

Science, the Deep Past, and the Political

Lowell Gustafson

Department of Political Science, Villanova University, Villanova, Philadelphia, USA

Email address:

lowell.gustafson@villanova.edu

To cite this article:

Lowell Gustafson. Science, the Deep Past, and the Political. *Social Sciences*. Vol. 6, No. 6, 2017, pp. 196-208.

doi: 10.11648/j.ss.20170606.18

Received: September 12, 2017; **Accepted:** October 26, 2017; **Published:** December 18, 2017

Abstract: Evidence from the natural sciences substantiate a narrative of the cosmos, earth, life, and humanity. Great amounts of matter do not become more complex and there is a highly uneven process of increasing complexity only where there are increasing energy flows. The pace of emergent complexity in pockets increases with the development of self-consciousness and social organization. This account influences the framing of key political issues such as identity, race and ethnicity, gender, globalization, and environmentalism.

Keywords: Big History, Deep Past, Cosmos, Political Anthropology, Anthropocene

1. Introduction

One of the great human achievements has been the development of an evidence based account of the entire known past that has moved through stages from the Big Bang until today. A great number of scientists have contributed to making possible a narrative that began 13.82 billion years ago with the beginning of the currently known universe, and the subsequent development of stars and galaxies a few hundred million years later, the formation of Earth 4.56 billion years ago, the origins of life about 3.8 billion years ago, the increase of complexity of life forms beginning about 500 million years ago, the eventual evolution of homo sapiens about 200,000 years ago, agricultural villages about 12,000 years ago, cities, empires, nations, industrialization, globalization and a contemporary digital economy.

While humans and human cultures do represent a new degree of complexity with new properties compared to previous ones, human nature – and human politics – emerged from earlier natural forms. Human nature evolved from non-human nature. As a result, political science is placed within the natural sciences.

How does the study of politics fit within the evidence based narrative of the deep past made possible by the natural sciences? It does so in two ways. The first is in how it recasts a number of currently pressing political topics by placing them in a much longer time frame than is often done. This recasts how to use science to analyze major political issues.

Evidence from the natural sciences substantiates an account of the deep past in ways that influence how to think about the politics of identity, nation, race, ethnicity, sex, gender, security, and globalization. Secondly, this approach demonstrates the increasingly complex ways that units are bound together, developing ever more complex structures, and leading to how humans are political now. Politics derives from polity, or the sustained, structured relationships among members. Humans' political nature adds new properties to its natural components, but it remains rooted in its component parts which emerged before writing and even well before humans.

In the section on *Political Issues*, contemporary political issues will be reframed by placing them in the context of the deep past. In *From Polity to Human Politics*, political science will be placed within the natural sciences.

2. Political Issues

2.1. Political Identity

The first political topic that is reframed by the deep past is political identity – or how groups of people develop a sense of belonging. The teaching of history has often had a political objective of identity formation through a national origin story. American political identity is bound up with being aware of the history of the American experience. When the American Historical Association (AHA) was founded in 1884, history had only recently emerged as a distinct

academic discipline. “The first few professors in the field of history had only been appointed at major universities in the 1870s.” [3] The country had survived its Civil War and the last spike of the transcontinental railroad had been driven in 1869. The nation had achieved its Manifest Destiny of integrating territory from sea to shining sea. It was ready to tell its story. And the state was ready to sponsor it in public schools in part to foster nationalism and good citizenship. This just barely begins the topic of how nationalism is instilled through the teaching of history. [4, 15, 17, 22, 23, 26, 29, 32, 54] There are many histories of many nations whose purpose is to encourage national political identity. Heroic figures, great battles, and epic events form the origin stories of many nations – and the political identities of many citizens.

Similarly, the American Political Science Association was founded a few decades after the AHA, in 1903. The study of political science, like history, was associated with being American and even participating in American public life. Courses on the three branches of government were eventually supplemented by work on ethnic and gender politics, along with many other sub-fields. Knowing about and understanding the events leading to – and the text of – the Declaration of Independence, Constitution, Gettysburg Address, the Letter from a Birmingham Jail, and much else became part of being a good American citizen.

Just over a century after the formation of the AHA, in 1982, some historians banded together in a World History Association to tell a story of globalization. Those with non-national agendas may teach more inclusive social or world histories. Still, most traditional history has limited itself to the period of the written record of the human past. Historians comb archives filled with primary documents, perhaps going back even as far as ancient Sumer. By the time writing had developed in Sumer by 2,700 BCE, there were different groups of people living on all continents and regions in the world except Antarctica. Peoples were speaking different languages and had developed distinct cultures; the now familiar physical differences among peoples were visible. Civilizational, regional, national, ethnic, and other differences were already well developed. Beginning the study of humans within this period of time leaves out a very long prelude.

