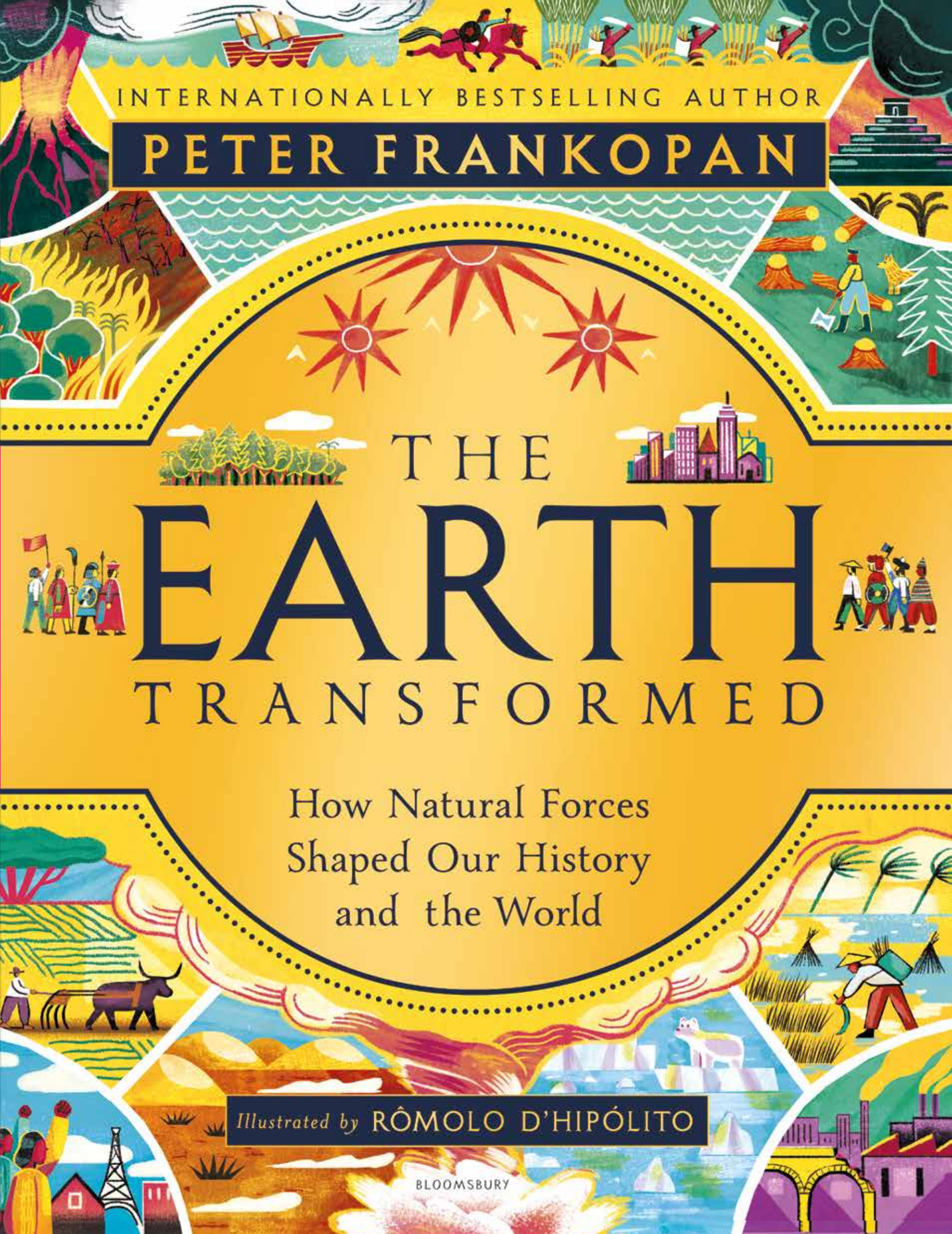




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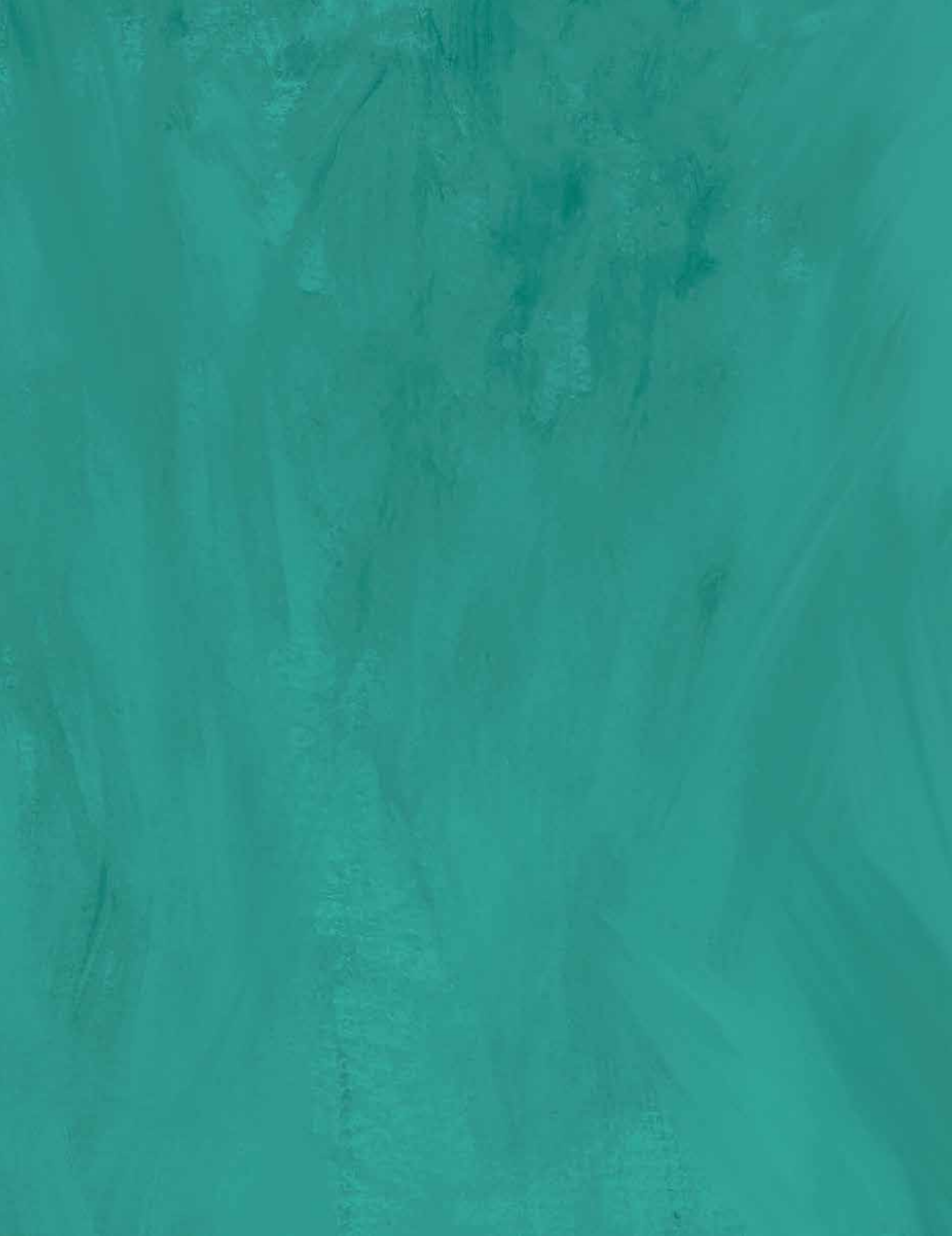
PETER FRANKOPAN

THE
EARTH
TRANSFORMED

How Natural Forces
Shaped Our History
and the World

Illustrated by **RÔMOLO D'HIPÓLITO**

BLOOMSBURY

A vertical teal-colored band with a subtle, organic texture, resembling watercolor or marbled paper, occupies the left half of the image.

