Abraham) (Genesis 11).

The task is complicated somewhat by the fact that different manuscripts of the Old Testament give different numbers. On the one hand, the standard Hebrew text of the Old Testament—the Masoretic text—suggests that Adam was created about 2,000 years before Abraham. On the other hand, the Greek text of the Old Testament—the Septuagint—suggests this period may have been about 3,400 years. Most scholars favor the Masoretic text, though some prefer the Septuagint. The difference between them is small, however, when both are contrasted with the long ages of conventional **chronology**.

Since we know that Jesus lived about 2,000 years ago and Abraham about 2,000 years before that, we can sum the ages to estimate that Creation must have taken place about 6,000 years ago (according to the Masoretic text) or 7,400 years ago (according to the Septuagint text).

Many people (including most scientists) do not accept such a recent date for Creation. They think that the world is billions of years old, and they appeal to dating methods based on the decay of radioactive atoms to support a much longer time scale. We can see from below, however, that there are many problems with these methods.

## RADIOMETRIC DATING AND ITS ASSUMPTIONS

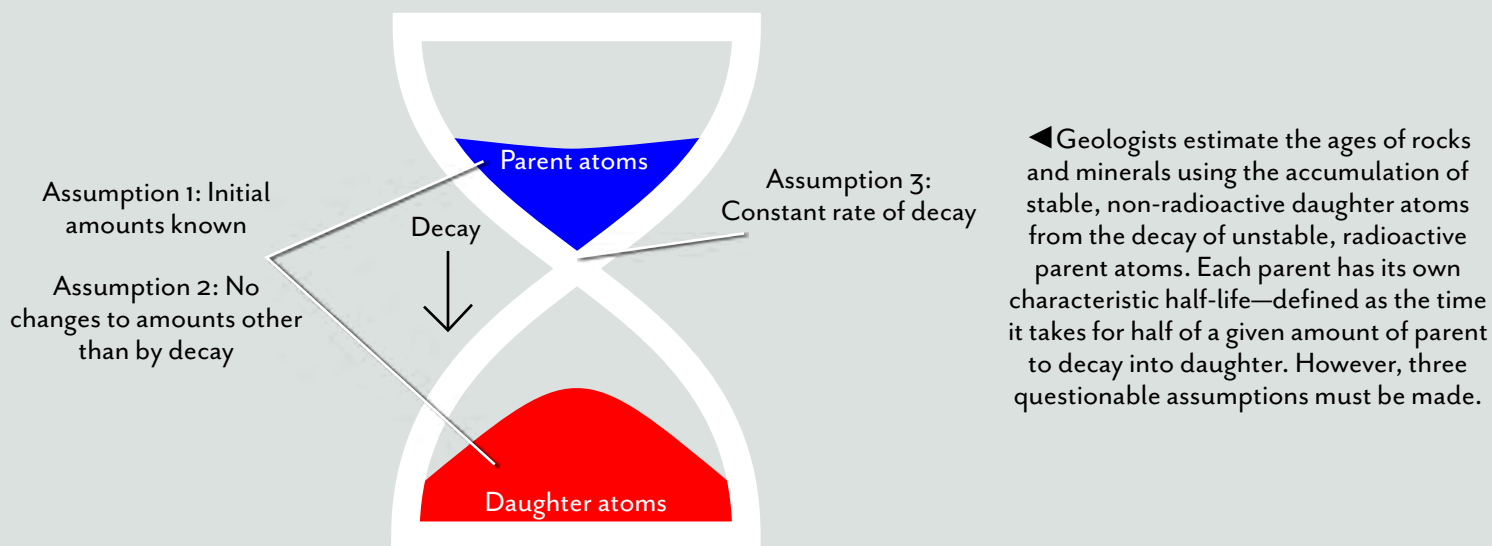
**Radiometric dating** uses naturally occurring radioactive elements to date rocks and minerals. Unstable, radioactive parent atoms decay through a series of intermediate steps until stable, non-radioactive daughter atoms form. The accumulation of daughter atoms allows the sample's age to be calculated.

Three assumptions must be made:

1. The rock or mineral contained a known quantity of daughter atoms in the beginning.
2. The amounts of parent and daughter atoms have not been altered by anything besides radioactive decay.
3. The rate of decay has been constant.

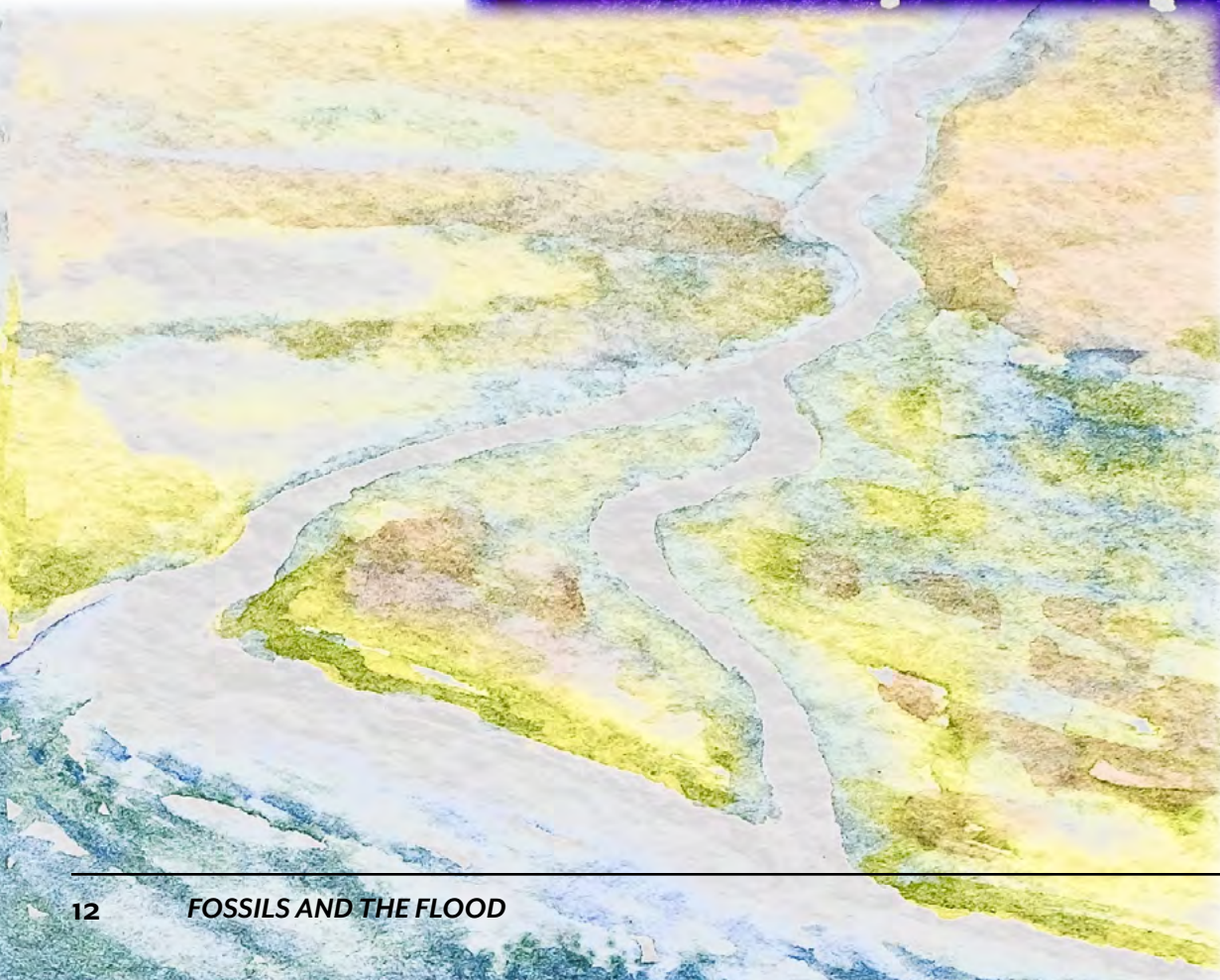
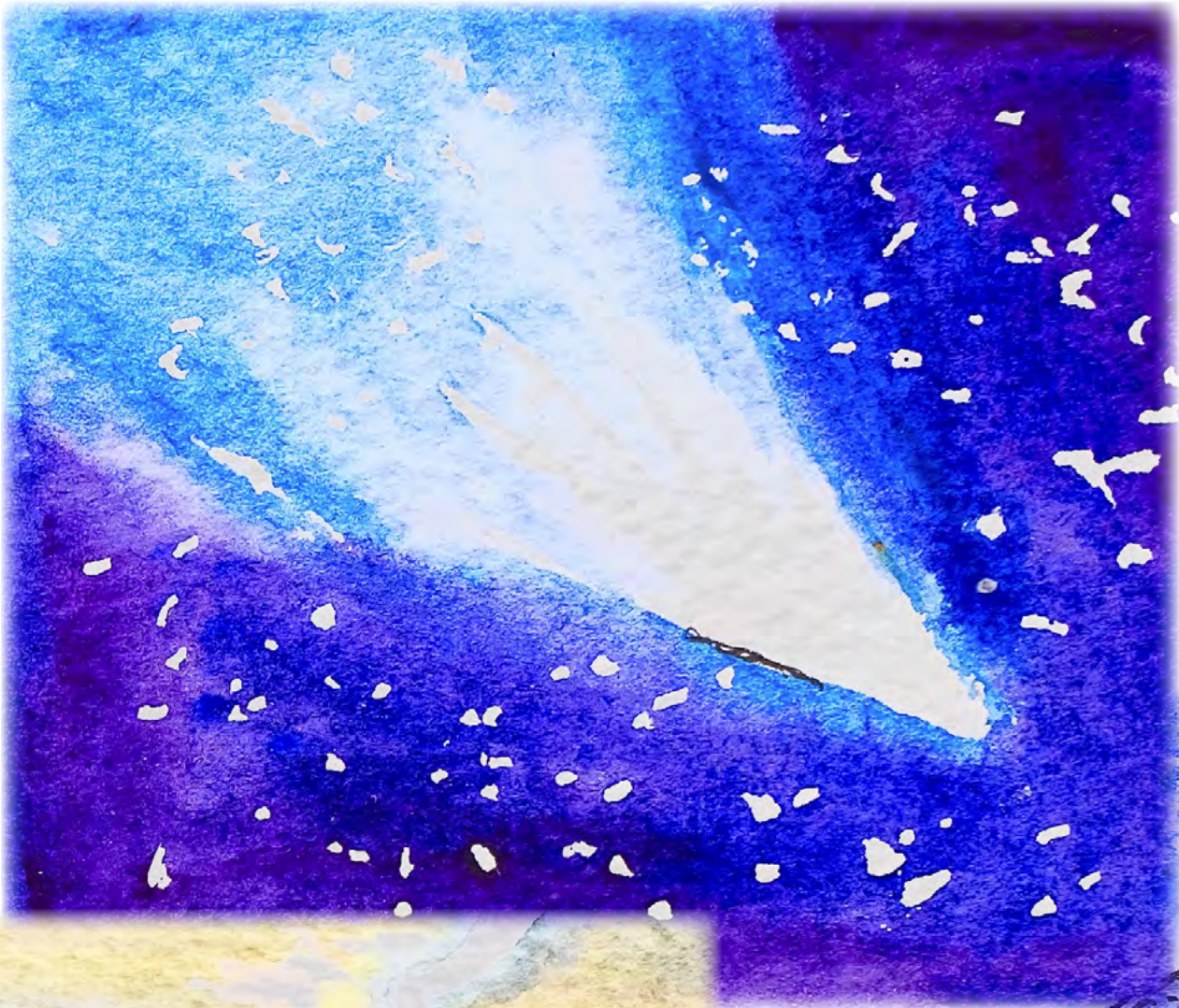
But biblical creationists think there are good reasons to challenge each of these assumptions:

1. The original quantity of daughter atoms is often uncertain.
2. Many processes besides radioactive decay can alter the amounts of parent and daughter atoms in a rock or mineral.
3. There is evidence that radioactive decay rates were higher during Creation and the Flood than today, which would make radiometric dates too old.



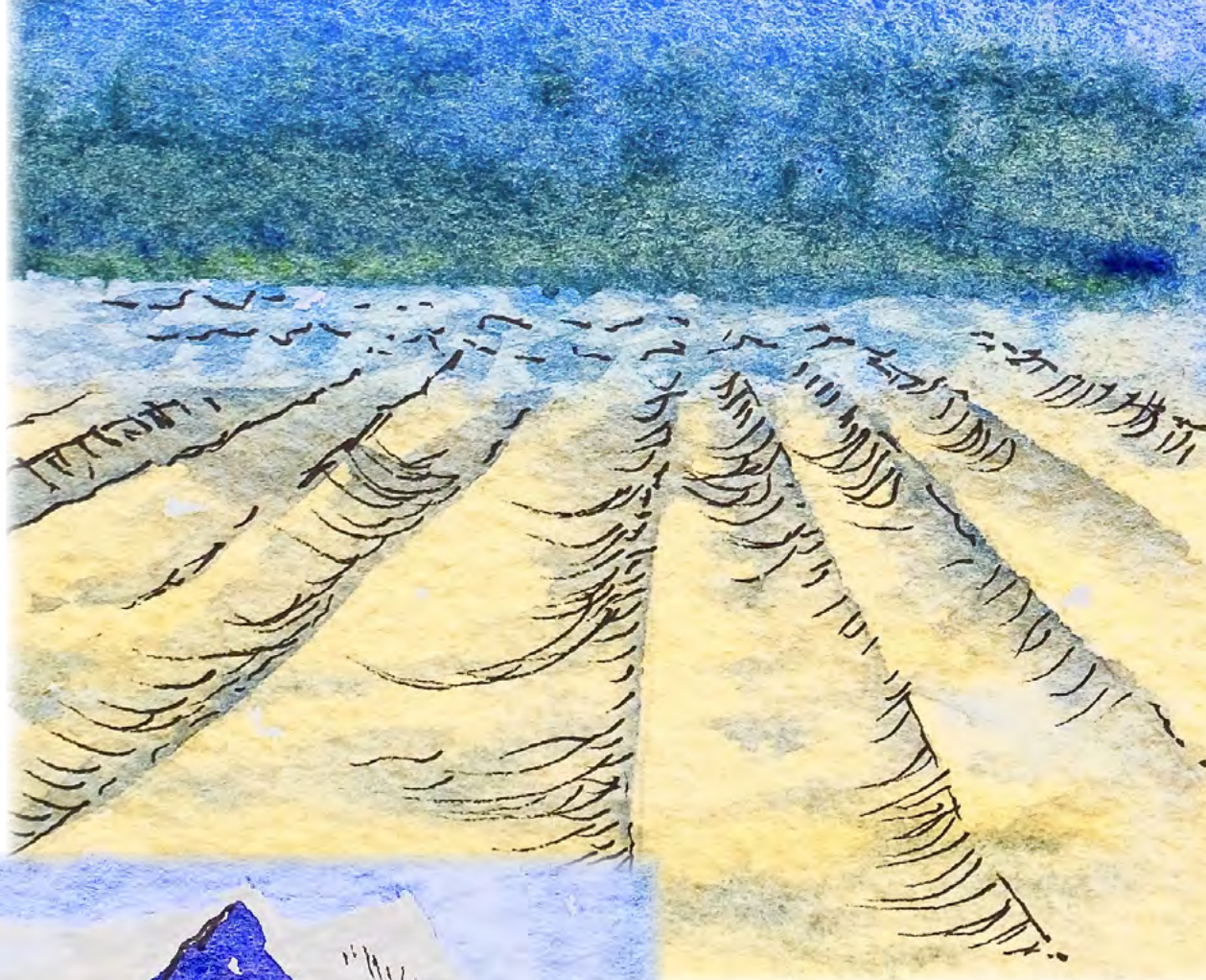
Furthermore, there is much scientific evidence that points to a young world. This evidence includes:

Short comet lifetimes: **Comets** are mostly ice and dust, and they lose material every time they orbit close to the sun. They cannot survive more than about 10,000 years. It is hard to explain how the number of comets in our solar system could have been sustained for billions of years.



Saltiness of the oceans: Every year, rivers and other sources wash large amounts of salt into the oceans, and most of it builds up there. If the oceans were billions of years old they ought to be much saltier than they are today.

Sediment buildup in the oceans: Rivers also carry sediments into the ocean. The average thickness of the sediments on the seafloor is less than 1,300 feet (400 meters). The oceans ought to have been filled many times over in hundreds of millions of years.



Wearing down of the continents: Water and wind **erosion** is wearing away the surface of the land. If the continents were billions of years old they ought to have been worn down to sea level hundreds of times—but we still have high-standing continents that appear not to have completed even one such cycle.

## THE CREATED WORLD I. CONTINENTS AND OCEANS

What was the world like when God made it? This is not an easy question to answer but the Bible and geology provide some important clues.

Genesis 1:9-10 tells us that on the third day of Creation, God gathered the waters into one place and made the dry land appear. He called the waters “seas” and the dry land “earth”. So it is reasonable to conclude that the world back then had oceans and continents much as today.

But in many other respects the world before the Flood was very different from today’s world. We know this because the Bible tells us that the Flood destroyed the old world in the days of Noah (2 Peter 3:6). The world we see today bears the marks of that awesome judgement.