Historians whose purpose is to foster a global identity face the task of trying to build bridges among various pre-existing cultural identities. By starting the teaching of history within the past few thousand years, the story starts with well-established differences that have often led to conflicts. This approach begins with difference and often with distrust and hostility. What political identity would be formed if the starting points of political stories are pushed back before the origins of nations? If the human political story is shown to begin in Africa at least 200,000 years ago, then new human identities may be a result of courses on Human Politics in addition to those on American, British, Chinese, and other nations.

2.2. Race and Ethnicity

Race or ethnic relations have been a long-standing issue in many nations, but certainly in the United States. A traditional account might begin with capturing slaves in Africa early in the American colonial era, the slave trade, eventual emancipation, Jim Crow, the civil rights movement, accounts of recent abuses of African-Americans by police, and seemingly coded language for white supremacy in current American politics. Without ignoring or denying the tragedies of past centuries and the current manipulations of racial divisions, would a longer time frame for investigating race offer a possible way to improve current ethnic relations?

It is possible now to tell a story of race and ethnicity that stretches back not just a few centuries, but much longer. Evidence accumulated and analyzed by physical anthropologists, archaeologists, and geneticists substantiates a narrative about humans over the past two hundred thousand years. These scientists have looked beyond archival texts to find evidence for the human past well before there was writing. They have found evidence to substantiate a story of humans evolving in Africa. A series of earlier hominin ancestors reach back to the australopithecines of some two million years ago, *Homo erectus*, *Homo habilis*, and others. [16] Humanity’s common ancestor with its closest living relative, chimpanzees, lived in Africa about seven million years ago. A thicket of hominin species evolved between then and about 200,000 years ago.

Evolution has had relatively recent effect on humans as well. For example, before the domestication of animals some 10,000 years ago, no human drank cows’ milk and needed to be able to digest it. Once that milk was available and some people started to drink it, those who developed lactose tolerance had a new source of nutrition. The majority of humans are still lactose intolerant and often still find digesting dairy products to be uncomfortable.

One possible importance of this for contemporary politics is how it reframes the questions of race and ethnicity. Physical evidence demonstrates that all living humans descended from a group of fewer than a couple thousand individuals in Africa about 200,000 years ago. [38] The oldest existing human language seems to be the African Click languages. The oldest human art and ritual artifacts are in Africa. Humans are all Africans; it is just that some left that continent a little more recently than others. Humanity’s racial differences developed only in the relatively brief time since humans left Africa and migrated across the globe.

The genetic, biological differences between human groups are minor, although they do seem to have effect on the distribution of certain diseases, such as cystic fibrosis, sickle-cell anemia, Thalassemia, Tay–Sachs disease, hereditary hemochromatosis, and lactose intolerance. It does seem as though natural selection has continued to play a role in human evolution since humans left Africa. For example, melatonin, produced by the pineal gland and accounting for darker skin pigmentation, provides protection from radiation and its effects of causing cancers. [40] As some populations

migrated to regions that had less intense sunlight for less time of the year, less protection from the sun proved advantageous. Sunlight on the skin helps the body produce vitamin D, which helps in the use of calcium and helps prevent soft bones or rickets. People with dark skin in Africa suffer from less cancer; people with white skin in Europe have stronger bones. Varying skin color provides distinct benefits depending on the environment. Shorter, stockier people in cold climates conserve heat better. Tall, lanky people in warm climates dissipate body heat better. Is it better to be black or white; short or tall? Depends on your environment. And if you have access to furnaces, air conditioners, and artificial light, then the environment outside has less impact.

All humans have a common origin; the scientifically substantiated story is of one human family, however dysfunctionally its members often behave. The biological traits among all humans are almost identical and none that significantly distinguish ethnic groups. None of this denies the more recent tragic history of racial relations in the United States and elsewhere. But by looking back further than the past few thousand years, it may be more possible to chart a way forward.

2.3. Sex and Gender

One of the great political issues of the last century has been the changing role of women and gender in politics. From the suffragettes' struggle for the right to vote, women's rights, women's running for office, and the changes in public opinion and law about lesbians, gays, bi-sexual, and transgender people, the role of sex and gender in politics has been important in the United States and elsewhere in recent centuries. As with race, it is instructive to see the issues in a much longer time frame. It is especially important for political scientists who wish to understand not only the origins of the state, but of human politics. Gender relations were a principal part of the origin of human politics.

The story of sexual differences is different from the one about racial difference. Different races did not develop until relatively recently and only after human all began with the same general genetic makeup. Racial differences are recent and not biologically significant. Sexual differences began much earlier, long before even humans existed. Racial differences among humans are some tens of thousands of years old. Sexual differences between males and females began with eukaryote cells about 1.2 billion years ago.

