Deep Time/Big History

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Where did you come from? Like many questions, the answer depends on the timeframe. At the one, most recent extreme is the seemingly straightforward response that you came from your mother, grown in the space of nine months from one of her eggs fertilized by one of your father's sperm. At the other, most distant extreme is the origin of the many atomic elements that went into making you. The carbon, nitrogen, oxygen, and other elements that make up your complex organic compounds were made long, long ago from the fusing of lighter elements in the interior of enormous stars and as these stars blew asunder in enormous explosions (supernovae, like the Carina Supernova pictured above) since the big bang 13.8 billion years ago. So, in this sense, it would be correct to say we come from ancient star dust. But what about the intervening time that separates these two extremes? How is it that the minute, elemental bits of star dust once made were able to assemble eventually into something as miraculous as you or any other living life form on Earth? This is the realm of deep time or what has become known as 'big history,' covering all events prior to the written word 5000 years ago.

And it turns out, it took a long time and a lot had to happen before anything even remotely resembling us lived on Earth. Hence, from the perspective of deep time we are a very late arrival. There are many ways to try and understand

just how recent our arrival is – such as the arrival of our species (*Homo sapiens*) seven and a half minutes before midnight on the 31 December relative to a start of the big bang on January first of that same year. Farming only arrives around 20 seconds before midnight, written history 10 seconds before and Edison's first commercial light bulb literally in the final wink of an eye (300 milliseconds) before the end of an all-time-encapsulated-in-one-year timeframe. But whatever device is used, deep time remains a difficult concept for most of us to grasp fully. Even in the course of our lives our perception of the passage of time changes, from the agonising wait for our birthday as children to the speed at which the years appear to fly by to an octogenarian.

The figure below provides a graphical representation of deep time from the big bang to the present day, a span of 13.8 billion years. More recent times are expanded successively in the columns from right to left. The second column on the right represents the classic geologic timescale, with the major ancient past epochs of the last 540 million years, including, for example, the Cambrian when trilobites crawled about and the Cretaceous when dinosaurs ruled. The third and final columns to the left represent the last three and the last half million years, respectively – the time span over which our human (*Homo*) lineage evolved. The last three million years, and particularly the last million, are demarcated by a wiggly line that represents fluctuations in climate from cold to warm and back again. These climate wiggles are important to our evolution because they are believed to have played a decisive role in shaping who we are.