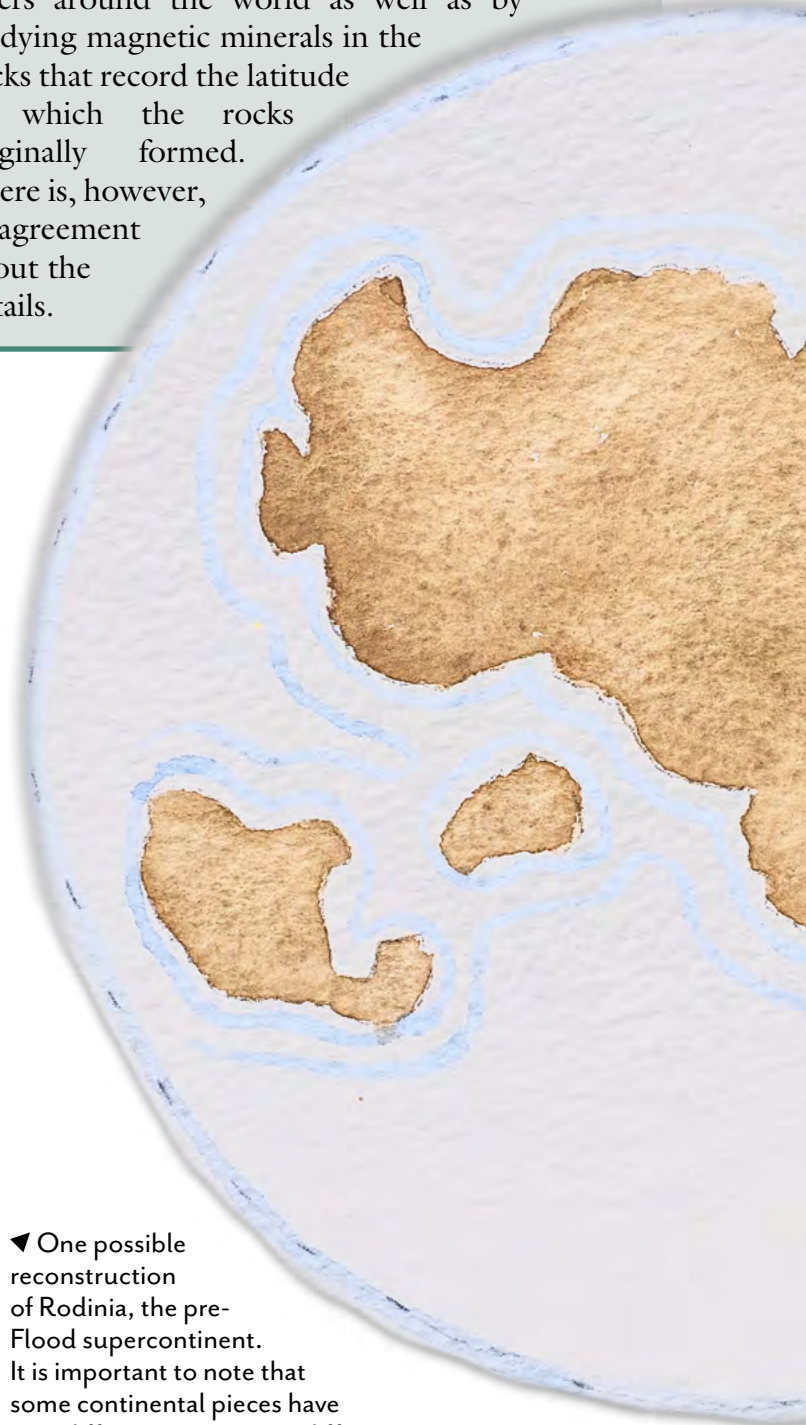
Clues preserved in the earth’s rock layers indicate that most of the earth’s landmasses were originally gathered together to form one super-sized continent. Scientists have named this supercontinent **Rodinia** (meaning *motherland*). This **supercontinent** was probably made up of large areas of land separated by shallow seas and waterways.

During the Flood this supercontinent broke apart and the pieces moved around. By studying the continental fragments that remain—fragments that geologists call **cratons**—scientists can piece together how those fragments might originally have been arranged.

Putting the broken and scattered pieces of the puzzle back together is difficult. But it seems likely the continent we now know as North America was near the center of the original supercontinent, with Australia and East Antarctica along its western edge.

### RECONSTRUCTING RODINIA

Geological evidence indicates that the earth’s continents are not fixed but moved around in the past. Scientists study clues in the rocks to work out how the continents used to be arranged. Rodinia was reconstructed by matching up rock layers around the world as well as by studying magnetic minerals in the rocks that record the latitude at which the rocks originally formed. There is, however, disagreement about the details.



▼ One possible reconstruction of Rodinia, the pre-Flood supercontinent. It is important to note that some continental pieces have very different positions in different reconstructions. This reconstruction will almost certainly have to be revised with additional study.



# THE CREATED WORLD II.

## LIVING THINGS

Another difference between today's world and the old world was in the diversity of living things that the old world supported.

At the time of Creation, God filled the world with an astounding array of living things. He made **bacteria**, **algae**, **fungi**, **plants**, and **animals**—and within each of these groups he created even more diversity.



In fact, some groups missing from today's world are represented by thousands of fossil species. Other groups have living representatives but seem to be less diverse or abundant than they are in the **fossil record**. It seems that the diversity of life was greater before the Flood than today.

At the time of Creation, God made different environments to provide homes for all these creatures, just as in today's world there are grasslands, forests, deserts, lakes, and seas. These major habitats—each with its own climate and populated by a distinctive community of plants and animals—is called a **biome**. Each biome provided many ecological niches, and God made creatures in a bewildering range of sizes, shapes, and diets to fill these niches.



Deserts, grasslands, and tropical rainforests are examples of modern biomes. Each biome has its own climate and is populated by a distinctive set of plants and animals.



God’s extraordinary design went even further. Today, the same biome can be found in many different places on the earth’s surface, yet it is populated by a different set of plants and animals in different locations. This allows an even greater variety of creatures to live on the earth.

For example, grassland biomes include the North American prairies, the South American pampas, the African savanna, the Asian steppe, and the Australian plains—yet each supports a distinctive set of animals. In the beginning, it appears that God did something similar by creating the same environment in more than one place on the

earth’s surface in order to maximize the amount of diversity that could be supported.

Some of the biomes originally created by God are now extinct, along with the creatures that lived in them. We can find out about these biomes, however, by studying the remains left behind in the fossil record. Over the next few pages we will take a close look at some of the biomes in the old world before the Flood. We will begin with an extraordinary biome that was floating over the deep ocean, before moving on to shallow ocean biomes, coastal biomes, and land biomes.

The presence of the same biome in many places on the earth’s surface allows for an even greater range of plants and animals to be supported. For example, grasslands are found on several of today’s continents and each provides a home for particular herbivores:



North American prairie with an American bison.



South American pampas with a llama.



African savanna with a springbok.



Asian steppe with a saiga antelope.



Australian plain with a kangaroo.

## WHAT WAS EARTH'S CLIMATE LIKE BEFORE THE FLOOD?

Fossilized plants—and especially their growth rings—provide some important insights into the climatic conditions of the pre-Flood world.

The range of plant types buried in Flood sediments suggests that they must have grown in a variety of climates before the Flood. Temperatures overall were probably higher than at present, and the temperate zones probably extended much farther towards the poles.

Some fossil trees buried during the Flood display growth rings with evidence of seasonality, late frosts, and severe droughts, indicating that the higher latitudes experienced distinct seasonal changes.

▼ Growth rings in fossilized trees from the Purbeck Group (Upper Jurassic to Lower Cretaceous) of Dorset, England, indicate they must have grown in a strongly seasonal environment.



◀ The famous “Fossil Forest” of Lulworth, Dorset, England. This photograph shows the hollows left where fossilized tree stumps once stood.

## THE FLOATING FOREST

The first of the major, pre-Flood biomes we will consider is the **floating forest**, a vast, thick mat of vegetation that floated over the deep, open ocean. Judging by the amount of fossilized plant material it left behind, this mat was probably the size of an entire continent.

At the edges of the floating forest grew small plants without true roots or leaves. They were well suited for life close to the water.

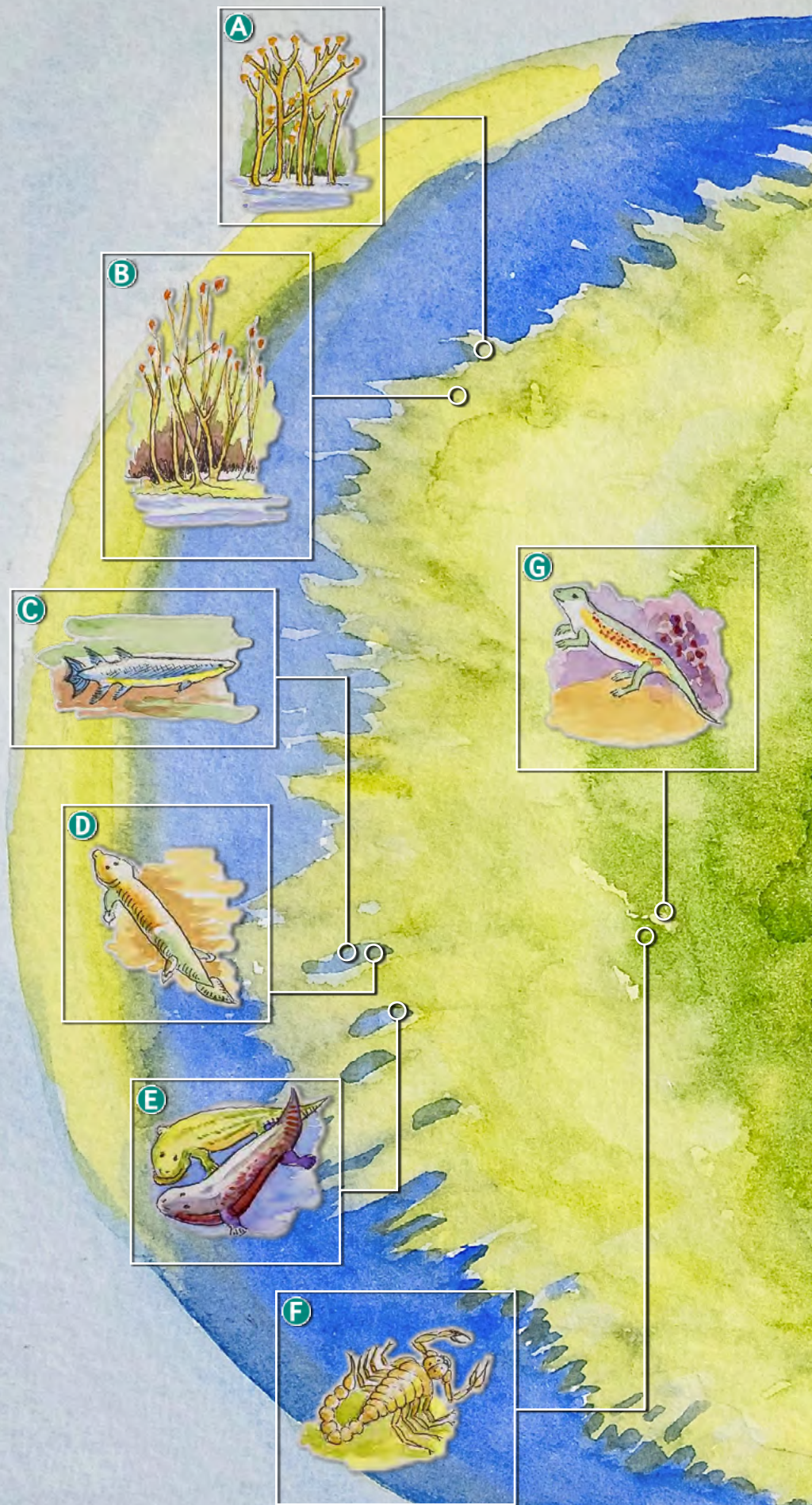
Farther into the floating forest there were small to medium-sized branching and bush-like plants. Some resembled ferns, while others were more like clubmosses. They were a bit less dependent on water, with tougher stems and extra vessels to carry water.

Large trees, including clubmosses and other lycopsids, grew in the center of the floating forest. Here the mat was thick enough to support trunks up to 100 feet (30 meters) tall and 6 feet (2 meters) around.

Many strange animals inhabited this floating forest. Scurrying through the leaf litter were insects, spiders, scorpions, and cockroaches. Giant millipede-like animals made wide trackways resembling tire marks.

The air above the floating forest buzzed with winged insects, including *Meganeura*, a giant dragonfly-like creature with a wingspan up to 30 inches (76 centimeters) from tip to tip.

Other strange creatures lurked in shallow pools on the floating mat. They had feet and legs (not fins) but in other ways were quite fish-like. These animals seem to have been well suited for life



in an ecosystem that was neither fully aquatic nor fully terrestrial.

Towards the center of the floating forest were animals more suited to life away from the water, including reptiles such as *Hylonomus*.



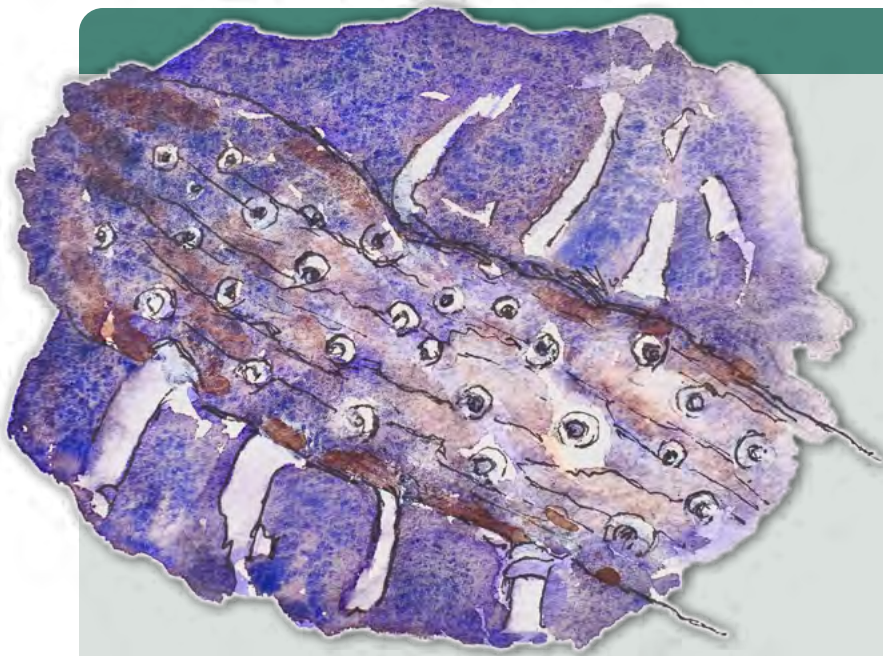
- A *Cooksonia*.
- B *Rhynia* and *Zosterophyllum*.
- C *Eusthenopteron*.
- D *Tiktaalik*.
- E *Acanthostega* and *Ichthyostega* (not to scale).
- F *Pulmonoscorpius*.
- G *Westlothiana*.
- H *Psaronius*, *Neuropteris*, and *Calamites*.
- I *Lepidodendron* and *Sigillaria*.
- J *Meganeura* and *Arthropleura*.
- K *Hylonomus*.
- L *Cordaites*.

## THE GIANT CLUBMOSES OF FOSSIL GROVE, GLASGOW, SCOTLAND

In a building in Glasgow's Victoria Park is the famous Fossil Grove, a group of eleven large tree stumps belonging to giant clubmosses. They have been preserved exactly where they were found back in 1887. In fact, the stumps are not the remains of the actual trees, but rather the result of sediment filling the hollow insides of the trees. The outermost layer of woody material rotted away to leave these extraordinary natural casts—a mute testimony to the long-lost pre-Flood floating forest.