Since life began about 3.8 billion years ago, that means that life had propagated itself asexually much longer (as many forms of life still do) than other forms of it have used sex for reproduction. Often reproduction could incorporate horizontal gene transfer in which prokaryote or eukaryote cells of the same or even different types could exchange certain genes. Hermaphroditic reproduction is practiced by some species in which an individual possesses the reproductive organs of both the male and female. Parthenogenesis, or asexual reproduction by a female, produces an exact replica or clone of itself. This is done by a

number of invertebrate species, such as aphids, nematodes, some scorpion species, some crayfish species, water fleas, and even some of the vertebrate such as certain types of gecko and some hammerhead sharks.

The benefits of sexual reproduction over the asexual methods used for much longer in the history of life is not obvious. But having more than one individual being involved in reproduction seems to permit better the ability to mutate quickly enough to keep pace with pathogens' evolution. [41] There may be other sexier reasons for sex, but dealing with pathogens is at least one plausible reason for it.

However it is done, a successful reproductive strategy is essential to a species' survival. If sex is to be used, one element of that strategy is associated with the relative size and other characteristics of males and females. Reproductive strategies vary widely by species. Comparative studies of species relatively close to humans may suggest behaviors of humanity's and chimpanzees' extinct common ancestor. The reproductive strategy of the great apes, with whom humans share a common ancestor about 10 million years ago for example, includes pronounced sexual dimorphism. Among humans' close relatives, the apes, males are larger than females. A dominant male will maintain a harem and have to fight other males to retain it, giving size and strength an advantage. Among common chimpanzees too, males are larger than females. Frans de Waal draws on his study of chimpanzees to suggest some possible comparisons between humans and pre-human ancestors. [60, 61, 62] Political intrigue and strategies to become or remain an alpha male with reproductive rights is the stuff of chimpanzee politics. There are many reproductive strategies and many different demands for caring – or not caring – for offspring.

Survival and reproductive strategies of species may be at the heart of humans' style of politics. Beginning the story of politics with the issue of reproduction is not new. It follows from the approach of Aristotle, St. Augustine, and others in ancient and medieval political philosophy who began their discussions about politics with the household. [5, 14] Evolving in Africa meant that humanity's ancestors faced competitors that enjoyed many advantages. These competitors had sharp teeth, fearsome claws, shells, wings, and running speed – none of which humans' forbearers did. Put someone down today alone on the plains of the Serengeti with only a rock and a stick, and the person would not be looking forward to a pleasant evening. Human ancestors' unchosen strategy was to develop larger, more complex brains that permitted them to develop more complex ways of analyzing problems (such as competitors' behavior and how to respond to them) and to relate in more complex political communities. Political, or social, organization was humanity's weapon. Larger and more complex brains, with a larger cerebral cortex made more complex social or political relationships possible; which in turn improved humans' chances of survival. [20] Brains, not brawn, eventually won the day; and even more importantly, the organization among people that brains permitted won the day.

Brain size increased well after human ancestors became

bipedal and saw their jaws and canines decrease in size. The average size brain of Australopithecus (3.9 – 3 mya) was from 375 to 550 cm³, that of homo habilis (1.9 to 1.6 mya) 500 to 800, homo erectus (1.8M to 200K years ago) 750 – 1225, and homo sapiens 200K to present 900 to 1880. A highly developed brain permitted increased social sophistication.

There are, nevertheless, a number of disadvantages with a big brain. First, brains require a lot of energy. Each of a person's three pounds of brain, two percent of total body mass, consume about 20% of a person's energy. That means they must be fed a lot, and for most of human history, finding or growing enough food has not been easy. It also means that childbirth is more risky and painful. Mortality rates for mothers and children have often been high. Additionally, the baby has to be born before its brain and skull are fully developed. It takes a very long time for that baby's brain to develop sufficiently for the child to become independent, much less sexually mature. It takes a lot of work and energy for its caretakers to get the baby not only from conception to birth, but from birth to maturity.

Life spans were normally shorter early in hominin history than they are now. The normal life span was often about 30 years once a person survived to 5 years old. Child mortality rates were relatively high. To have a few children survive to maturity often meant having a number more. Unlike now, early polities needed more people if they were to survive. Women often would be involved in child bearing and raising, along with many other tasks from gathering, to farming, food preparation, weaving, and more throughout their child-bearing years. Additional resources were usually needed from males, who needed reason to be invested in making such provisions. Longer periods of childhood dependency, even if childhood was much briefer than it is in human society, required long-term cooperation in childcare if the species was to survive. Kinship organization was humans' first political structure.