*The world was all before them,
where to choose*

*Their place of rest, and
Providence their guide*

JOHN MILTON,
PARADISE LOST, BOOK XII

Dedications to go here – P.F.

To my mum – the first person who made me believe the world is worth drawing. – R.D.

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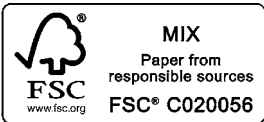
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INTRODUCTION

When I was a boy, I loved history lessons. It was so exciting to learn about different regions and different periods in the past. One of the most obvious things, though, was that history was always about people: often it was about heroes who did incredible things, won battles they should have lost, or whose actions paved the way for empires to be built. Sometimes it was about men and women who stood up for their beliefs and showed amazing courage when they did so. Sometimes history lessons were about leaders who did terrible things, inflicting pain and suffering because of their cruelty; and every now and again, they were about people who were neither famous nor special, neither unkind nor remarkable, but whose lives told us about how most people lived in different times and different places.

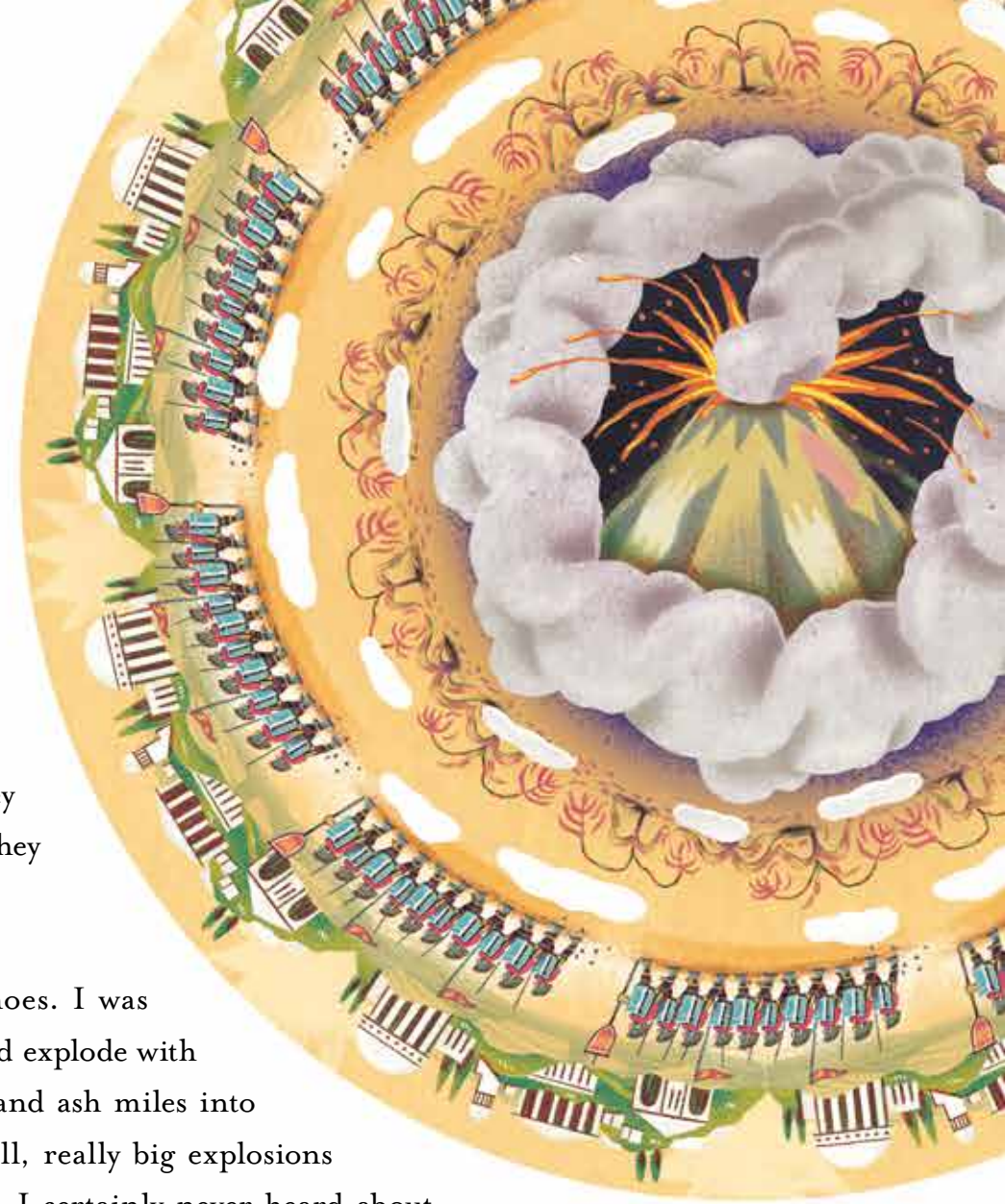
History, however, was always about what people did, thought or said, about the buildings they made, about the music they wrote or the art they created.