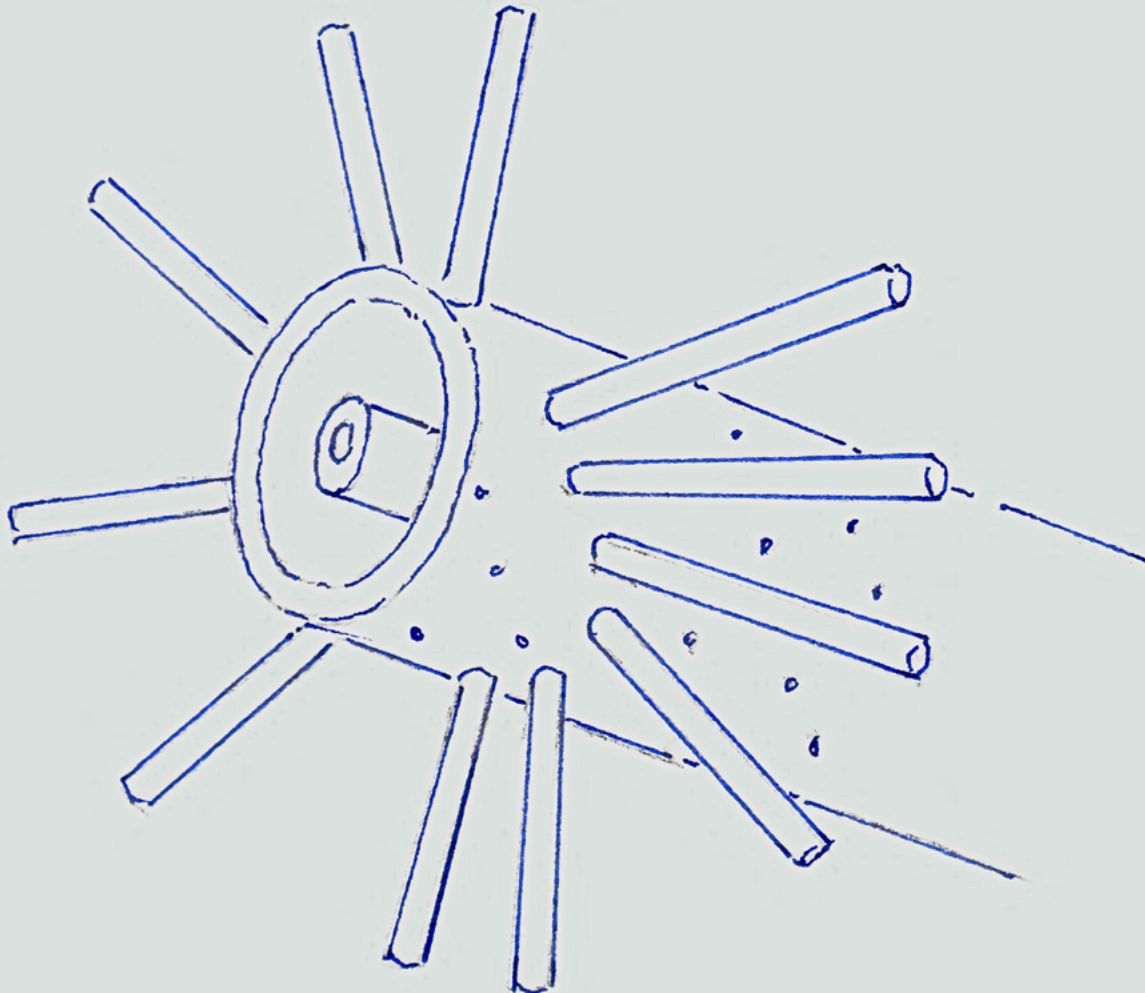


## PLANTS THAT GREW IN WATER



Evidence that some of these trees grew in water, not in soil, can be seen by examining their anatomy. For instance, lycopsids had roots called *Stigmaria* with secondary rootlets arranged around the roots like spokes around a wheel. This type of root pattern is found only in water plants. Also, the trees, roots, and rootlets appear to have been hollow and filled with air when the plants were living—an ideal design for floating in water.

▲ Fossil specimen and ▼ life reconstruction showing the spoke-like-arrangement of *Stigmaria* rootlets.



## SALTY, HOT-WATER REEFS

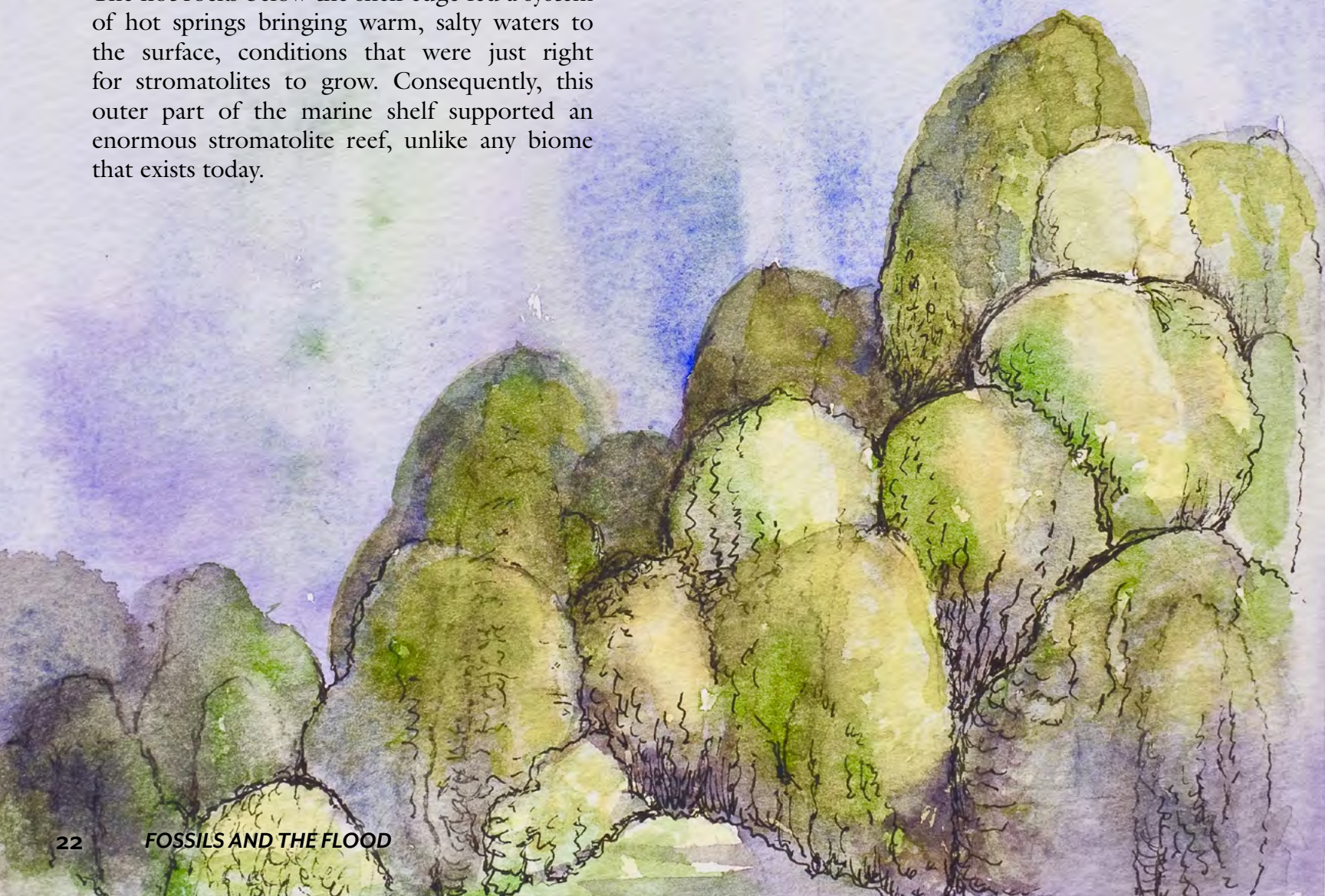
Another unusual pre-Flood biome was a continent-fringing stromatolite reef. The word *stromatolite* comes from the Greek words *stromata* meaning *layers* and *lithos* meaning *rock*. Stromatolites are layered mounds or columns built by microbes trapping sediment particles (such as sand grains).

It seems that parts of the pre-Flood supercontinent were surrounded by a shallow-water marine shelf hundreds of miles wide. The part of the shelf farthest from the land was raised up by hot, buoyant rocks below so that it was close to sea level. The raised shelf margin acted as a kind of barrier between the open ocean on one side and a wide, shallow marine lagoon on the other.

The hot rocks below the shelf edge fed a system of hot springs bringing warm, salty waters to the surface, conditions that were just right for stromatolites to grow. Consequently, this outer part of the marine shelf supported an enormous stromatolite reef, unlike any biome that exists today.

The shallow water allowed plenty of light to reach the microbes building the stromatolites and the salty conditions inhibited animals that might have grazed on them. This meant that the stromatolites could grow abundantly and to large sizes.

There are places where stromatolites can be found growing today, such as in the warm, salty waters of Shark Bay in Western Australia. But these are a poor reflection of a biome that was much more extensive and supported a much greater diversity of stromatolite-building microbes before the Flood.





## STROMATOLITES IN THE GRAND CANYON, ARIZONA

One place where you can see fossilized stromatolites that were growing before the Flood is in the Precambrian Kwagunt Formation in the Grand Canyon, Arizona, USA. An extensive layer within this formation contains hundreds of mushroom-shaped stromatolites, each about 8.2 feet (2.5 meters) tall. They probably grew in the shallow, warm, and salty waters of a stromatolite reef that fringed the margins of the pre-Flood supercontinent.

▼ The stromatolite bed in the Precambrian Kwagunt Formation in the Grand Canyon, Arizona.



▲ One of the many mushroom-shaped stromatolites in the bed.



▲ This stromatolite cross section on display at the Grand Canyon demonstrates its layered structure.

## LIVING ON THE MARINE SHELF I. THE EDIACARANS

The shallow waters of the marine lagoon behind the stromatolite reef were home to many creatures.

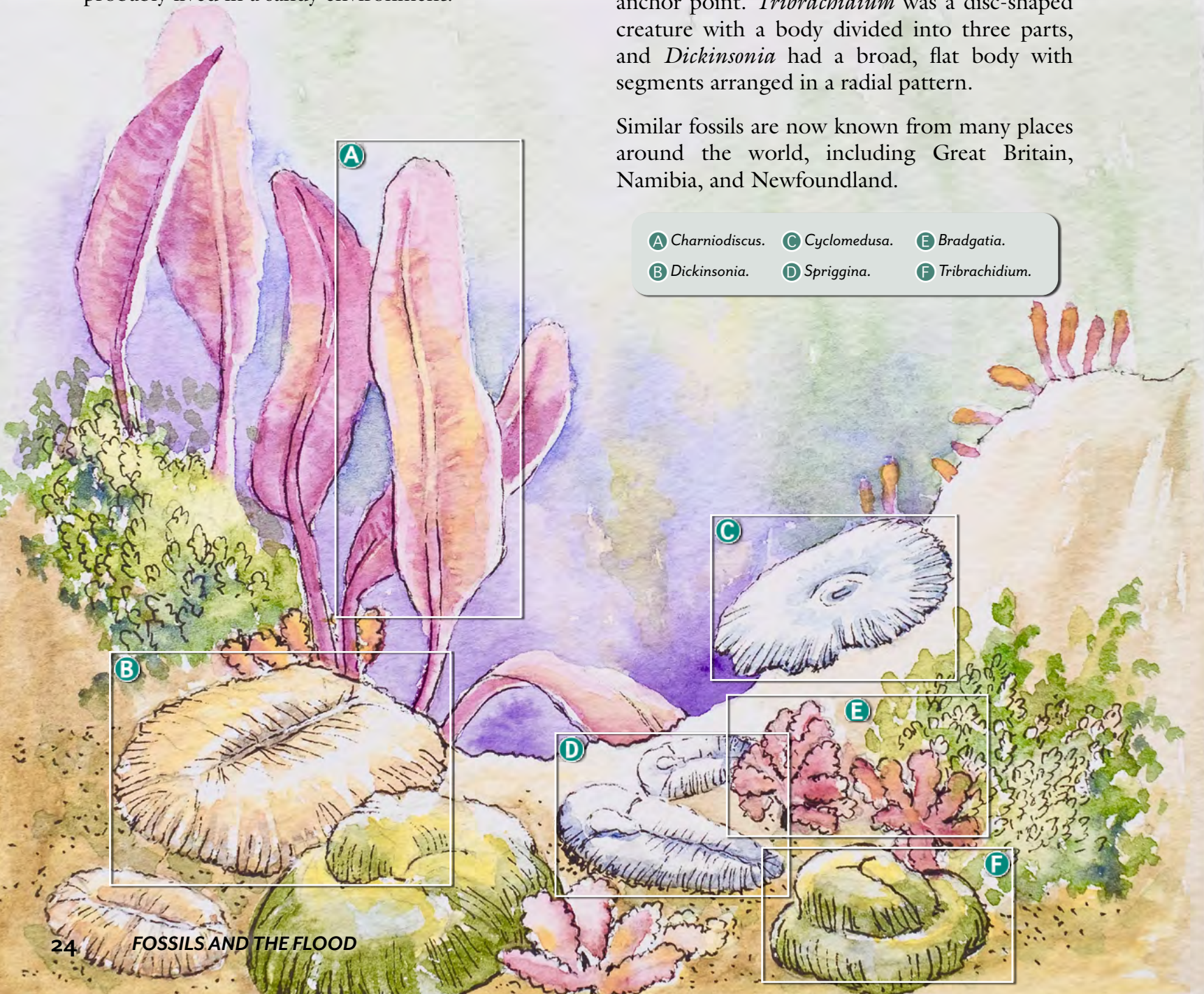
In the deepest waters closest to the reef there were large, soft-bodied organisms called **Ediacarans**, named after the Ediacara Hills in South Australia where their fossils were discovered. Their fossils are mostly preserved in sandstone, so they probably lived in a sandy environment.

Most of the Ediacaran creatures had bodies with a quilted appearance, and some seem to have lived in dense colonies. A few might be classified in modern groups if they were living today, but most were unlike any creatures in the modern world.

*Spriggina* was a worm-like organism with a head shaped like a horseshoe. *Cyclomedusa*, an enigmatic creature, had a circular body and concentric rings. *Charniodiscus* had an elongated frond-like body attached to the seafloor, while *Bradgatia* had a cabbage-like appearance with six or more fronds radiating from a central anchor point. *Tribrachidium* was a disc-shaped creature with a body divided into three parts, and *Dickinsonia* had a broad, flat body with segments arranged in a radial pattern.

Similar fossils are now known from many places around the world, including Great Britain, Namibia, and Newfoundland.

- |                                 |                               |                                 |
|---------------------------------|-------------------------------|---------------------------------|
| <b>A</b> <i>Charniodiscus</i> . | <b>C</b> <i>Cyclomedusa</i> . | <b>E</b> <i>Bradgatia</i> .     |
| <b>B</b> <i>Dickinsonia</i> .   | <b>D</b> <i>Spriggina</i> .   | <b>F</b> <i>Tribrachidium</i> . |



## EDIACARANS AT MISTAKEN POINT, NEWFOUNDLAND

▼ Multiple rock layers bearing Ediacaran fossils are exposed along the shoreline at Mistaken Point in Newfoundland.



Mistaken Point, on the southernmost tip of the Avalon Peninsula in Newfoundland, is famous for its Ediacaran fossils. Frond-like, bush-like, and spindle-like forms are found in large numbers on the exposed rock surfaces. There are also abundant disc-shaped forms. Some are similar to fossils from the Charnwood Forest in England but others have not been found anywhere else in the world. These soft-bodied animals probably lived in moderately deep water and were preserved at the beginning of the Flood when they were smothered by volcanic ash carried by submarine currents.

▲ A spindle-shaped fossil called *Fractofusus* on one of the bedding planes.

▼ A digital representation showing what *Fractofusus* may have looked like.



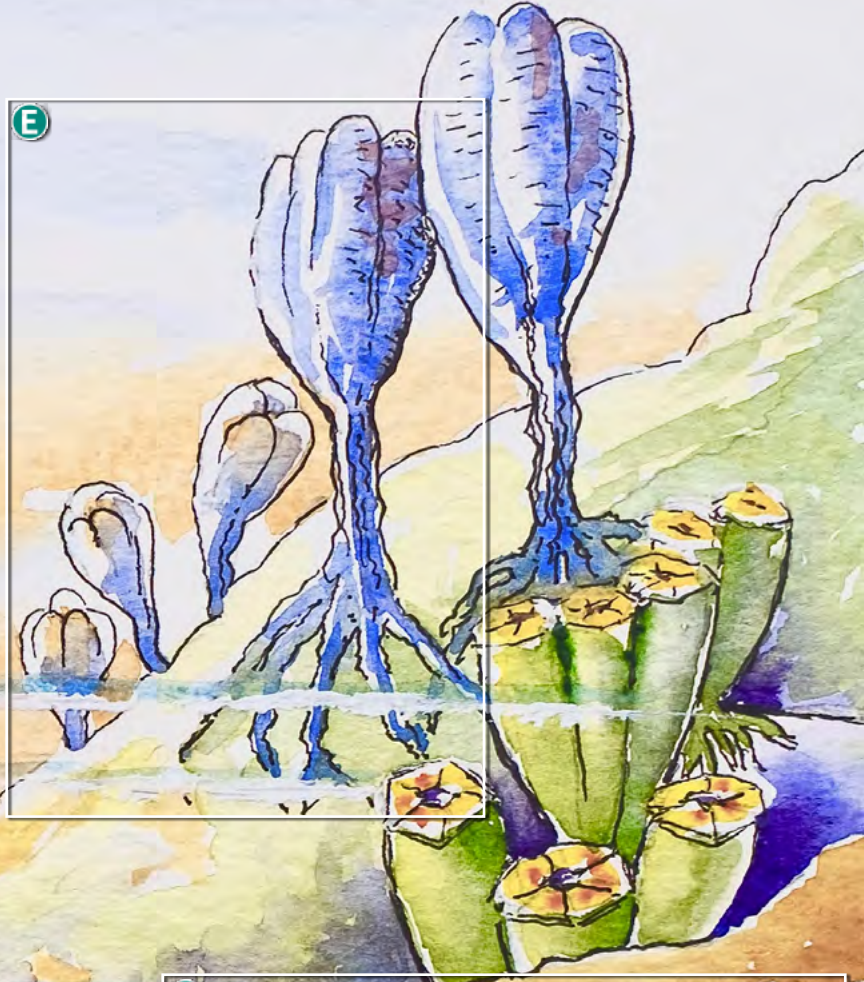
Oleg Kuznetsov / CC BY-SA 4.0

## LIVING ON THE MARINE SHELF II. SMALL SHELLY CREATURES

Farther into the marine lagoon there were lime-rich muds in which many small shelly creatures lived.

Some had coiled shells while others were cone- or tube-shaped. Few of the shells are more than 0.5 inches (1 centimeter) long. We cannot be certain what kinds of animals lived in these shells, but they may have been worms or mollusks. Some may even represent parts of the skeletons of bigger animals.