In humans, size differences between genders are less pronounced. By and large, humanity has evolved to permit far more males to reproduce than the ape strategy permits. Human harems are not unknown, but it is more common to have many, if not most, males involved in reproduction. Males need not fight among themselves as much for the right to mate, and relative size and strength between males are less important than they are for strictly harem reproducers. More access to a female means there is less need for size and strength in fights with other males. It also encourages males to be more willing to provide goods if they feel invested in the long term care of children.

Reduced mortality rates, longer life spans, better health care, and population increases have transformed gender relations in very recent times. However, the help of the polity in raising children is no less an issue. Mothers get help in raising children in a variety of ways, but it is difficult for human mothers to follow the polar bear mother's strategy of raising cubs entirely on their own. The long term care of children, and long term relationships among children's

caretakers, are made necessary by humanity's large brains. It is those brains that make possible complex social and political relationships. These relationships, which start with the mother – child relationship and go on to include caretakers' relationships, are humans' principal source of power. Politics does not begin with electoral strategy and opinion polls either in the deep past or now. Politics does not begin even with the state, or full-time specialists in leading political communities such as cities. Politics has its origin in human reproduction. In both race and gender, pushing the origins of the human story back into deep time reframes the discussion about the origin of human politics and clarifies what is of fundamental importance today: the community's long term interest in child rearing.

2.4. Globalization

Ethnicity and gender are recast by examining them in time frames that reach back hundreds of thousands or even billions of years. Another key contemporary issue – globalization – is as well. Globalization can be a short hand way of talking about closer and denser relationships among people throughout the world through increased economic and cultural interactions. International trade and investments, tourism, and cultural exchanges are all part of this.

Increased interactions may be leading to changes in political identity. Meeting, trading, visiting, and otherwise interacting with people from other nations and cultures may have an effect on the development of a more global identity. There is little reason for overconfidence about the development of global citizenship – but the phrase does resonate for many.

A narrative about globalization often begins with a choice of origin dates. Did it begin with the 1989 or so with the collapse of the Soviet Union and the end of dividing the world into three: the First (US, North America, and Japan), Second (Communist nations), and Third (Africa, Asia, Latin America) Worlds? Did it begin with the British Empire on which the sun never set in the 19th century and the rule of the Pound Sterling? Did it begin with the European Imperial period beginning with the Age of Discovery in the 15th century? Did it begin with the Silk Road integrating political economies from Asia to the Middle East a couple thousand years ago? Again, by pushing its dates back, there are at least two major changes in the narrative about globalization. The first is about the role migration stories in political identity. The second reaches much further back to the origins and evolution of life.

2.4.1. Migration and Political Identity

The importance of migration for political identity has long been part of the American story. The movement of explorers, settlers, trappers, and others across the Atlantic and then the continent is woven into the American mythos. The Lewis and Clarke expedition from 1804 – 1806, the Oregon Trail in the mid 19th century (and the video game about it that sold over 65 million copies since 1974), Ellis Island, and Pioneer Courage Park that sprawls across six city blocks in Omaha,

Nebraska are but a few examples of migration in traditional American identity. John Gast's 1872 painting, "American Progress" shows a personified America, schoolbook in hand, leading settlers, trains, and wagons across the land with fleeing Indians and wildlife in front of them. More recently, immigration has been a hotly contested political issue, with all of its many angles influencing contemporary American political identity.

The story of global migration that has been developing in recent decades is of no less importance to human identity and politics. Total global migration has been steadily increasing in recent decades. [58, 70] The movement of labor, no less than the trade of goods and flow of capital across borders, are transforming the political and economic world.

Although the total numbers of people now migrating dwarf figures from the deep past, the story of early migration and globalization is being traced by archaeologists and geneticists. [45] It is generally accepted that *Homo erectus* migrated as far as Asia, but eventually went extinct. Modern humans left Africa about 70,000 years ago. From the time human ancestors left Africa, perhaps due to climate changes that were making available food sources more limited, people gradually spread out to inhabit the entire world, except for Antarctica, over the next 50,000 years. Humans reached the Americas via Beringia by 15,000 to 20,000 years ago. The story of peoples migrating across completely previously unknown territory is one of heroism, courage, ingenuity, and identity formation.

2.4.2. *Humans and the Globe*

As impressive as the global migration of humans from Africa across the globe is, the story of globalization of humans begins much further back than 70,000 years ago. It begins with the stuff that makes humans up right now. Humans – like all living beings on Earth – are made of the stuff that is commonly available on the surface of the globe. Each person is made of about 7×10^{27} atoms. About two-thirds of them are hydrogen, one-quarter oxygen, and one-tenth carbon. With nitrogen, they add up to about 87% of your body. Calcium accounts for 1.5% of human body weight, phosphorus just under 1.5%, potassium about 0.3%, sulfur .2%, sodium about 0.1%, and magnesium 0.05%. About 57% of an adult human body is water: H_2O . All of these are relatively common atoms or chemicals found on the surface of Earth. Humans are made out of the same stuff of which Earth is made.