Every now and again, there would

be mention of a great ocean, a vast desert, a mighty river or an imposing mountain range – but it was never possible to get a sense of their true size or importance. Even though their names appeared on the map on my bedroom wall, I found it hard to imagine what they really looked like, let alone what kind of role they might have played in history – if they even played a role at all.

It was the same with volcanoes. I was fascinated to learn that they could explode with awesome power, sending rocks and ash miles into the sky; but as far as I could tell, really big explosions happened millions of years ago. I certainly never heard about them at school. It was a similar story with storms, droughts or even the weather in general. There were the epic rains that created the flood that killed everything and everyone, except Noah, his family and the pairs of animals that he made sure were on his ark in good time. But that was the only flood I ever heard about – and that was not even in a history lesson. Storms, heavy rainfall and droughts were not mentioned once when I learned or read about the past.

When I was a bit older, that changed – but only a bit. I learned that bitter winter and freezing conditions affected Napoleon's attack on Russia in 1812, as they did the German attack on the Soviet Union during the Second World War. I learned how 'kamikaze' – or divine winds – were said to be responsible for preventing attacks on Japan 800 years ago by the Mongols, and that this name was later given to Japanese pilots in the Second World War who used their planes as missiles against enemy ships. But that was it. The way I was taught it, history had nothing to do with the weather, with climate or with environmental change.