- |                                |                                |
|--------------------------------|--------------------------------|
| <b>A</b> <i>Hyolithellus</i> . | <b>D</b> <i>Microdictyon</i> . |
| <b>B</b> <i>Tommotia</i> .     | <b>E</b> Archaeocyathids.      |
| <b>C</b> <i>Latouchella</i> .  | <b>F</b> <i>Halkieria</i> .    |



Living alongside these small shelly animals were strange cup-shaped creatures called archaeocyathids. They resembled modern sponges and probably had a similar lifestyle. Some grew in patches on the seafloor and formed small reefs.

Other animals living here included *Halkieria*, a worm-like creature covered in tiny scales and capped at each end with a limpet-like shell, and *Microdictyon*, with ten pairs of legs and sieve-like plates running down its sides.

◀ Some small shelly animals are reconstructed here as types of mollusks or worms, but some scientists think that they are actually parts of larger animals.

## SMALL SHELLY CREATURES OF THE SIBERIAN PLATFORM

The fossilized remains of these small shelly animals were first discovered in rocks exposed along the Lena and Aldan Rivers in a remote and inaccessible part of Siberia.

Since then, similar fossils have been found in many other places around the world, including China, India, Canada, England, France, and Australia. Scientists sometimes refer to these fossils as the Tommotian fauna, after the subdivision of Cambrian rocks in which they were first identified.

▼ Spectacular pillars of rock along the Lena River in the Sakha Republic (Yakutia) are composed of Lower Cambrian (Tommotian) sediments yielding fossils of the small shelly creatures.



## LIVING ON THE MARINE SHELF III. THE ATDABANIAN ANIMALS

The part of the marine lagoon nearest the land teemed with yet more strange animals.

The giant predatory arthropod *Anomalocaris* and the fish-like vertebrate *Myllokunmingia* swam above the seafloor, while trilobites such as *Olenellus* lived on the muddy sea bottom or burrowed into it.

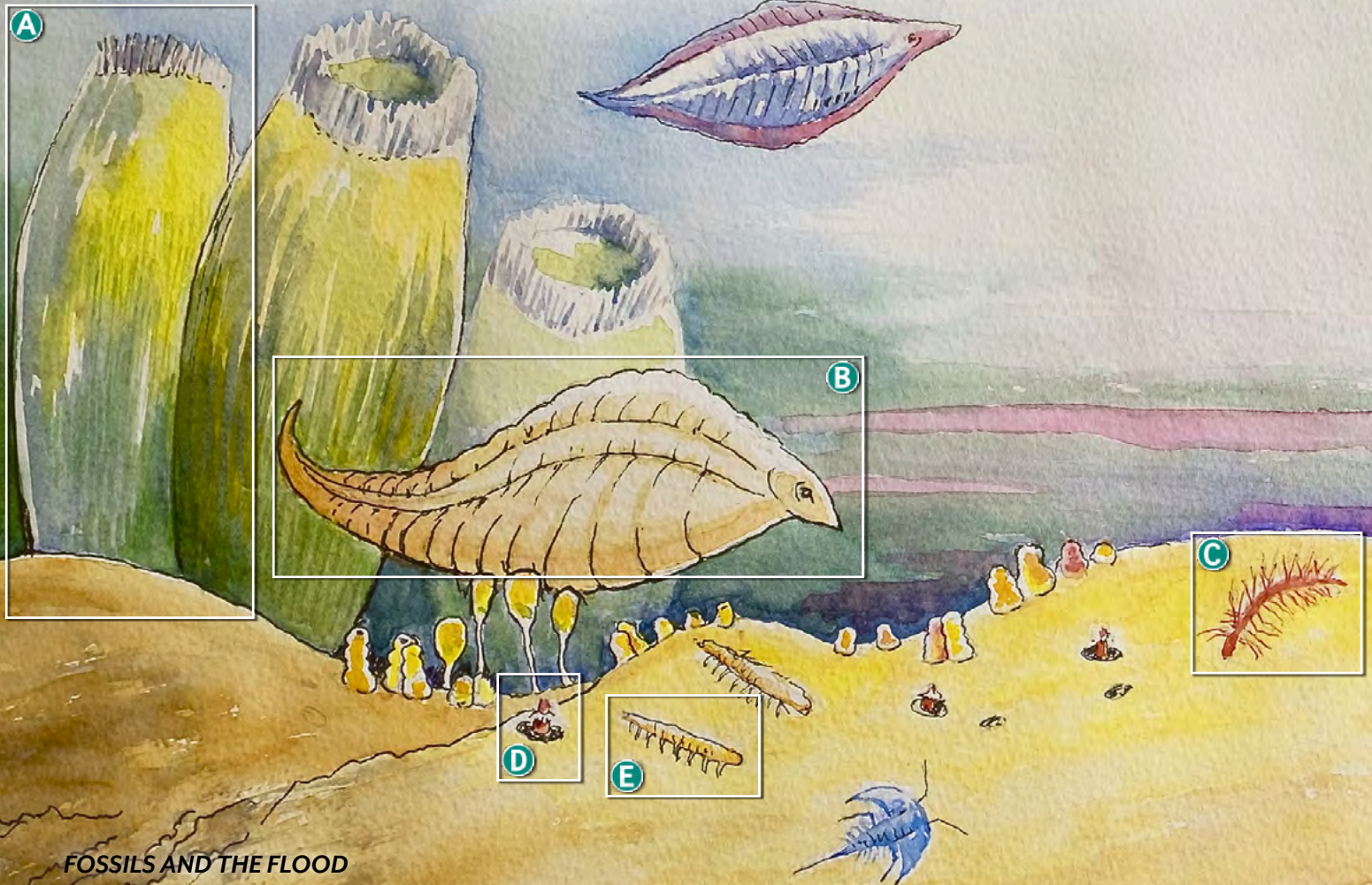
On the seabed, worms such as *Paraselkirkia* waited for passing prey in their U-shaped burrows while clusters of brachiopods such as *Longtancunella* strained tiny food particles from the seawater. *Quadrolaminiella* had a long vase-shaped body and was probably a kind of sponge.

One oddity was *Hallucigenia*, with its multiple legs and shoulder spines. It may have been a type of spiny velvet worm. *Paucipodia* was similar but lacked the paired spines on its back.

There were also echinoderms, but not like the starfish and sea urchins that we are familiar with. The enigmatic *Helicoplacus* was shaped like the bob on the end of a plumb line and covered with small armor plates. It did not have the five-fold symmetry of modern echinoderms.

Another strange creature was *Eldonia*, with its soft, disc-shaped body and tentacles. Although it somewhat resembled a jellyfish, it is not known exactly what kind of animal *Eldonia* was.

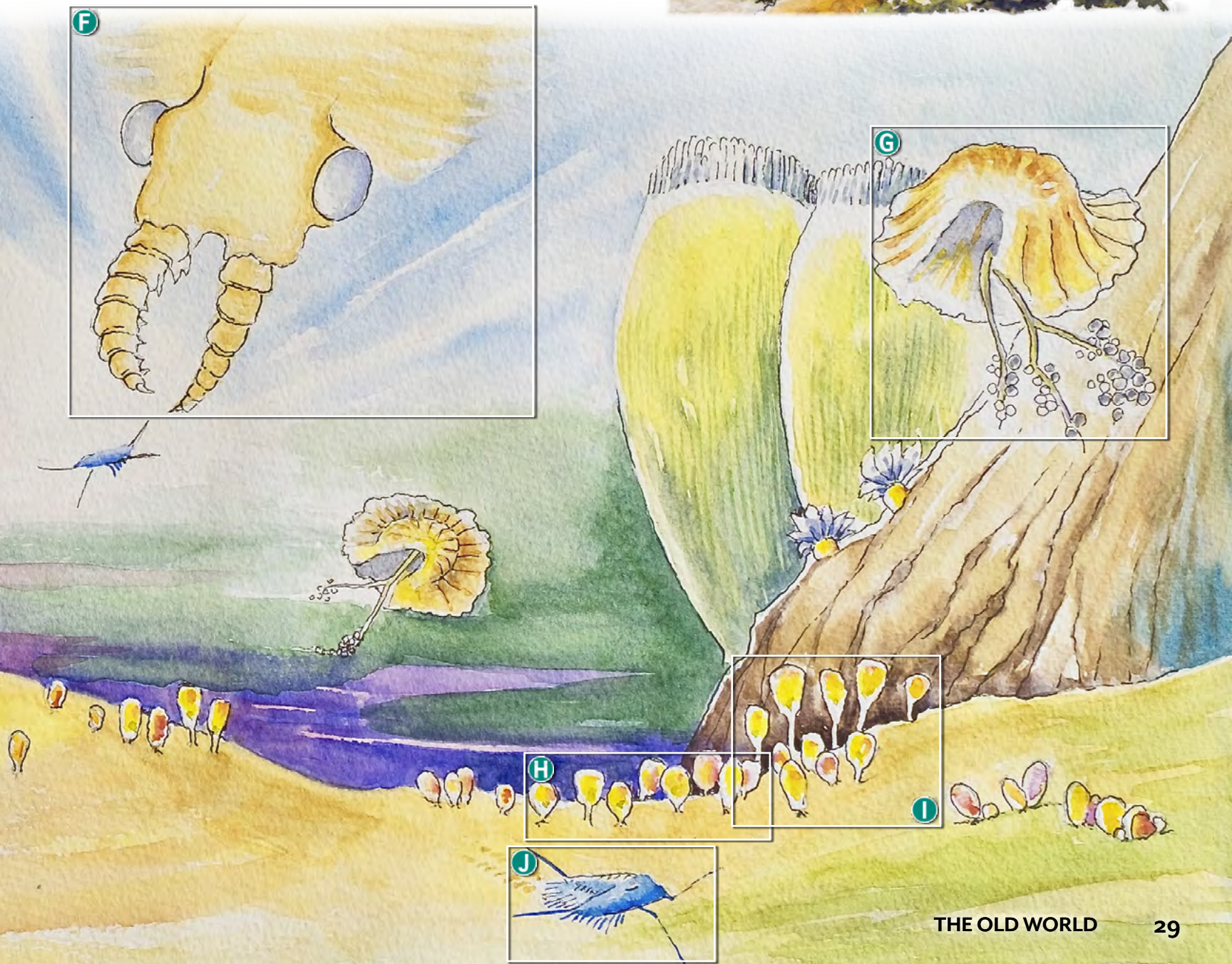
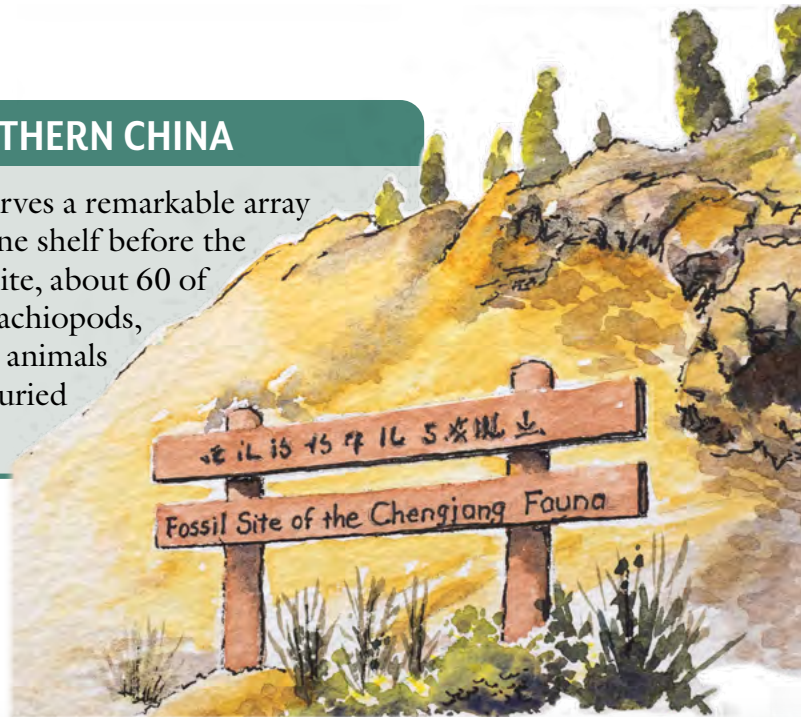
- |                                   |                               |                                 |
|-----------------------------------|-------------------------------|---------------------------------|
| <b>A</b> <i>Quadrolaminiella.</i> | <b>E</b> <i>Paucipodia.</i>   | <b>I</b> <i>Longtancunella.</i> |
| <b>B</b> <i>Myllokunmingia.</i>   | <b>F</b> <i>Anomalocaris.</i> | <b>J</b> <i>Olenellus.</i>      |
| <b>C</b> <i>Hallucigenia.</i>     | <b>G</b> <i>Eldonia.</i>      |                                 |
| <b>D</b> <i>Paraselkirkia.</i>    | <b>H</b> <i>Helicoplacus.</i> |                                 |



## ATDABANIAN FAUNA OF CHENGJIANG, SOUTHERN CHINA

The Chengjiang fossil deposit in southern China preserves a remarkable array of animals that populated this part of the shallow marine shelf before the Flood. More than 150 species have been found at this site, about 60 of them arthropods. Others include worms, sponges, brachiopods, and what seem to be vertebrates. Even the soft-bodied animals are well preserved, suggesting that they were rapidly buried by catastrophic sediment flows during the Flood.

► The Lower Cambrian (**Atdabanian**) rocks of Chengjiang in Yunnan Province, China, are famous for their exquisite fossils that represent a diverse assemblage of invertebrates and vertebrates and include the preservation of both hard and soft tissues.



## EXTENSIVE INLAND SEAS: THE MARINE PALEOZOIC

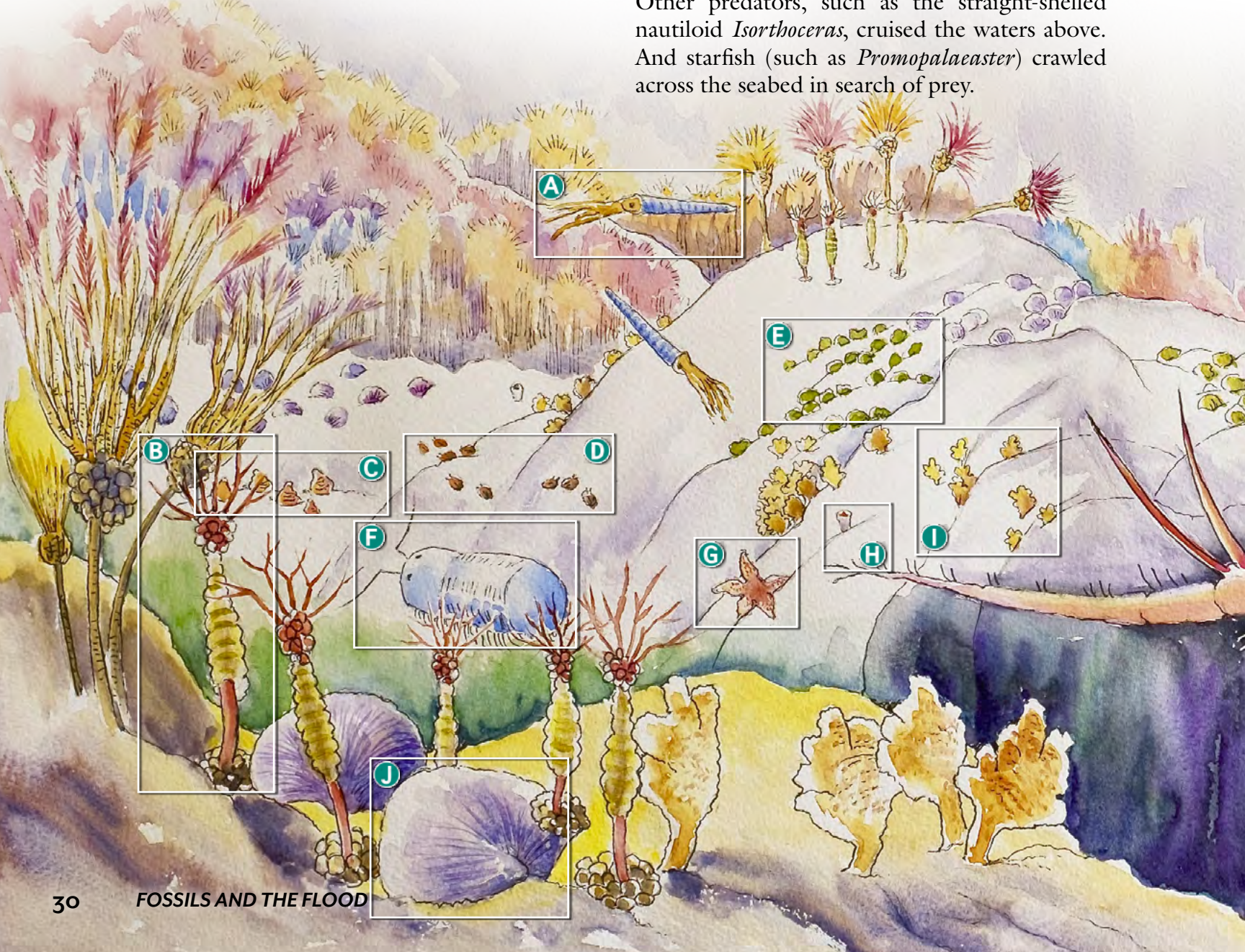
An extensive shallow sea may have covered much of the supercontinent itself. In these inland waters lived a community of organisms distinctively different to the Atdabanian fauna.