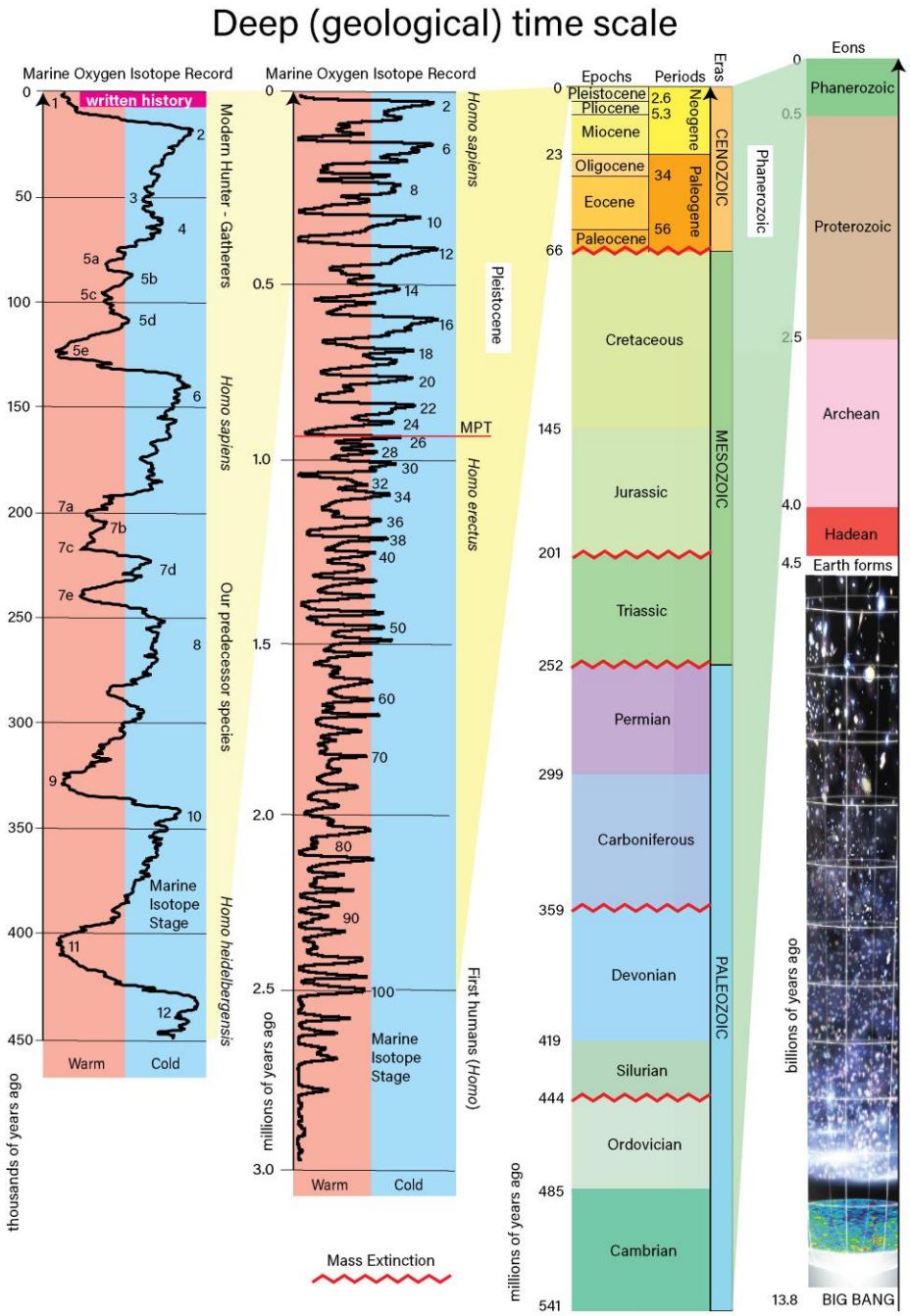

Figure of deep (geological) time from big bang to today.

(Big bang image from NASA/WMAP Science Team; timescale adapted from Walker, J.D., Geissman, J.W., Bowring, S.A., and Babcock, L.E., compilers, 2012, Geologic Time Scale v. 4.0: Geological Society of America, doi: 10.1130/2012.CTS004R3C. Marine oxygen isotope records are from Lisiecki, L. E., and M. E. Raymo, 2005. A Pliocene-Pleistocene stack of 57 globally distributed benthic d18O records, Paleoceanography, 20, PA1003 (doi:10.1029/2004PA001071).

Climate change in many respects was the 'master variable' because climate ultimately determines the types of habitats our ancestors adapted to in order to survive - the types of food on offer, the other animals we shared our habitat with, the frequency of fire, the severity of seasonal differences, just to name a

few. All of these factors influenced how our features were selected for over time. But is deep time still relevant to us today? For some among us, curiosity and a wanting to know how it happened is ample justification for learning about our deep past. Most of us love stories and what better story is there than our big history, writ large over millions of years? So many things could have happened differently from the way they did, and yet the unique events that did unfold are what ended up shaping us into who we are today. If we are to understand ourselves in the deepest sense, we need to know our deep past.

We forget most of our past but embody all of it.

(Quote from John Updike in his Introduction to *Rabbit Angstrom)*

We do quite literally embody our past – from our cellular functions, to upright walking, to our unusually large brain – these and all of our other features have origins rooted in our deep evolutionary past, origins that link us in many respects to all other life forms on Earth. There are many events that shaped each of our individual lives that we have forgotten and there are many events in the deep past that shaped who we are today that are unknown to us. But for some of these past events we have bits of evidence preserved in the rock and archaeological records that allow us to speculate on our big history; to tell the story of how it happened that we came to be.