In the well-known Biblical Genesis story, God made humans from the dust of the ground. The name Adam came from the Hebrew word *adama*, meaning ground or earth. So Adam might best be translated as *Earthling*. Current scientific views of the origins of life find evidence for the basic building blocks of life being made out of elements and chemicals that are common on the face of the earth. [25] Of course, a big difference between the Biblical and current scientific origin of humans is that in the former, humans were made directly from the earth. In the latter, the first life did rise from the earth, although probably in the seas rather than

where it is dusty. And it took a very long time before the first prokaryote cells evolved in many stages to become humans, along with all other life forms. In either case, there are narratives about humans as having been made out of the stuff that makes up the surface of Earth. In both stories, the stuff of the globe is what humans are made of. [25, 47] Humans are made from humus. The stuff of the earth, how it led to humans – and sustains humanity – now is part of the story of globalization. No less a part is humanity's response to the Earth. Is it humanity's goal to dominate, protect, and / or sustain the planet?

2.4.3. *Globalization: Protecting the Homeland*

How groups seek to protect particularly prized portions of Earth has long been part of human politics. Even in the scavenging / gathering / and then hunting periods, groups may well have sought to protect particularly productive areas. During the agricultural / village era, some land that was rich and close to water sources was often considered to be more valuable than other land, and worthy of protection from use by other humans. An attachment to a portion of land often became part of what being a nation meant. In the international period since Westphalia, the most common cause for which wars have been fought is control of particular territory.

There are seemingly endless cultural expressions about the motherland and fatherland. One might point to classics like Rig Veda, part of Hindu sacred writings, which says that "One should respect his motherland, his culture and his mother tongue because they are givers of happiness. A person who is respectful towards his land, civilization and language, attains greatness and he acquires all the happiness of life. His deeds should be such that makes the motherland, the culture and language proud." [42] One might also point, in a very different cultural setting, to the evocative painting by Jacek Malczewski (1854 – 1929) who expressed the martyrdom of the motherland.

There is *Má vlas*, a set of six symphonic poems composed in the nineteenth century by the Czech composer Bedřich Smetana. The second poem is *Vltava, Mein Vaterland* (My fatherland). There is the moving *Finlandia* by Jean Sibelius. These are expressions of the great significance attached to land as an ancestor from which humans have been born and that deserves protection or veneration.

Many famous expressions of American attachment to the land easily come to mind. Irving Berlin's "God Bless America," Woodie Guthrie's "This land is your land," and "America the Beautiful" by Katharine Lee Bates are iconic American songs that celebrate the land. Not to be outdone, the Brazilian national anthem praises the "beloved, idolized homeland." The "Lied der Deutschen," written by Hoffmann von Fallersleben, from which the German national anthem was taken, praises the "German fatherland." A famous English poem by William Blake, whose words are still sung at some English sporting events, celebrates "England's mountains green." One might also recall Elton John's tribute to princess Diana at her funeral, which closely follows

Blake's line with "England's greenest hills." These are but a few of the many expressions of reverence for the motherland or fatherland, the land which is an ancestor, the hills where the ancestors still walk. Nations have a powerful relationship with defined portions of land. Nationalists often seek to protect their nest, mourn the loss of their nation and the losses it has suffered. Sometimes they call for preemptive aggression against imminent or possibly future attacks.

In World War II and the Cold War, nations were interested in how to deliver bombs by missile to enemies' homelands. Following the Soviet Union's successes with Sputnik in the late 1950s, the US was worried about what this might mean for future ICBMs. This concern is largely what motivated JFK on May 25, 1961 to tell Congress that he wanted America to send an American to the moon by the end of the decade. The experience of many astronauts transformed how they understood their home planet. Alexei Arkhipovich Leonov, a former Soviet cosmonaut, became in 1965 the first person to step out of a spacecraft and walk in space. His personal response was to observe how "the Earth was small, light blue, and so touchingly alone, our home that must be defended like a holy relic." He later reflected that space exploration had shown "all of humanity that we are different... but can work together." And he remembered "that time {the Cold War} – the insane mistrust, not just for people but between countries." [37]

US astronaut William Anders was part of the Apollo 8 mission in 1968. While orbiting the moon, he took a picture of the earth over the horizon. *Earthrise*, the name given to the photograph was has had great influence on the environmental movement. No one could look at the picture and feel entirely secure that Earth could always protect humanity from dark, cold, foreboding space. Many felt that they had to protect it.