These waters were rich in brachiopods. Some burrowed into the sediments, while others (such as *Rafinesquina* and *Platystrophia*) made their home on the seabed and filtered food from the passing currents. There were trilobites of many kinds, including phacopids (such as *Flexicalymene*) and asaphids (such as *Isotelus*).

Gastropods (such as *Cyclonema*) were also present, though less abundant and diverse than the brachiopods.

Thickets of crinoids (such as *Cincinnaticrinus*) colonized the seafloor alongside sponges, corals, and bryozoans, sometimes constructing reef-like environments. Corals (such as *Protaraea*) were encrusters, growing as thin sheets on the shells of other animals. Others grew singly, such as the horn corals *Streptelasma* and *Grewingkia*. Bryozoans also included encrusting forms, while other types (such as *Constellaria*) grew as branching colonies attached to the seafloor.

Lurking in the depths were large, predatory animals (such as the eurypterid *Megalograptus*). Other predators, such as the straight-shelled nautiloid *Isorthis*, cruised the waters above. And starfish (such as *Promopalaeaster*) crawled across the seabed in search of prey.







## FOSSIL FAUNA OF THE CININNATIAN ROCKS OF OHIO

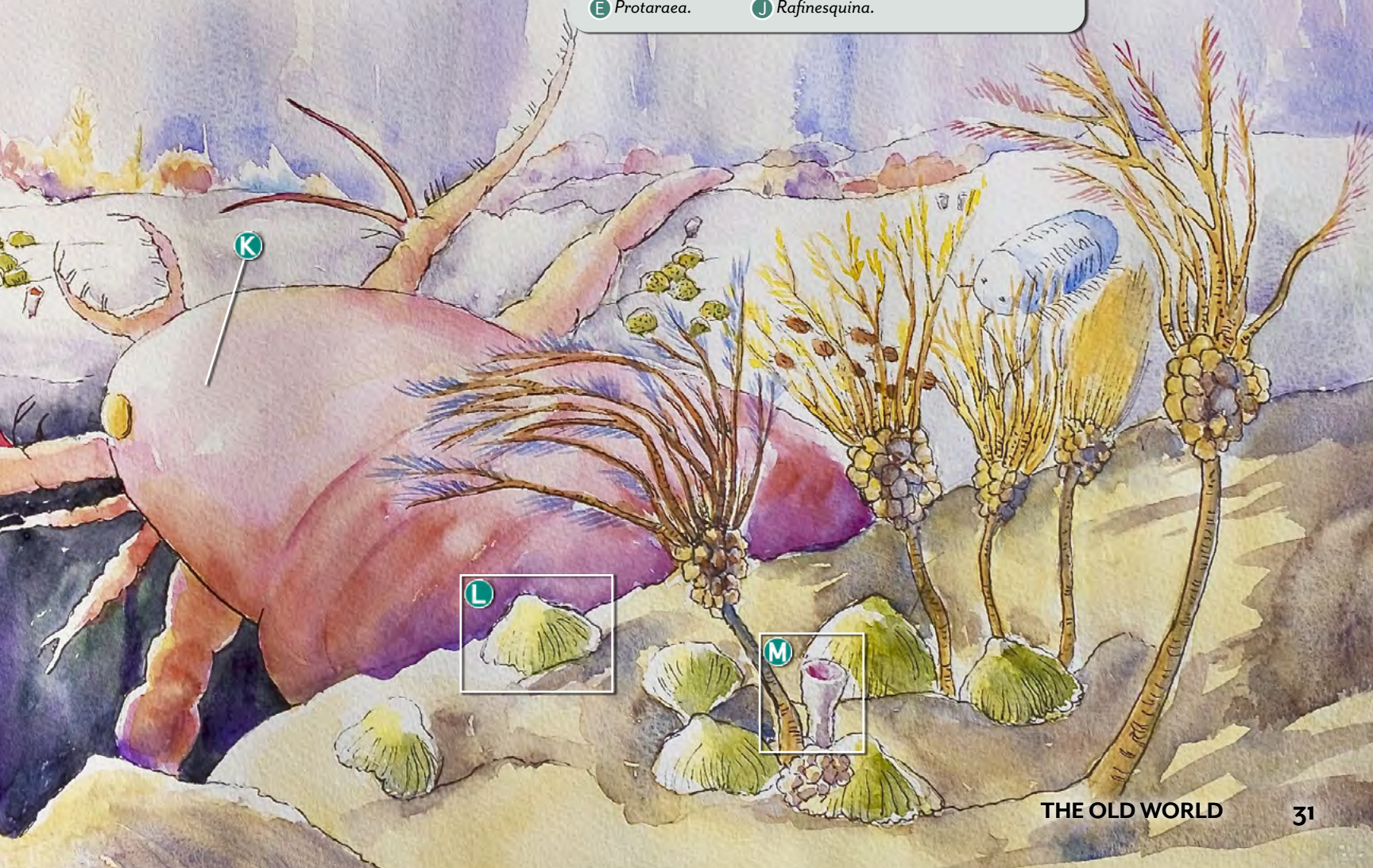
Fossils of the kinds described here can be found in great abundance in the Upper Ordovician rocks exposed along the interstate highways of the Cincinnati area of Ohio, USA. In fact, the trilobite *Isotelus maximus* is the state fossil of Ohio.

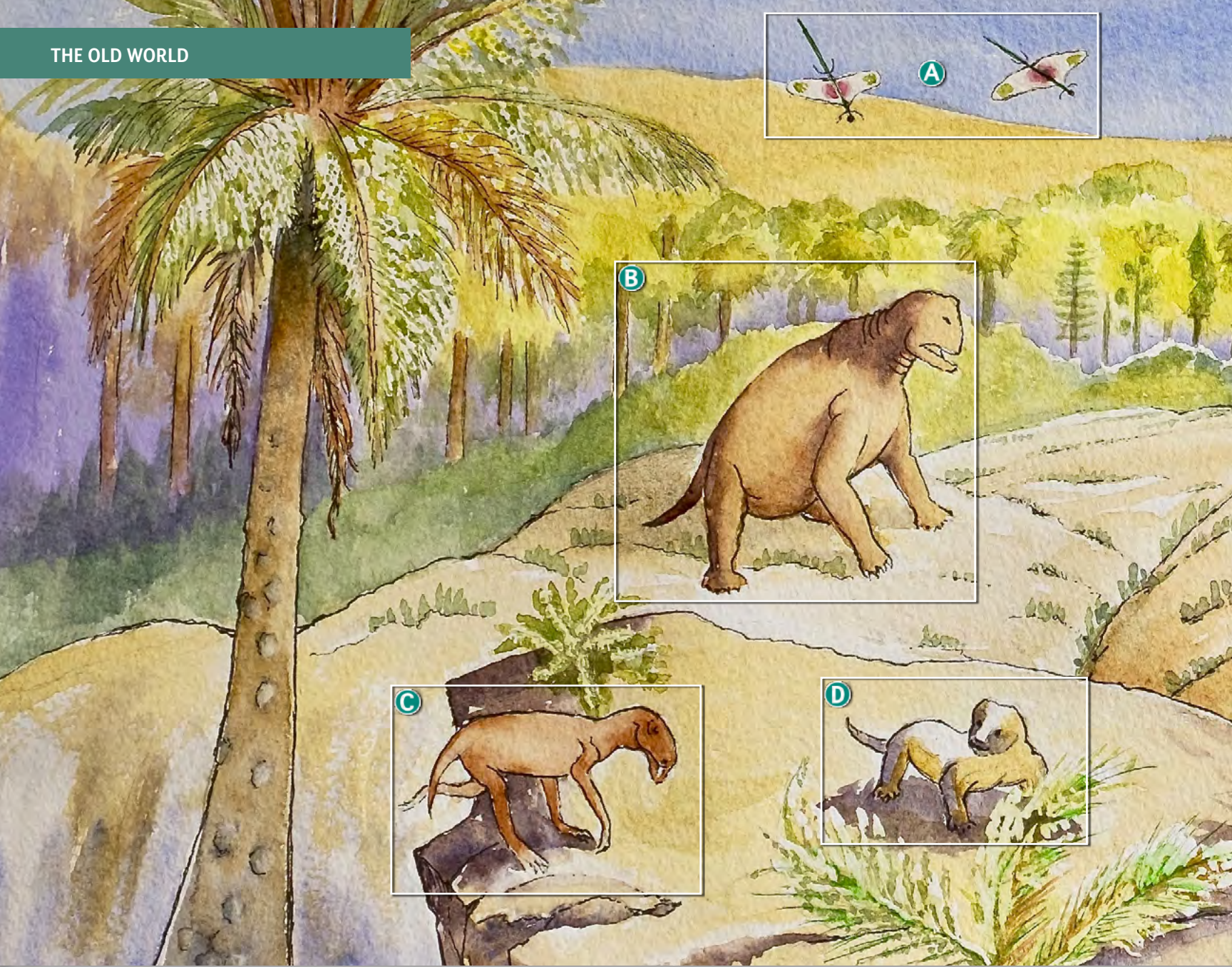
Road cuts near Cincinnati expose stacks of alternating thin layers of limestone and shale. The limestone beds are packed full of fossil brachiopods, bryozoans, and crinoids, often in a broken condition.

▲ Upper Ordovician shales and limestones in a road cut along Interstate 75 in northern Kentucky, with the city of Cincinnati, Ohio, USA, in the background.

Only rarely are whole fossils found. It seems that during the Flood turbulent waves uprooted these creatures from the places where they were living and transported them some distance before burial.

- |                              |                            |                          |
|------------------------------|----------------------------|--------------------------|
| A <i>Isorthoceras</i> .      | F <i>Isotelus</i> .        | K <i>Megalograptus</i> . |
| B <i>Cincinnatiocrinus</i> . | G <i>Promopalaeaster</i> . | L <i>Platystrophia</i> . |
| C <i>Cyclonema</i> .         | H <i>Grewingkia</i> .      | M <i>Streptelasma</i> .  |
| D <i>Flexicalymene</i> .     | I <i>Constellaria</i> .    |                          |
| E <i>Protaraea</i> .         | J <i>Rafinesquina</i> .    |                          |





## THE FRINGES OF THE LAND: COASTAL DUNES AND FORESTS

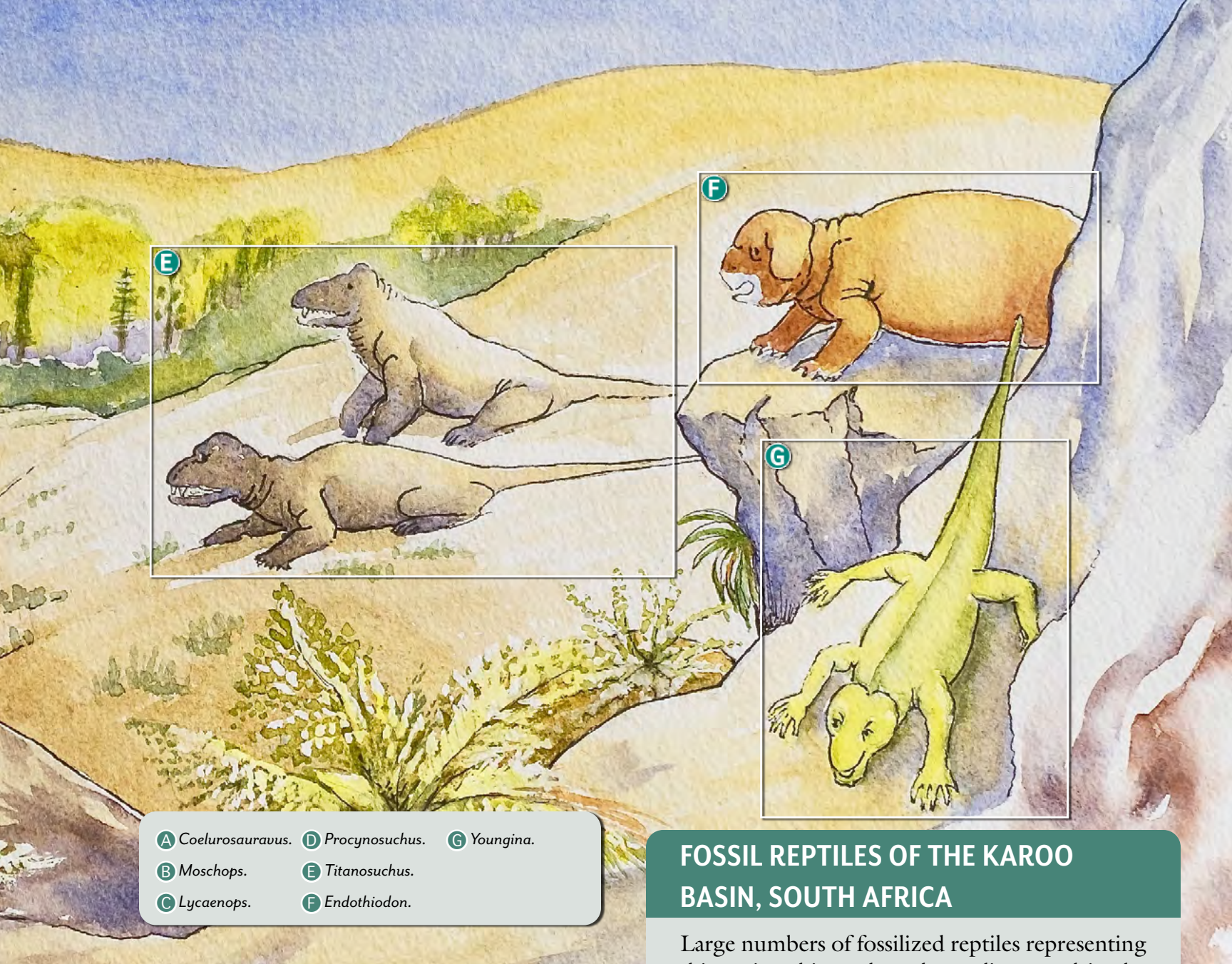
Reptiles thrived in the sand dunes and forests fringing the coasts of the pre-Flood supercontinent. Gymnosperm plants such as seed ferns and conifers dominated the forests.

Most of the animals inhabiting this biome were therapsids, a very diverse group with a peculiar mixture of reptile-like and mammal-like characteristics.

Most abundant were the dicynodonts—herbivores such as *Endothiodon* with two canines and a horny beak that they used for slicing and crushing plants.

There were also saber-toothed carnivorous therapsids called gorgonopsians. A typical example was *Lycaenops*, with its heavy skull, wide mouth, and massive canines.

Also common were the cynodonts, a group that included small- to medium-sized carnivores such as *Procynosuchus*.



- A *Coelurosauravus*.    D *Procynosuchus*.    G *Youngina*.
- B *Moschops*.            E *Titanosuchus*.
- C *Lycaenops*.            F *Endothiodon*.

## FOSSIL REPTILES OF THE KAROO BASIN, SOUTH AFRICA

Large numbers of fossilized reptiles representing this extinct biome have been discovered in the Upper Permian sandstones and mudstones of the Karoo Basin in South Africa.

Robert Broom (1866-1951), a Scotsman who moved to South Africa at the turn of the twentieth century to practice medicine, made the largest collections. During his fifty-year scientific career, Broom named hundreds of fossil therapsids—including well-known types such as *Moschops* (in 1911), *Lycaenops* (in 1925), and *Procynosuchus* (in 1937)—as well as other reptiles such as *Youngina* (in 1914).

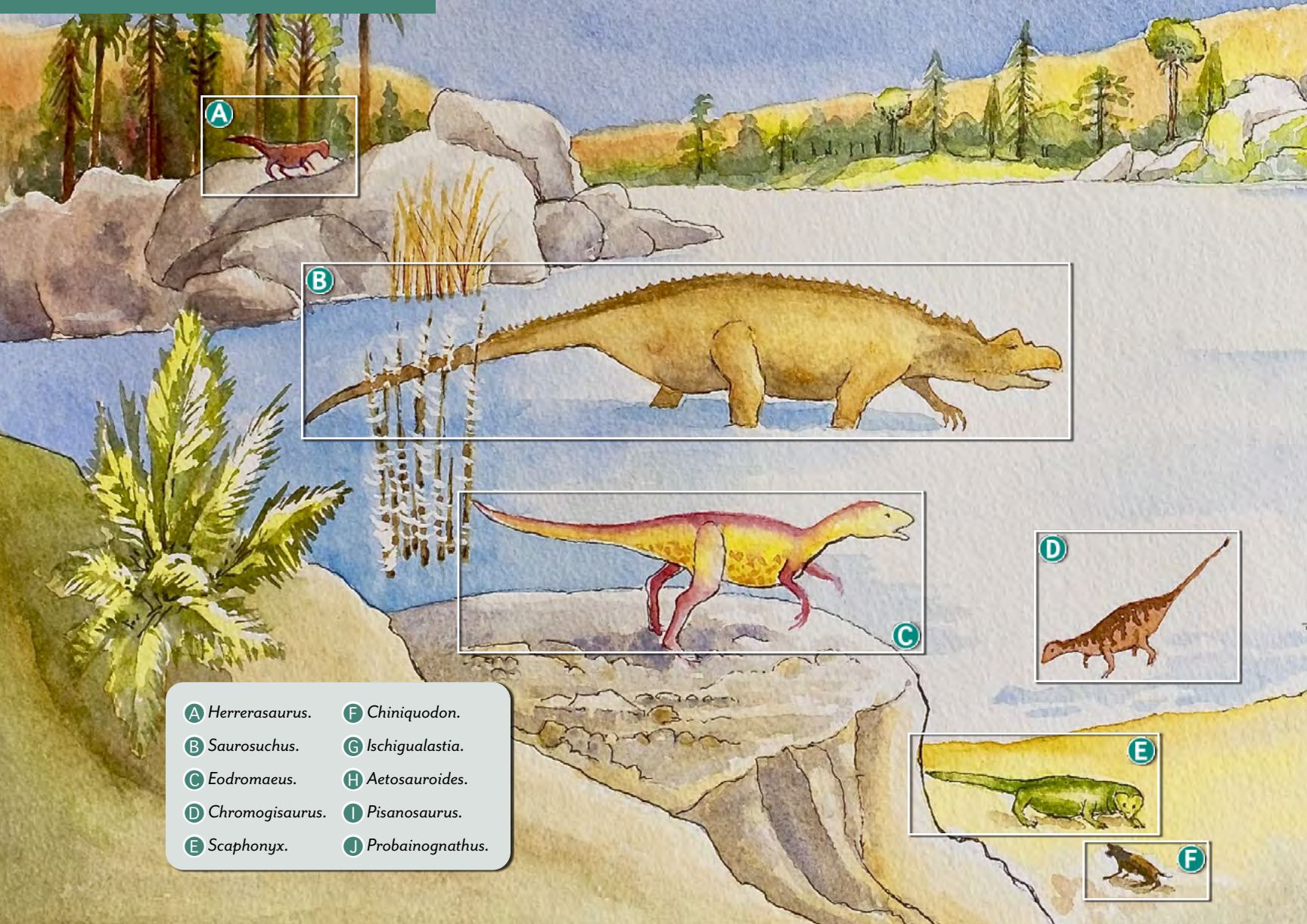
Other therapsids included the dinocephalians, a group comprising bulky herbivores like *Moschops* and dog-sized carnivores like *Titanosuchus*.