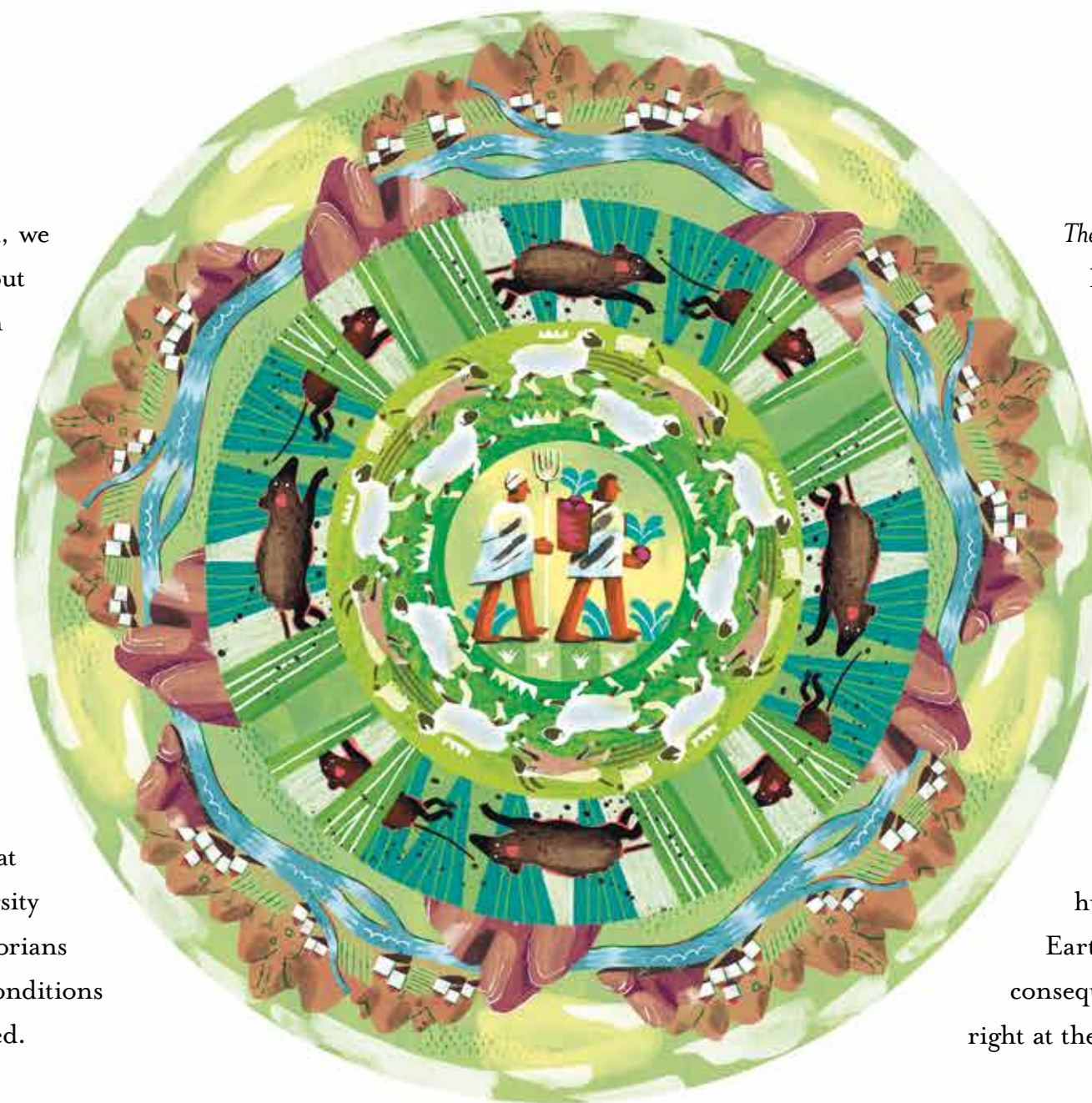
Nor did it have anything to do with the natural world. At school, we studied animals and plants in biology lessons; you did not learn about them in history classes. No one thought it was important to explain how people in the past warmed their houses, or where the energy came from to provide the heat needed to make bricks or glass or metal or indeed to cook their food. No one explained about how important metals were or how they changed the ways people lived. No attention was paid to how growing conditions for crops were not only crucial for providing food but that changes to soil chemistry could mean that populations could suddenly face the threat of starvation.

The good news is that historians today are much more interested in these topics, and in thinking about the past in new and exciting ways. As it happens, many of those involve looking at how humanity has been shaped by nature, and how we have in turn transformed the world around us – both for good and for bad. One reason for that is that we are living in a time of global warming, of major changes to biodiversity and of serious concerns about sustainability. Another, though, is that historians have new tools, new powers even, to look back and measure climate conditions in the past, to assess how ecosystems changed and how diseases evolved.

All of these factors make studying history today incredibly exciting.

By widening the lens of history beyond just looking at people to include the roles of geology and plate tectonics, of crop redistributions, of deforestation and so much more, the past becomes more vibrant, richer and more exciting. It can feel like a new dimension – like holding up and rotating a cube in one's hands rather than staring at a square drawn flat on a page.