The moon dust brought back helped tell a story about the formation of Earth and the moon. As Earth was being formed by gravity drawing space dust together, just over 4.5 billion years ago, it started to become a respectably sized planetoid when another one about the size of Mars hit it. This Big Thwack knocked all kinds of dust and debris into the space above Earth, where some of it accreted into the moon, which was at first much closer to Earth than it is today. The collision also knocked Earth off to the side a bit, resulting in the seasons Earth has today. The Moon has gradually added to the length of the day (it used to be six hours long), affects Earth's tides, and much else. Astronauts went to the Moon and learned more about the history of the human homeland.

An equally striking picture was taken in 1990 by the exploration of the solar system by Voyager 1, which has been traveling away from Earth at the rate of 40,000 miles an hour since 1977. The formation of the whole solar system was part of a single process, with the Sun grabbing over 99% of the matter in the area. The leftovers were put to good use, with planets from Mercury to Neptune (and the now deposed former planet of Pluto). Voyager 1 made it as far as Saturn by 1990. (It is now beyond Pluto; it would take another 165,000 years to get to Alpha Centauri, the next nearest star to us.) In

1990 astronomer Carl Sagan asked that camera of Voyager 1 be pointed at Earth to take a picture of humanity's home. It is just barely possible to notice the pale blue dot, 3.7 billion miles away, on which humans live. The exploration of deep space made Sagan reflect on the human condition:

"From this distant vantage point, the Earth might not seem of any particular interest. But for us, it's different. Consider again that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar," every "supreme leader," every saint and sinner in the history of our species lived there – on a mote of dust suspended in a sunbeam.

The Earth is a very small stage in a vast cosmic arena. Think of the rivers of blood spilled by all those generals and emperors so that in glory and triumph they could become the momentary masters of a fraction of a dot. Think of the endless cruelties visited by the inhabitants of one corner of this pixel on the scarcely distinguishable inhabitants of some other corner. How frequent their misunderstandings, how eager they are to kill one another, how fervent their hatreds. Our posturings, our imagined self-importance, the delusion that we have some privileged position in the universe, are challenged by this point of pale light. Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity – in all this vastness – there is no hint that help will come from elsewhere to save us from ourselves.

"The Earth is the only world known, so far, to harbor life. There is nowhere else, at least in the near future, to which our species could migrate. Visit, yes. Settle, not yet. Like it or not, for the moment, the Earth is where we make our stand. It has been said that astronomy is a humbling and character-building experience. There is perhaps no better demonstration of the folly of human conceits than this distant image of our tiny world. To me, it underscores our responsibility to deal more kindly with one another and to preserve and cherish the pale blue dot, the only home we've ever known." [43]

For these people, and for those in the environmental movement, Earth is humanity's homeland. It is a one-of-a-kind planet in the solar system. The current ability to get to another inhabitable planet is, at least not now, within humanity's reach. It is Earth that keeps humans alive. Humans are made of the stuff that makes the Earth. Its history is part of the solar system's history, the Milky Way's history, human history. Jonathan Yavelow notes that it was after the Earthrise photo that a series of environmental actions were taken:

- 1969- National Environmental Policy Act
- 1970- First Earth Day - 22 April
- 1970- Clean Air Act

1970- Environmental Protection Agency Formed

Some people respond to the story of life emerging from Earth and sustained by it by supporting policies that will sustain it. [71] As the editors of a recent book on Thomas Berry write, "He is particularly well-known for articulating a "universe story" that explores the world-changing implications of contemporary science. Berry pointed the way to an ecological spirituality attuned to humanity's place in nature and giving rise to an ethic of responsibility and care for the Earth."

In changing the focus from national to human identity, then the homeland includes not only sea to shining sea in North America, but the entire globe. A concern for sustainability is one way to protect the homeland and one meaning of globalization that may emerge from the deep past.

3. From Polity to Human Politics

The topics of national identity, race, ethnicity, sex gender, humanity, environmentalism, and globalization are influenced by the evidence that the natural sciences have provided about a deep past that is embedded in humans today. The deep past affects how a number of key political topics can be considered. But there is even a more fundamental way in which science and the deep past help to improve an understanding of the political. The highly complex politics of human societies emerged from earlier structures that can be called polity. Human politics has new properties and is of a different order than earlier polities, but includes many of the older, often simpler structures. Because of this, political science is necessarily distinct from other natural sciences, but still needs to be placed within them. What follows below begins with human politics and then works its way back to its relationships with earlier forms of polity.