Diapsid reptiles were also present, including the lizard-like *Youngina* and gliders such as *Coelurosauravus*.

► Robert Broom, the paleontologist who discovered many of the fossil reptiles of the Karoo Basin, South Africa.



◀ The magnificent rock exposures in the Karoo desert are a rich source of vertebrate fossils.



## DINOSAURS I. TRIASSIC BIOME

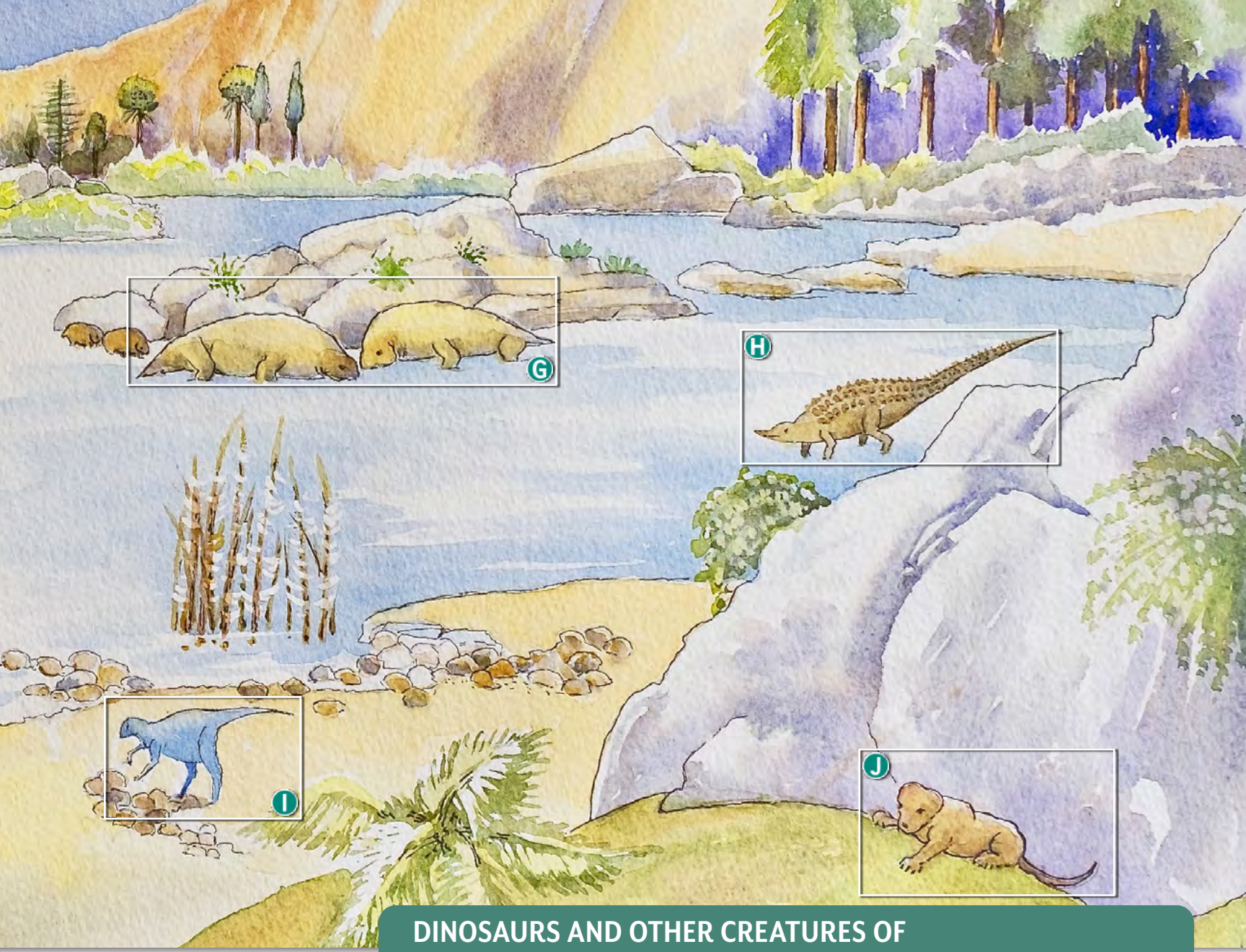
Large regions of the pre-Flood world must have been dominated by the extraordinary animals we call dinosaurs. In fact, it seems that there were at least three dinosaur biomes.

One of these biomes comprised the dinosaurs and associated creatures we find in Triassic rocks. Non-flowering gymnosperms dominated the flora, including conifers (such as *Protojuniperoxylon*). There were also horsetails and ferns (such as *Cladophlebis*).

The dinosaurs of the Triassic biome were mostly small, slender animals, including carnivores (such as *Herrerasaurus* and *Eodromaeus*) and plant-eaters (such as *Pisanosaurus* and *Chromogisaurus*).

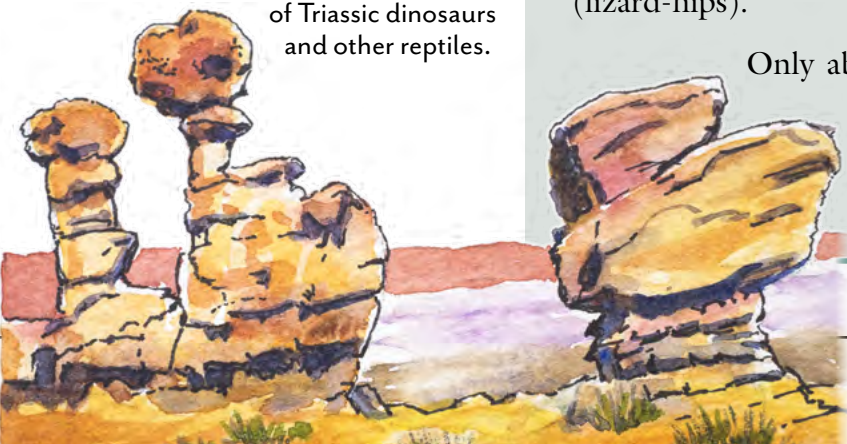
But other kinds of reptiles were more numerous in this biome than the dinosaurs. There were the rhynchosaurs with their triangular skulls and sharp beaks; the aetosaurs with armored bodies, small heads, and upturned snouts; and the loricatans, crocodile-like in appearance but walking upright on four, long legs.

Therapsids were also represented by small forms (such as *Probainognathus*), medium-sized forms (such as *Chiniquodon*), and large, bulky forms (such as *Ischigualastia*).



## DINOSAURS AND OTHER CREATURES OF ISCHIGUALASTO, ARGENTINA

▼ Wind-sculpted rock formations in the Valle de la Luna (Valley of the Moon) in Ischigualasto Provincial Park, San Juan Province, northwestern Argentina. These rocks belong to the Ischigualasto Formation, which has yielded many fossils of Triassic dinosaurs and other reptiles.



Fossils representing this Triassic biome are preserved in the Ischigualasto Formation of the Valley of the Moon in northwestern Argentina.

Sparse dinosaur remains were discovered in this region in the 1950s, but our knowledge of these animals was greatly expanded when collecting resumed in the 1990s. The Ischigualasto dinosaurs include representatives of both main dinosaur subgroups: the ornithischians (bird-hips) and saurischians (lizard-hips).

Only about 10 percent of the vertebrate fossils in these rocks are dinosaurs. There are also fossils of many other reptiles, with the medium-sized rhynchosaur *Scaphonyx* accounting for more than half of the tetrapod remains in this formation.

## DINOSAURS II.

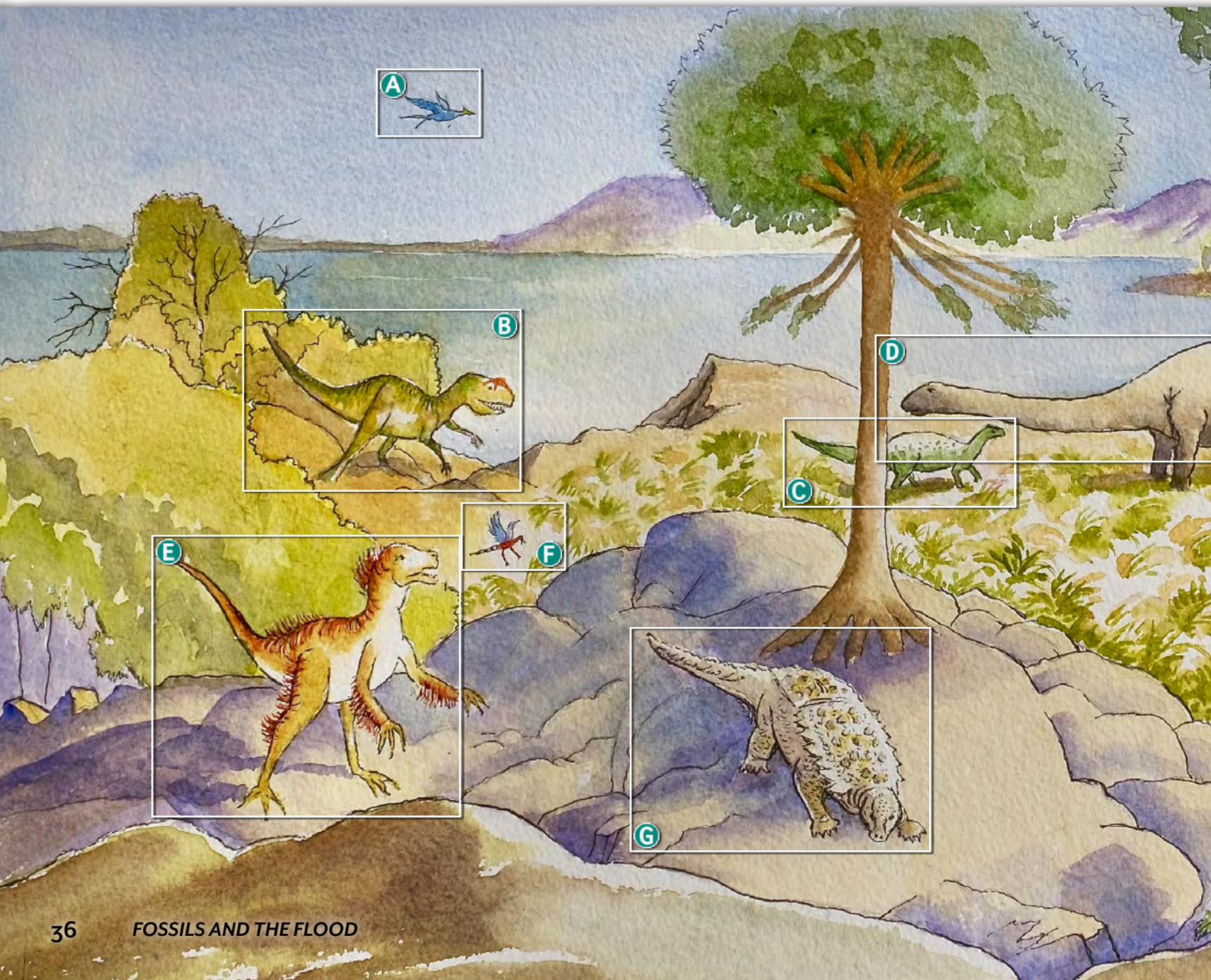
### JURASSIC BIOME

Another biome hosted the dinosaurs and associated animals and plants that we find in Jurassic rocks.

Conifers were the dominant trees in this biome, growing alongside mid-size plants such as ginkgos, cycads, tree ferns, and clubmosses. Small ground plants included horsetails and ferns (such as those belonging to the order Marattiales).

Giant sauropods like *Brachiosaurus* and *Apatosaurus* browsed the leaves from the tops of the tallest trees, while smaller ornithomids such as *Camptosaurus* and *Dryosaurus* browsed on the lower stems. Armored dinosaurs such as *Mymoorapelta* and *Stegosaurus* grazed on the small shrubs and ground plants.

The largest meat-eater in this biome was the theropod *Allosaurus*, but there were also smaller carnivores such as *Ceratosaurus*. The small, bird-like theropod *Ornitholestes* may have preyed on lizards and insects.



► The famous fossil wall at Dinosaur National Monument in Colorado, USA. About 1,500 dinosaur bones can be seen in the wall, which is part of the Jurassic Morrison Formation. The bones belong to *Allosaurus*, *Apatosaurus*, and *Stegosaurus*, among others.



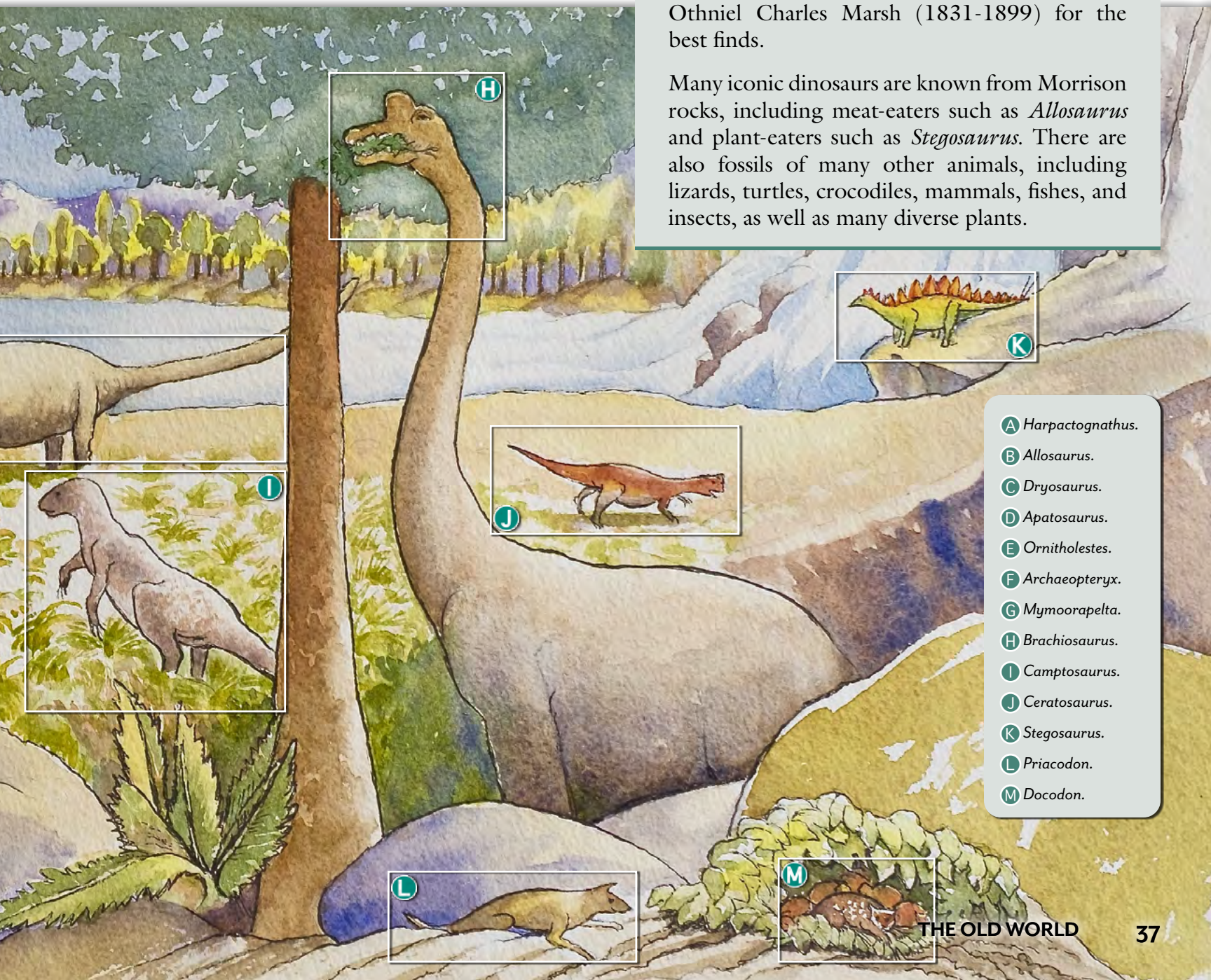
## DINOSAURS AND OTHER CREATURES OF THE MORRISON FORMATION

The Morrison Formation is a widespread rock unit, extending for hundreds of miles across parts of seven American states: New Mexico, Oklahoma, Colorado, Utah, Montana, South Dakota, and Wyoming.

