An Introduction to Big History: Thresholds of Increasing Complexity or Four Movements?

By Bob Bain

The Big History story of the universe – and human’s place in it – is told from two perspectives that are outlined in this article. The first, from historian David Christian, is based on thresholds of increasing complexity. The second, from geologist Walter Alvarez, concentrates on four movements: the Cosmos, the Earth, Life, and Humanity.
Introduction

Everyone and everything—from your great-great grandparents to a World War II battle—has a history. There’s a history of the planet and even a history of the entire cosmos. In order to make sure a history fits together as a story, you need to periodize it. That’s a fancy way of describing how historians divide history into distinct chunks of time or eras.

The Big History story of the universe and humanity has been told from many different perspectives. Two of those perspectives are outlined in this article. The first is based on critical points of increasing complexity, while the second concentrates on four periods in history.

Thresholds of Increasing Complexity: David Christian’s Big History

David Christian is a historian who teaches at Macquarie University in Australia. Dr. Christian’s work focuses on the stories people tell and the ways these stories connect people. According to him, stories show how we are connected to each other, the world, and the Universe in which we live.

Some of these stories are origin stories. They explain the beginnings of where we came from, where we are in the universe, and where we are going. The story of Adam and Eve in the Christian and Jewish Bible is an example of an origin story. Dr. Christian explains that every culture had an origin story. These stories allow people to explain where they and their communities fit into our vast, beautiful universe.

There is no common origin story that suits our global community of over seven billion people. However, Christian claims one has been emerging over the last 50 years, which he calls “Big History.” This modern story is different from other origin stories in two crucial ways. First, it is not tied to one region or culture. Second, it draws on an evidence-based understanding of the universe, the Earth, life, and humanity.

Christian’s story centers around the idea that sometimes completely new and more complex phenomena comes into existence. These phenomena are more complex because they have more parts. These parts are arranged in an entirely new way than previous “things.” Christian created the term “thresholds of increasing complexity.” A threshold refers to a key moment when everything changes. For Christian, a threshold of increasing complexity is a time when new forms of complex phenomena emerged. He and other Big Historians identified eight such thresholds of increasing complexity. Together, these eight thresholds tell a Big History of the universe.

So, what’s the story? And why does it matter to world history?

This story begins with the emergence of the universe with the Big Bang. Our understanding of this event developed recently. Physicists figured out how to measure the distance between the Earth and other stars. To our surprise, we learned that stars are moving away from us, which indicates that the universe is expanding. Scientists reasoned
that that our expanding universe at one time must have been smaller. They theorized that there must have been a point when the expanding universe first emerged, and called this emergence the Big Bang. Early on in the existence of the universe, there were only a few elements and gravitational forces.

These early elements and forces were enough for more complex phenomena to emerge, such as stars and galaxies. In Christian’s system, this was Threshold 2. Then, more complex and heavier elements emerged (Threshold 3). Eventually our Solar System and Earth (Threshold 4) emerged. About 4.5 billion years ago, our Sun formed as gravity compressed gases. Gravity acted on the left-over “stuff” from the formation of the Sun to create the other planets and moons in our solar system. One of those planets is our Earth, a rocky planet with a single moon.

The development of life is Threshold 5 in Christian’s Big History story. How living organisms emerged from inanimate or non-living objects, is still a mystery. But it is an example of complex things emerging from less complex things. The first organisms were single-celled bacteria. Some of these bacteria gave off oxygen into the air, helping to form the ozone layer that protects us from the harmful rays of the sun. More complex life evolved from single-celled organisms. Today we have organisms ranging from micro-organisms to plants to animals to us humans.

This story is not only a story of how the universe became more complex. It is also the story of how we humans developed our understanding of the universe. It is quite an amazing story about our curiosity, our innovations, and our collective learning.

By understanding the science of physical and natural forces around us, we can develop clearer pictures of the past, present, and future. For example, we have learned a lot about the way the Earth formed. We know about the origins of the Earth’s elements, minerals, climate, landforms, and even its Moon. This knowledge has allowed us to better understand our past and prepare for the future.

There are three final thresholds of increasing complexity. There is the Emergence of Humans and Collective Learning (Threshold 6). Next is the Emergence of Agriculture (Threshold 7) and the Emergence of Modernity and Use of Fossil Fuels (Threshold 8). These represent three major turning points in the history of humanity. The emergence of humans as a species, farming, and using fossil fuels for energy have transformed the Earth.

This story covers over 13.82 billion years of time and an infinite amount of space. It explains how our universe has grown more complex, from the Big Bang to modern times.
Another Big History story: Walter Alvarez’s Improbable Journey in Four Movements

Not all Big Historians use Christian’s threshold system to structure their history. Indeed, not all Big Historians are even historians. Walter Alvarez is a geologist who studies Big History, and he does not use thresholds. Instead, Alvarez structures his Big History around four periods, which he calls regimes: the Cosmos, Earth, Life, and Humanity. For Alvarez, a regime is an orderly system that has shown patterns across time.

For example, Alvarez says that the Earth has provided “gifts” for humans. These gifts include silicon, which he argues is the Earth’s favorite element and ours. It has played a role in the tools we have created, beginning with our first stone tools through to computers. Using silicone is a pattern that has been seen throughout humanity’s history.

Alvarez’s Big History does not simply focus on the consistent patterns of a regime. He also sees rare events, or contingencies, that lead to significant changes in history. He focuses on changes that people could not have predicted far ahead of time. Dr. Alvarez and his father discovered that a comet or asteroid wiped out the dinosaurs. This was one example of a contingency and an important contribution to our understanding of our own history.

When dinosaurs were dominant, mammals were limited in both size and diversity. Since humans evolved from mammals, it is highly unlikely that we could have evolved alongside dinosaurs. Evidence suggests that a huge comet or asteroid hit the Yucatan Peninsula of Mexico about 66 million years ago. This rare event enabled mammals to thrive in ways they could not while the dinosaurs dominated. Obviously, comets wiping out species are not regular events. This is an example of a rare event that altered history. Human life depended upon this irregular event. This type of contingency is essential for Alvarez’s Big History.

While Dr. Alvarez tells historical stories in presenting his Big History, he does not create one timeline. He treats each of the regimes as separate but part of a connected story. It is also a story about the people who discovered the patterns that shaped and continue to shape our lives. It’s a story about the people that discovered the laws of gravity, light, and the Earth’s elements.

Like Christian’s Big History, Walter Alvarez’s version stresses events such as the Big Bang. He too appreciates the path that has led to our current existence. In many ways, it was extremely unlikely that we humans would exist at this time, on this Earth, and in this universe.

These two versions of Big History help to explain the context of human history. All other events play out on this stage.
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