3.1. Relationships Within Relationships: Increasing Complexity of Polity

The deep past is in part the story of what builds over time periods the relationship upon relationship that binds humans together as they are now. Historians might focus on the time periods – when did matter, stars, terrestrial planets, life, etc first appear? The focus here is on the increasing complexity in the relationships between units, with earlier combinations often being incorporated within newer and more complex ones. *A polity is a sustained community that has structured, sustained relations among its units; over time ever more complex relationships incorporate some earlier ones.* With consciousness, or at least with the self-consciousness of social animals, there is a threshold from polity to the political. Human politics has new properties, but it is profoundly rooted in past levels of polity. Human nature evolved from nature.

Although usually considered a human phenomenon, politics can be seen in a much wider context and as having emerged from earlier, simpler sustained, structured polities. It

is as rooted in pre-human forms as spines are rooted in the evolution of the notochord of the Cambrian era. These relationships became more complex at certain thresholds, with each new level of complexity exhibiting new properties. Human politics is best understood when it is seen within such a holistic narrative and, as a result, human politics can be seen as the study of how polity has become more and more complex over time. The issue here is the origins of politics.

3.2. Political Anthropology

Political Science is often about political relationships among people in relatively recent times. Some focus on the most recent election or the upcoming one. Some go back to the founding of the nation and its constitution. Some go back to the origins of the international system or of written political theory. Going backwards in time, there is much evidence for human polity before the great texts of political theory were written, before there was even writing. There is a considerable literature on the origins of the state and chiefdoms. Irrigation systems in ancient Egypt motivated political unification and increased that ancient nation's organization. Long before that, beads, shell necklaces, tools, precious stones and post holes hint at how humans lived in sustained, patterned polities. There is evidence of social organization in large ceremonial buildings, soldiers fighting battles, exchange between merchants, farmers, hunters and gatherers, cities with populations of 100,000 and bands of 50. The 2.5 million year old Oldowan tool industry, often associated with *Australopithecines* in East Africa, exhibited similar styles over large areas and long periods of time that suggest sustained polities in regular contact. Narratives about prehistoric polities are not told from careful readings of texts in archives or from opinion surveys, but from the interpretation of physical evidence.

Political Anthropology analyses, among other topics, the development of more complex forms of human relationship over time. Human politics began with relatively small bands or kinship groups. The long period of childhood among hominids required extended child-rearing that required stable, long-term relationships. Given the great importance of fertility, many of these early polities may have been matriarchal. Extended families or bands of fifty or so people joined into villages in which some family relations became relatively distant. With cities, non-kinship groups began living together.

New symbols fostered sustained relations among people in these larger political units, and patriarchal systems became the norm. As greater amounts of surrounding land became governed by city leaders and as cities were unified, humanity experienced the development of nations and empires. Each of these new and increasingly complex polities sustained and incorporated earlier units. Present human societies are fumbling towards a unity among nations in a process of globalization. Many types of kinship groups continue to develop, as well as cities of various sizes, and different national structures in this globalizing period. Indeed, the most complex combinations of the greatest numbers of

people in history are developing today.

Physical anthropology and linguistics provides evidence that reaches back before written history. They substantiate the story of how hominins became bipedal, due to climate change, when humanity's early ancestors lived in Africa, before venturing out to populate the globe. They tell how tongues and larynxes developed to permit versatile speech long before writing. But speech could never have developed without a long series of transformations. If grooming helps baboons create and maintain polities, a drawback is that a baboon can only groom one other at a time. Speaking around a campfire permits one to 'groom' many individuals. Thus speech between foragers from different patches and thickets permitted them to develop multiple relationships during such gatherings. Speech permits the growth of the human type of polity. [7]

Syntactical, vocabulary-rich speech altered human polity and made it more complex. The increased complexity of organization made possible through speech provided a most powerful weapon for a species that lacked shells, talons, fangs, wings, or relative speed. Relationship, social organization and polity have become the powerful force that supports the idea that humanity has reached a new age: the Anthropocene. [68] In this, humans have become so powerful a force of nature and have so reworked the natural environment that the Anthropocene has become a new age like the Jurassic or Cambrian.

3.3. *Biology: From Polity to Politics*

Our having heads with sensory organs and four limbs goes back into the ancient oceans. Humans' ability to hear is related to the gills of fish. Wrists are derived from an early amphibian now called *Tiktaalik*. Biological politics widens the story by looking at polity beyond humanity.

As many profound insights as Aristotle had, he did not get it all right. In *Politics*, he continued his famous quote about humans being social by adding: 'Anyone who either cannot lead the common life or is so self-sufficient as not to need to, and therefore does not partake of society, is either a beast or a god.' [5] It is a common study to investigate what makes humans different. Humans are said to be rational, speak in a syntactical, vocabulary-rich language, and write books. While it is true that humans and human society have unique abilities, these abilities are actually just more complex versions of earlier forms. The question of what is new about human polity makes sense only when it is seen as emerging from earlier forms, forms with which humanity still shares a great deal.