Looking at the past is interesting in its own right, but – as I wrote in a book called



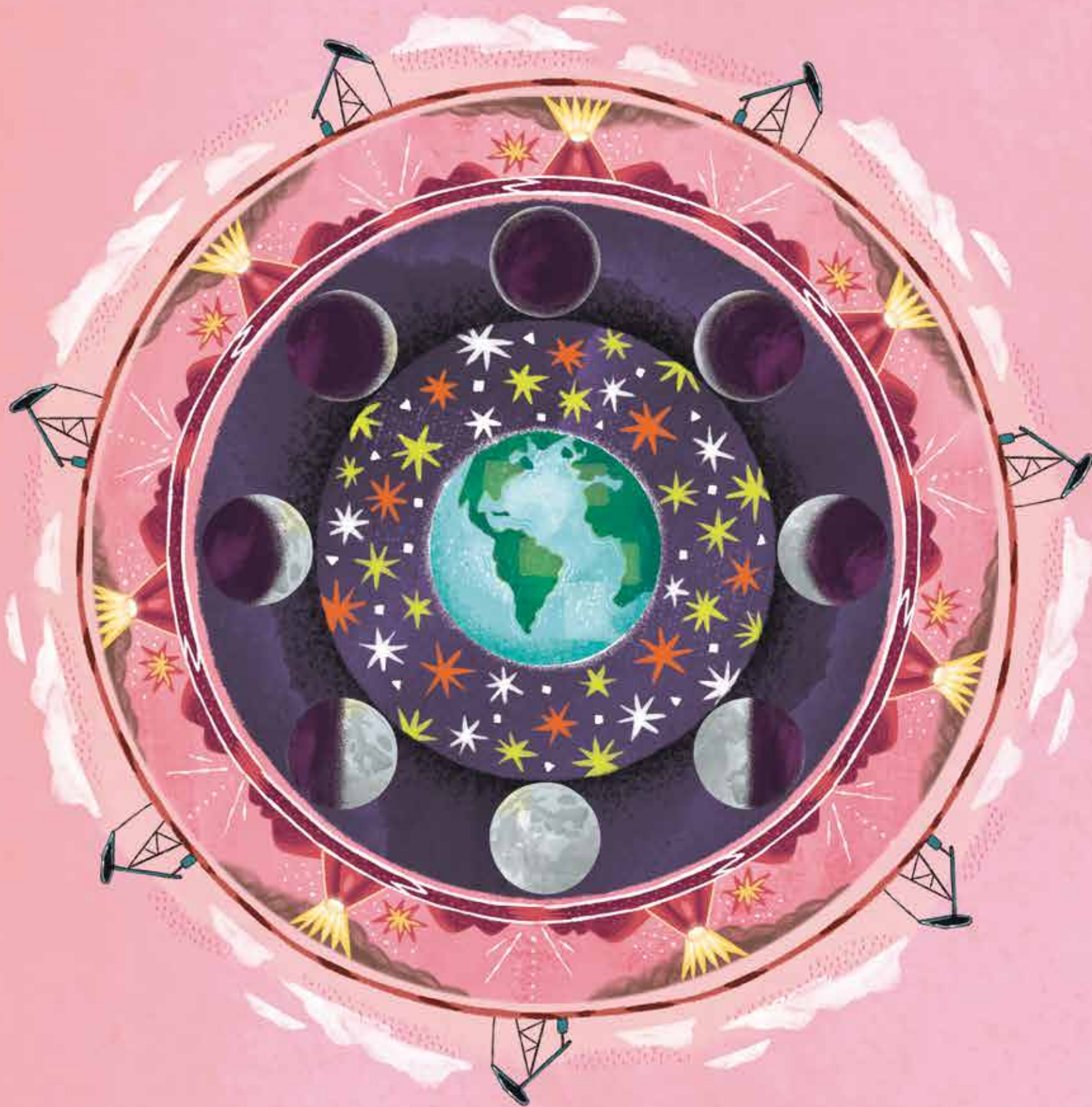
The Silk Roads – looking backwards in time can also be like looking back at footsteps in the sand: they help us understand where we have come from. There has never been a more important time to do that than today, because we are living through an age of astonishing changes to the environment, to ecosystems, to global climate and to the natural world. Although some of these will provide opportunities, many will provide challenges, including very serious ones.