Hundreds of dinosaur skeletons have been excavated from these rocks since the days of the Great American Bone Wars, when Edward Drinker Cope (1840-1897) competed with Othniel Charles Marsh (1831-1899) for the best finds.

Many iconic dinosaurs are known from Morrison rocks, including meat-eaters such as *Allosaurus* and plant-eaters such as *Stegosaurus*. There are also fossils of many other animals, including lizards, turtles, crocodiles, mammals, fishes, and insects, as well as many diverse plants.

Flying reptiles dominated the skies, including pterosaurs such as *Harpactognathus*. Scurrying around the feet of the dinosaurs were also small mammals. Some were burrowing animals, while others climbed trees. They all belonged to groups that are now extinct.



- A *Harpactognathus*.
- B *Allosaurus*.
- C *Dryosaurus*.
- D *Apatosaurus*.
- E *Ornitholestes*.
- F *Archaeopteryx*.
- G *Mymoorapelta*.
- H *Brachiosaurus*.
- I *Camptosaurus*.
- J *Ceratosaurus*.
- K *Stegosaurus*.
- L *Priaecodon*.
- M *Docodon*.

## DINOSAURS III. CRETACEOUS BIOME

The dinosaurs and associated animals and plants that we find in Cretaceous rocks inhabited another biome.

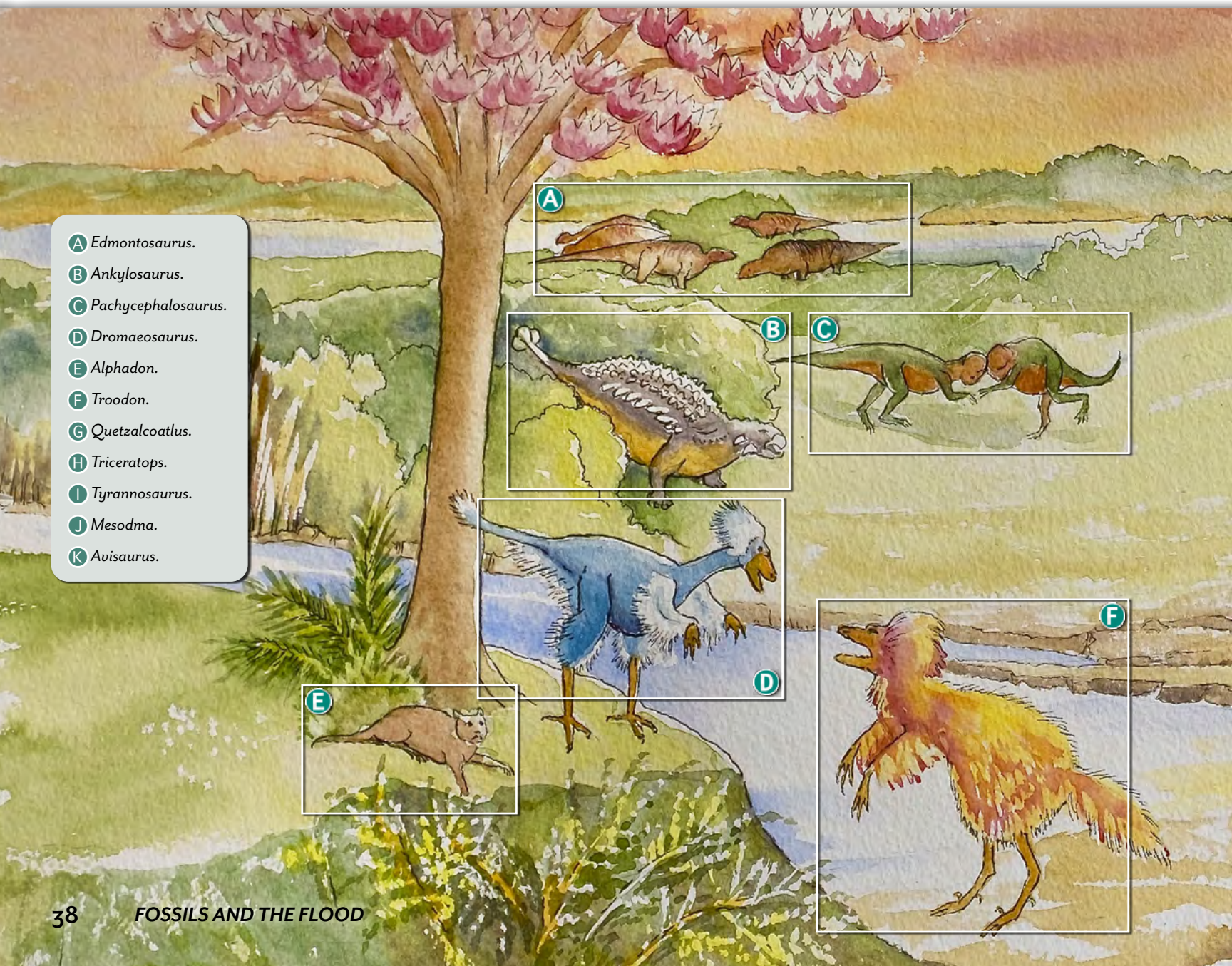
Large trees included the fruit-bearing angiosperms such as sycamores and magnolias. Mid-size plants included laurels, and there were small ground plants such as the fern *Dryopteris*.

Browsing and grazing on these plants were herbivores such as the hadrosaur *Edmontosaurus*,

the horned dinosaur *Triceratops*, the armored *Ankylosaurus*, and the bone-headed *Pachycephalosaurus*.

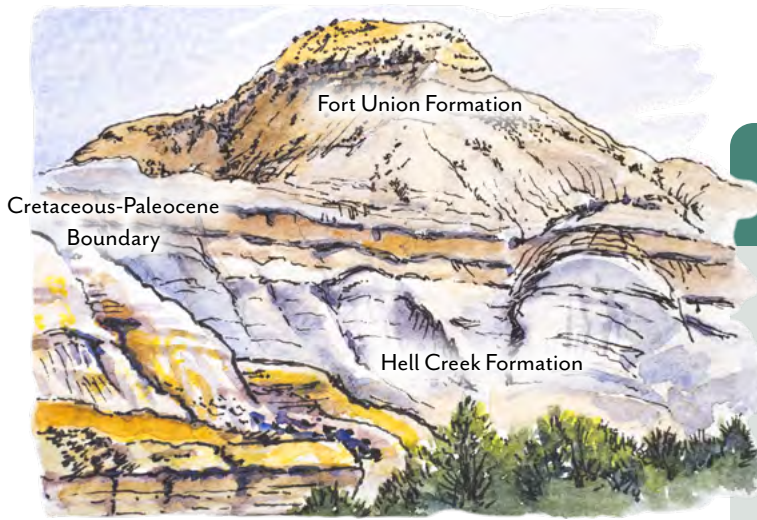
The largest meat-eater in this biome was *Tyrannosaurus*, but there were smaller carnivores such as *Dromaeosaurus* and *Troodon*, both of which probably possessed a feathery covering.

Pterosaurs included true giants such as *Quetzalcoatlus*, with an estimated wingspan of 33 to 36 feet (10 to 11 meters). This extraordinary pterosaur was one of the largest flying animals ever to have lived. Small birds such as *Avisaurus* and small mammals such as *Alphadon* and *Mesodma* also inhabited this biome.



- A *Edmontosaurus*.
- B *Ankylosaurus*.
- C *Pachycephalosaurus*.
- D *Dromaeosaurus*.
- E *Alphadon*.
- F *Troodon*.
- G *Quetzalcoatlus*.
- H *Triceratops*.
- I *Tyrannosaurus*.
- J *Mesodma*.
- K *Avisaurus*.



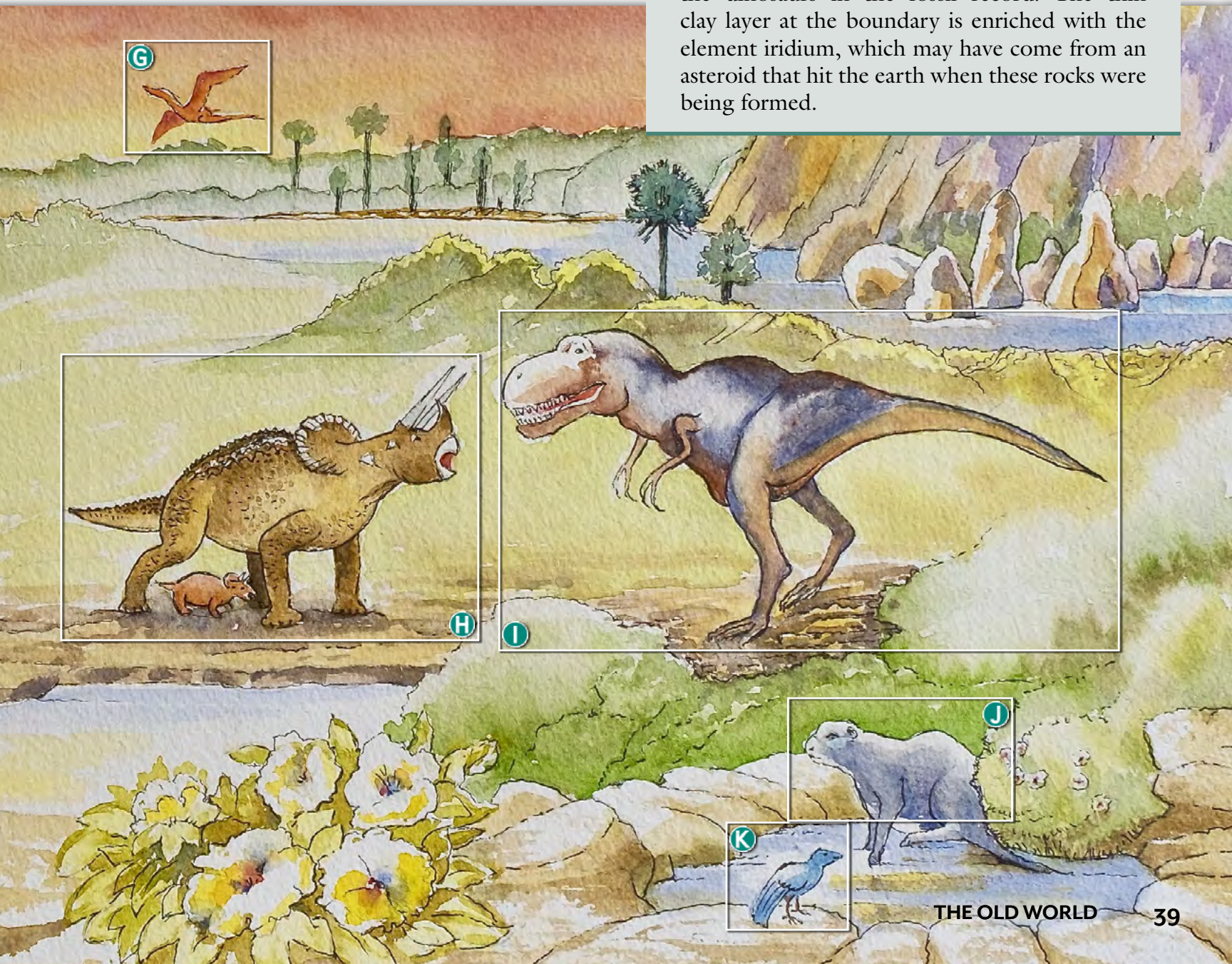


▲ The Cretaceous-Paleocene boundary in Makoshika State Park near Glendive, Montana, USA, is marked by a narrow band of iridium-enriched clay and carbonized plant material. The dinosaur-bearing Hell Creek Formation (Cretaceous) lies below the dark band; the Fort Union Formation (Paleocene) lying above it does not have dinosaur fossils.

## DINOSAURS AND OTHER CREATURES OF THE HELL CREEK FORMATION

The Hell Creek Formation in Montana, USA, has yielded many fossil skeletons belonging to inhabitants of the Cretaceous dinosaur biome. These include dinosaurs and pterosaurs, but also crocodiles, lizards, turtles, frogs, fishes, and mammals. Among the most famous Hell Creek dinosaurs are the top predator, *Tyrannosaurus*, and the horned dinosaur, *Triceratops*.

Scientists have studied the Hell Creek Formation extensively because these rocks include the boundary that marks the last appearance of the dinosaurs in the fossil record. The thin clay layer at the boundary is enriched with the element iridium, which may have come from an asteroid that hit the earth when these rocks were being formed.



## MARINE REPTILE BIOMES

The world before the Flood was also home to a greater diversity of marine reptiles than are living today. These animals may have inhabited the warm, shallow waters of inland seas closely associated with the dinosaur biomes of the Triassic, Jurassic, and Cretaceous.

Among the best known of these fossilized marine reptiles are the ichthyosaurs (meaning *fish lizards*). They had streamlined bodies with front and rear paddles, and a deep tail fin. Their long, thin snouts were equipped with an array of sharp teeth, and they seem to have lived on a diet of fish and shellfish.

Another well-known group is the plesiosaurs (meaning *ribbon lizards*). They had compact bodies and short tails but elongated necks. They probably used their paddles to swim with an underwater flying motion, darting out their long necks to catch fish and squid.

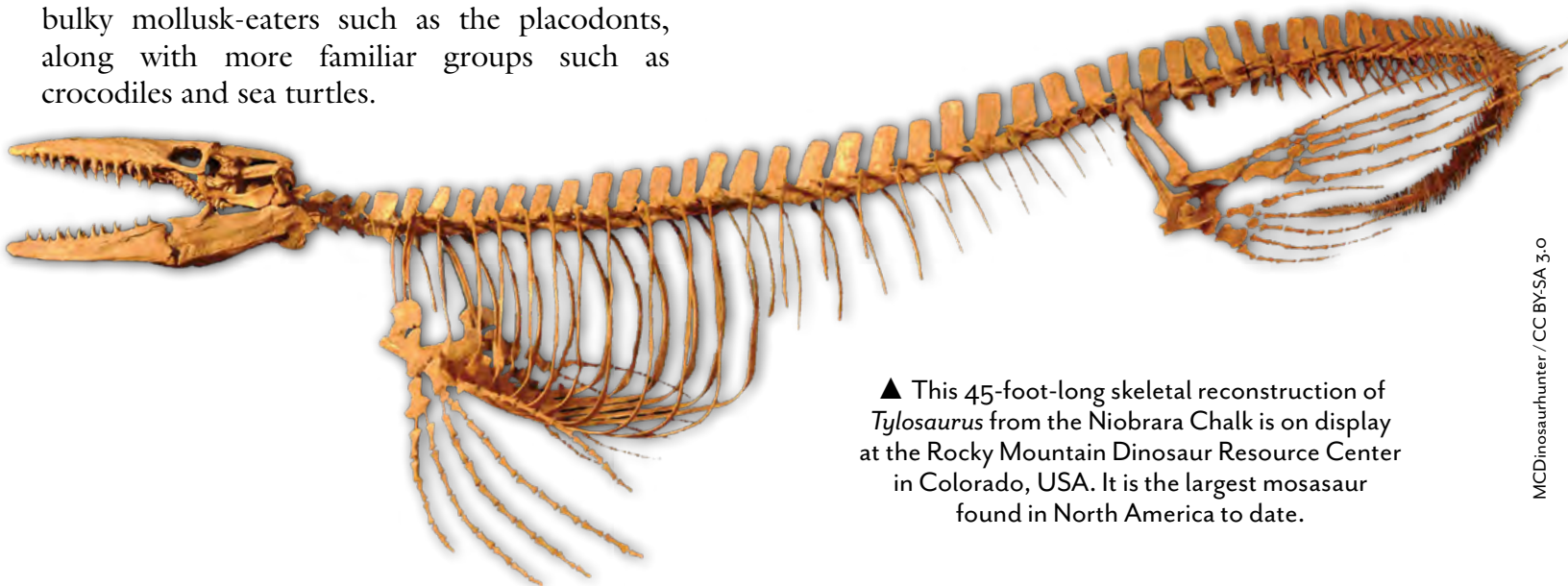
Perhaps most spectacular of all were the giant marine lizards called mosasaurs. These animals had long bodies, deep tails, and paddle-like limbs. Their wide jaws were lined with sharp, conical teeth, which they used to catch fish and crack open mollusk shells.

Other marine reptiles included the nothosaurs, slender animals with four paddle-like limbs, and bulky mollusk-eaters such as the placodonts, along with more familiar groups such as crocodiles and sea turtles.