So this book will help introduce you to peoples and places you might not have heard of, and to subjects you might not have covered at school, at home or when talking with your friends. It will help explain how nature has shaped the history of humanity, but also how humans have transformed Earth – sometimes for good, sometimes with devastating consequences. But let's start at the beginning. And I mean right at the beginning: the point where Earth was made.

Looking backwards in time can also be like looking back at footsteps in the sand

PETER FRANKOPAN





CHAPTER ONE

OUR PLANET TRANSFORMED

Our planet is around 4.6 billion years old. It was formed from particles of dust and gas that were dragged into the Sun's orbit and smashed into each other to form solid objects. Over the course of millions of years, these crashed into each other to form bigger and bigger clumps of rocks that eventually accumulated to create a single object that grew bigger still because of impacts with dust, rocks, asteroids and other small planets that added more and more layers. This process is known as accretion, and it is how Earth was made.

Around 4.5 billion years ago, the young Earth was struck by a planet about the size of Mars in a massive collision. The impact was so powerful that lots of new material was added to Earth, but the collision also threw molten rock, vaporised debris, dust and gases up into space. These eventually went through the same process of accretion as Earth to form something we can see when we look up into the sky: the Moon.

The Moon keeps moving forward (this is called inertia) while Earth's gravity constantly pulls it inwards. This combination of pull and forward motion results in the Moon orbiting Earth in a stable, curved path. The Moon plays an important part in what happens on our planet: the length of its orbit around Earth helps explain reproductive cycles in many species, including our own, as well as the hunting patterns of predators, while its gravitational pull helps create ocean tides that rise and fall twice a day. The Moon is the reason why we use the word 'month' as a key unit of time.

Years, on the other hand, are measured by how long it takes Earth to do a rotation around



the Sun – which means that we measure our age (and the dates of all events) because of the time it takes our planet to make a lap around the star that is at the centre of our Solar System. The Sun’s role in life on Earth is absolutely central: it provides the warmth that makes it possible for life on Earth to survive – not just for us, but for all animals – while also providing the light that allows us to see and that enables plant life through photosynthesis. The Sun is the source of changes in ocean currents, seasons and climates – and more.

Solar activity has an important function in global climatic conditions, in particular because of the Sun’s magnetic activities. The most prominent of these are sunspots and aurora that follow cycles typically lasting 11 years. A sunspot is an area of dense magnetism on the Sun’s surface, which is cooler than the surrounding hot glowing gas on the surface of the Sun (the photosphere). Sunspots are usually found in pairs with magnetic fields pointing in opposite directions. There are times when the Sun is more or less active (in periods called ‘maxima’ and ‘minima’) – with these periods often being linked to global climate patterns.

The Sun, though, is just one character in a complex set of actors that shape weather systems that often interact with each other. These include the tilt of Earth’s axis and slight ‘wobbles’ in its orbit around the Sun, as well as the uneven distribution of energy between the equator and the poles. On top of that are changing atmospheric conditions, shifting ocean currents and geological shifts too, such as plate tectonics and oscillations in the flow of liquid iron in Earth’s outer core.

The most important global climate system is the El Niño Southern Oscillation, or ENSO, which describes the relationship between the atmospheric and oceanic conditions in the Pacific. This affects rainfall patterns in South America as well as conditions in

South Asia, East Africa and Australia, and can influence the Indian monsoons as well.

ENSO is characterised by three phases: El Niño (warm phase), La Niña (cool phase), and a neutral phase. These phases can last for up to two years each, with a typical warm-neutral-cool phase lasting for approximately four years.

The ENSO cycle of alternating warm El Niño and cold La Niña events is the dominant year-to-year climate signal on Earth. As well as ENSO, it’s important to remember the effects of one other factor: the North Atlantic Oscillation (NAO), which broadly describes the balance of sea-level* pressure between the Azores and Iceland, which creates periods of cyclonic and anti-cyclonic patterns that affect western Europe. NAO also plays a role in winter rain in the Mediterranean, and driving cold air from Siberia and the polar regions into central and western Europe.

All these factors mean that we live on a planet that is in what scientists call the ‘Goldilocks zone’ – not too hot, not too cold, but just right. For most of its history, however, that was not the case: for around half Earth’s existence, despite the role of the Sun and the Moon, there was little or no oxygen in the atmosphere – which means that most species today could not have survived. Those that exist now do so because of extraordinary changes that have taken place over the course of hundreds of millions of years.

Sometimes, change was dramatic and cataclysmic: scientists talk of five ‘mass extinction events’ in the past that resulted in the loss of almost all life on Earth at the time. These were caused by changes in climate and ocean chemistry, by massive volcanic eruptions or by asteroid strikes, the most famous of which struck Yucatán, Mexico, causing huge

*While the ocean’s surface isn’t perfectly level, sea level is defined as the average still-water level, meaning the level without the effects of tides and waves.

firestorms and enormous tsunamis. It ejected so much dust into the atmosphere that it blocked the Sun's rays, which caused temperatures to plummet and led to the extinction of around three-quarters of all species on Earth – including the dinosaurs.

We should be grateful, in other words, for the extraordinary times of enormous change that have shaped our planet's past because without those, we would not be here today, and nor would any of the other animals, plants and fungi we share the planet with. We owe our existence to the tiny numbers of species that survived the challenges of many hundreds of millions of years. We all descend from those small numbers who made it through the bottlenecks when most did not. And most really did not: it is estimated that 99 per cent of all life forms to have ever existed are extinct.

If that shows how lucky we are, it also reminds us that time does not stand still, for change is and always has been constant. The map of the world provides a good example. The world's seven continents, and therefore the oceans and major bodies of water too, whose locations are so familiar to us, are not in the same places as they were in the distant past. Around 200 million years ago, changes to Earth's outer layer led to the slow break-up of a giant supercontinent that was surrounded by water – whose origins on Earth are still a matter of scientific discussion and debate.

In some cases, large pieces of continental plates smashed into each other, sometimes being forced under each other, but sometimes forcing each other to push upwards to form great mountain ranges, such as the Andes and the Himalayas. The latter was formed when the Indian subcontinent crashed into Eurasia (the combined landmass of Europe and Asia) around 50 million years ago, pushing land that had been at sea level upwards to form the world's highest mountains, including Mount Everest. It's amazing to think that the top of these mountains used to form the seabed floor and that, as a result, marine fossils can be found at or near the summit of some of the highest peaks on Earth. In other places, changing environmental and geological conditions helped create giant basins that were formed when dead animal and plant life was compressed into layers and layers of rock, known as sedimentary levels. Over millions of years, these turned into coal, oil and gas – which have in turn become key sources of energy that have been and are still used

Millions of years ago, the continents were joined in one huge block called Pangaea, surrounded by a vast ocean.





'Endlessly fascinating ... an important read'

The Times

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encounter dramatic climatic moments
and meet warriors, gods and the ordinary
people who shaped history – to see how our
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The Earth Transformed reveals how our ever-shifting natural world
has formed the story of our planet. From the Big Bang to roaring
volcanic eruptions, and from meteor strikes to sudden, strange
weather events, this book shows how Earth's climate has influenced
so much of our past – and how looking back at these changes
can help us understand our future.

From the internationally bestselling author of *The Silk Roads*
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