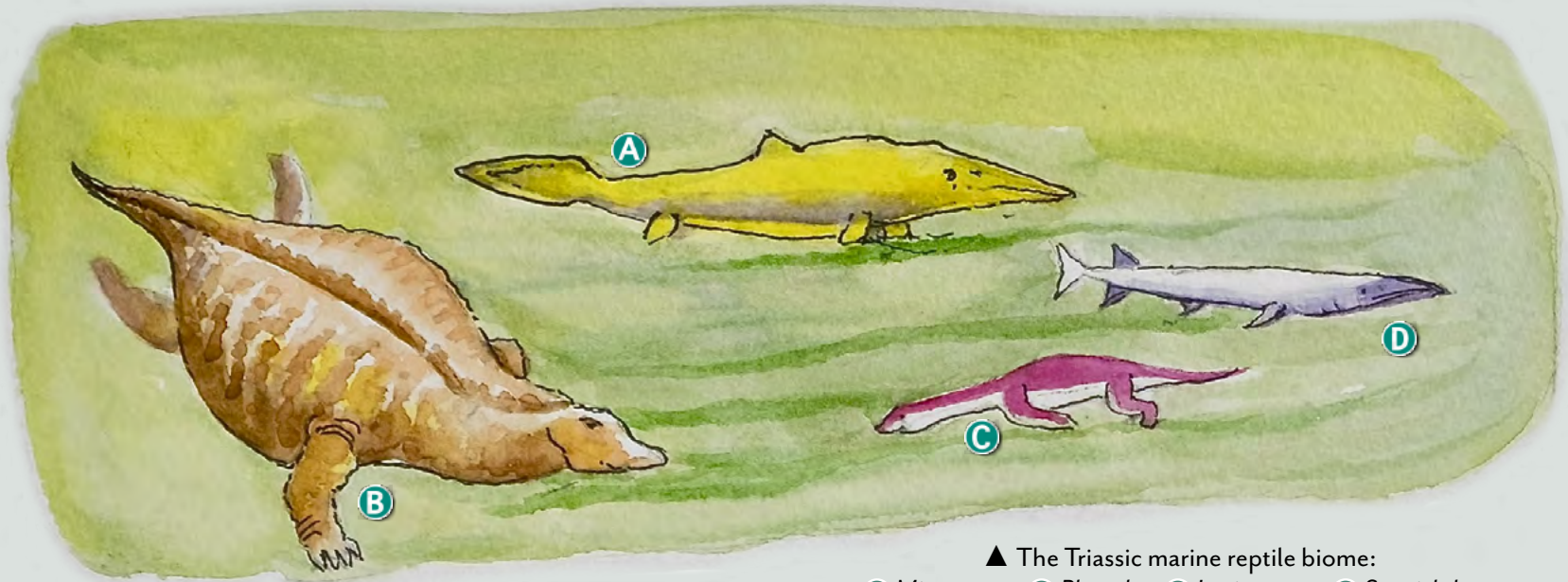
The Triassic marine reptile biome was home to ichthyosaurs (such as *Mixosaurus*), placodonts (such as *Placodus*), and nothosaurs (such as *Lariosaurus*). Also shown is the ray-finned fish, *Saurichthys*. This reconstruction is based on fossils from the Middle Triassic “Lower Reptile Bed” of the Guanling Formation in Guizhou Province, China.

The Jurassic marine reptile biome was inhabited by ichthyosaurs (such as *Stenopterygius*), plesiosaurs (such as *Plesiosaurus*), and crocodiles (such as *Steneosaurus*). Ammonites (such as *Dactylioceras*) and ray-finned fishes (such as *Lepidotes*) also swarmed in these warm waters. This reconstruction is based on fossils from the Lower Jurassic Posidonia Shale of Holzmaden, Germany.

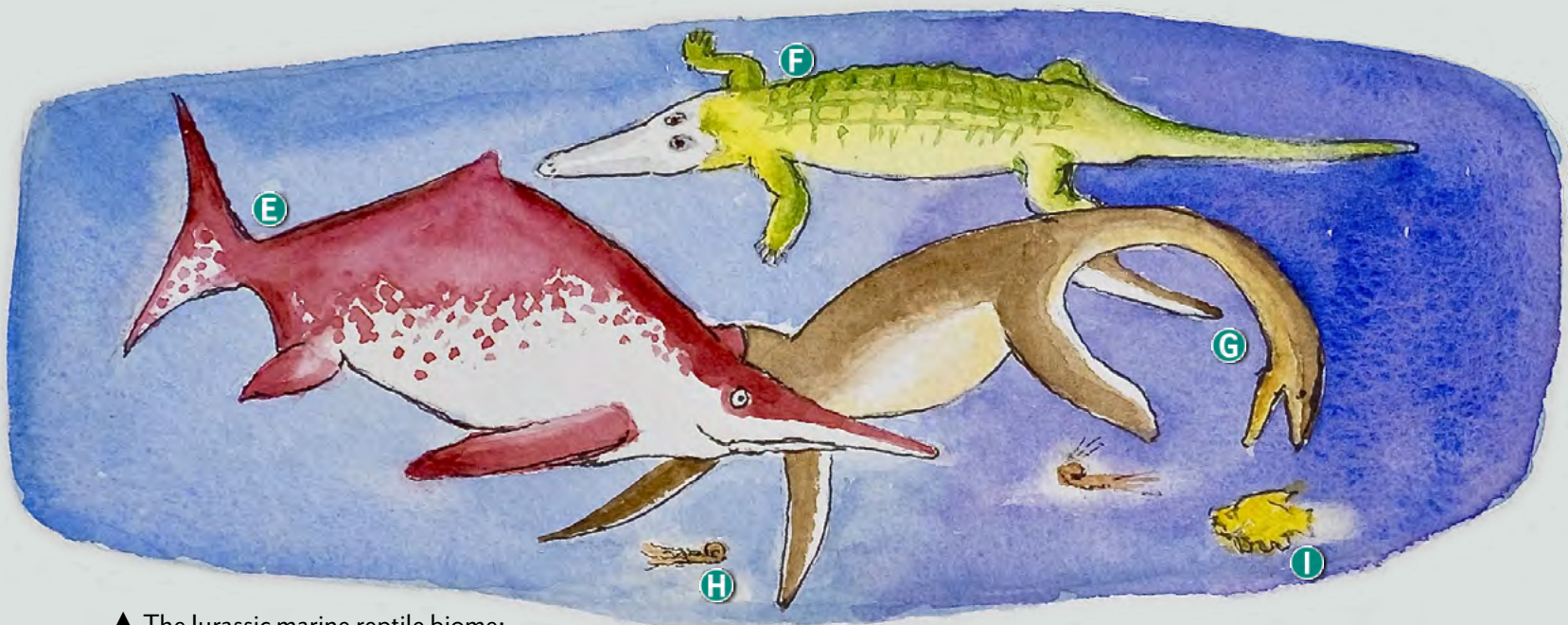
The Cretaceous marine reptile biome was populated by mosasaurs (such as *Tylosaurus*), plesiosaurs (such as *Elasmosaurus*), and sea turtles (such as *Archelon*). Also shown is *Squalicorax* (a shark), *Protosphyraena* (a swordfish), and *Pachyrhizodus* (a bony fish). This reconstruction is based on fossils from the Upper Cretaceous Niobrara Chalk of Kansas, USA.



▲ This 45-foot-long skeletal reconstruction of *Tylosaurus* from the Niobrara Chalk is on display at the Rocky Mountain Dinosaur Resource Center in Colorado, USA. It is the largest mosasaur found in North America to date.

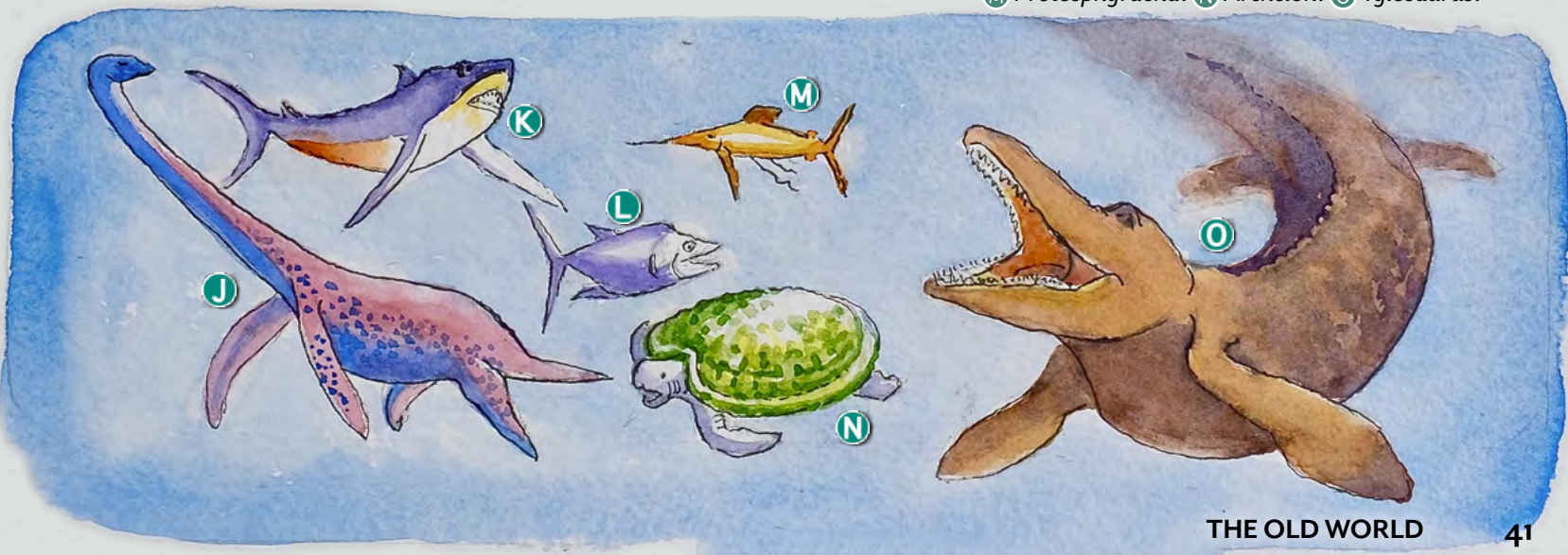


▲ The Triassic marine reptile biome:  
 A *Mixosaurus*. B *Placodus*. C *Lariosaurus*. D *Saurichthys*.



▲ The Jurassic marine reptile biome:  
 E *Stenopterygius*. F *Steneosaurus*. G *Plesiosaurus*.  
 H *Dactyloceras*. I *Lepidotes*.

▼ The Cretaceous marine reptile biome:  
 J *Elasmosaurus*. K *Squalicorax*. L *Pachyrhizodus*.  
 M *Protosphyraena*. N *Archelon*. O *Tylosaurus*.



## EDEN AND ITS SURROUNDINGS

There must have been at least one other biome before the Flood—one in which most of the mammals and birds lived alongside humans. The dominant plants in this biome were probably angiosperms (flowering plants).

For reasons we will explore later, this biome seems to be entirely missing from Flood sediments. This means that we must speculate to a considerable degree about what this biome and its inhabitants were like.

We can get some clues about this biome from the Bible's description of the Garden of Eden and its surroundings. Genesis 2:10-14 tells us that a river ran out of Eden and split into four rivers that ran into four different countries. This suggests that Eden was at a higher elevation than the lands surrounding it.

Making the reasonable assumption that the humans were living in a biome centered around Eden, it seems likely that this was an upland ecosystem.

Furthermore, the river in Eden may have been fed by a spring bringing water from below the ground. Genesis 2:6 refers to a mist that came



up to water the ground. Although the precise nature of this mist is not clear, the use of the same word in languages similar to biblical Hebrew suggests that it may have been a flowing spring of some kind.

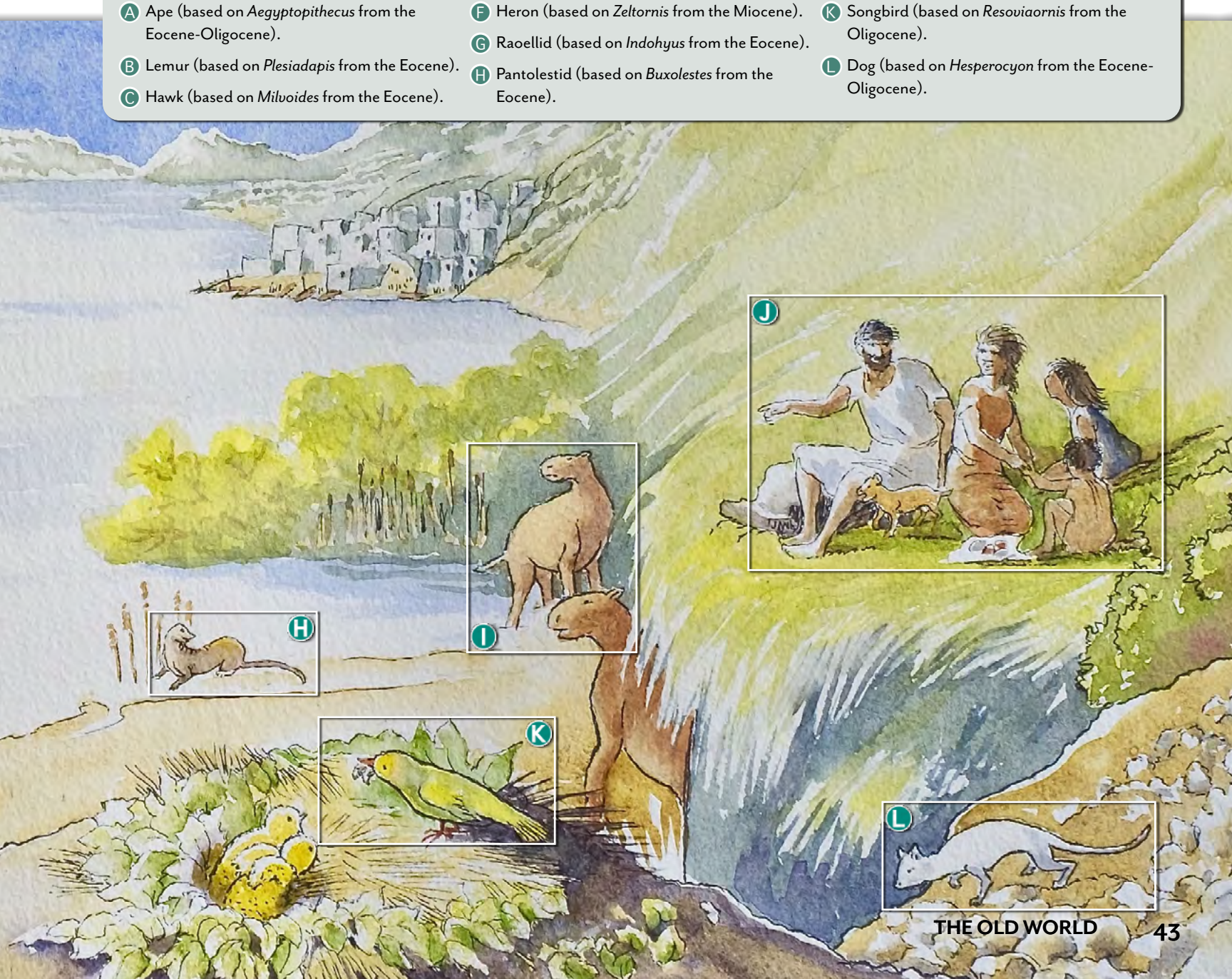
Perhaps this biome was located right on top of one of the “fountains of the great deep” that broke open at the beginning of the Flood (Genesis 7:11).

We can also infer that humans living in this biome had an advanced culture. The Bible tells us that before the Flood, humans were farming arable crops and livestock (Genesis 4:2), building cities (Genesis 4:17), composing music, and working with metals (Genesis 4:19-22).

The next section of the book will look at the destruction of these biomes in the worldwide catastrophe of Noah’s Flood.

This biome and its inhabitants were not preserved in Flood rocks, so we have reconstructed them here based on clues from the Bible and the earliest post-Flood fossil record:

- A** Ape (based on *Aegyptopithecus* from the Eocene-Oligocene).
- B** Lemur (based on *Plesiadapis* from the Eocene).
- C** Hawk (based on *Milvovides* from the Eocene).
- D** Mesonychid (based on *Dissacus* from the Paleocene-Eocene).
- E** Kingfisher (based on *Primobucco* from the Eocene).
- F** Heron (based on *Zeltornis* from the Miocene).
- G** Raoellid (based on *Indohyus* from the Eocene).
- H** Pantolestid (based on *Buxolestes* from the Eocene).
- I** Chalicothere (based on *Schizotherium* from the Eocene-Oligocene).
- J** Humans (based on early *Homo* from the Plio-Pleistocene).
- K** Songbird (based on *Resoviaornis* from the Oligocene).
- L** Dog (based on *Hesperocyon* from the Eocene-Oligocene).





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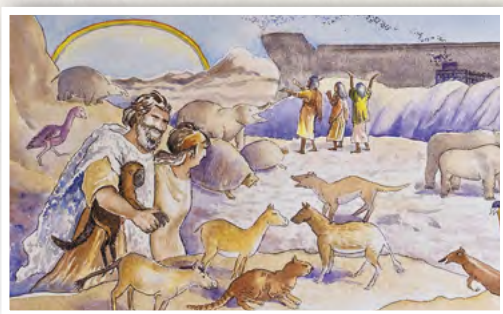
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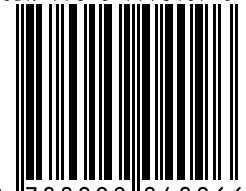
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