An individual fish in a school, an antelope in a herd, a wolf in a pack or a bird in a flock may be a beast, but each is social. The matriarch in an elephant herd decides when the group should migrate, the route to take, and the destination. Clearly her legitimacy depends on the group arriving at where the water is, but her leadership makes sense only in the context of other elephants following her. The alpha male in a chimpanzee troop seeks to organize mating, with himself as the only male who mates; females escaping to trysts with

other males are notable, but there is a high price to pay if it is discovered. [60] Bees communicate the location of newly discovered pollen to their hive members through aerial dances. Ants live in highly organized colonies whose members carry out specialized roles. If humans are social animals, they are by no means the only ones. Those who evolved long before humans lived highly complex social lives. [68] Is human polity more complex? To be sure. Is it a unique phenomenon without precedent? By no means.

Sociable life may well have originated with microbes. [27] Single cells had to go through an intricate process in order to live together in multicellular units. The earliest single-celled life forms included prokaryote cells, complex combinations of biochemicals that formed membranes defining territorial boundaries between themselves and the outside world. They formed DNA to reproduce and were able to carry out metabolism. They were 'prokaryote' since they did not have a cell nucleus where the DNA was kept separate from the rest of the cell. Prokaryote cells did quite well, surviving for two billion years before they changed. Most could not process food by using oxygen. Tiny organisms like cyanobacteria carried out anaerobic respiration in which they exhaled oxygen as a waste product. After two billion years, oxygen levels in the Earth's atmosphere became so high that it was toxic to some prokaryote cells. In essence, they polluted the atmosphere with oxygen, not a desirable condition for anaerobic cells.

However, at least one kind of cell developed an efficient way to get energy in this new atmosphere – by converting chemical energy from food into a stored form of fuel, adenosine triphosphate (ATP). This mitochondrial cell inhaled oxygen and carried out aerobic respiration, burning ATP with oxygen and exhaling CO². A prokaryote cell then absorbed a nearby mitochondrial cell, but somehow managing to form a coalition with it rather than digesting it. It permitted the mitochondrial cell to maintain its own structure and co-opted its energy-producing abilities. In return, the host cell went out to find nutrients for both of them. The mitochondrial cell maintained its own DNA and lived in the cytoplasm of the host cell. The host cell's DNA retreated to a protected kernel or nucleus. The new, more complex *eukaryote* cell had a more efficient internal structure that set it on a path to considerable evolution.

In addition to a nucleus and mitochondria, these cells also developed centrioles, cilia and other components, each contributing a particular function. If the mitochondrial organelle had been its own cell in the past, the eukaryote cell was itself something of a bicellular unit. Multi-celled organisms and animals could never have existed without this greater complexity or without the mitochondrial organelle producing larger amounts of energy than had been available before aerobic respiration developed.

How else can this single cell be considered other than as a polity? It represents an impressive increase in complexity over what had existed before, as well as being the ancestor of every redwood, whale, ant, person and society that exists today. It had to establish ways to decide when and how to eat,

move, and accomplish specified tasks. The history of any great modern nation or city is no more magnificent than the story of the origins of the first single cells. Eukaryotes seem to have retained their basic structure for a billion years before they began to experiment with cooperating with each other in larger units of multicellular life, around a billion years ago.

After single cells evolved, colonies of the same type of cells formed a multicellular unit. Stromatolites, accretions of single cyanobacteria, go back to 3.5 billion years ago. These very simple types of multicellular life have advantages relative to each cell trying to survive independently. The increase in cell numbers protect some of them from predators, facilitate reproduction, and provide for greater adaptability to their environment. The transition from the accumulations of the same type of cell to clusters of cells that control different functions happened about a billion years ago. They are clearly in evidence by 580 million years ago, when sponges were widespread.

A sponge is an animal that lives in water and is made up of a single type of cell. All the cells cooperate with each other by siphoning nutrient-rich water through its cavities. The nutrients are absorbed and wastes excreted, which get pumped out of the cavities. It is a living irrigation system with no brain, nervous system, legs, eyes or ears. But its cells somehow 'know' how to work together. This one type of cell can adjust to any role within this animal. If you take a sponge, force it through a sieve so all its cells get separated and float to the bottom, they will scoot back together to reform a new sponge. No rugged individualists here. Sponge cells have long since decided that they have no interest in living separate lives. Each sponge is a polity of cells without central direction. Another example is *Dictyostelium*, a slime mold from a billion years ago, which is 'like a society of amoebas that come together for a common cause, for which some will sacrifice themselves.' [73]

Or, there is the case of quorum-sensing (QS), a process by which bacteria communicate with each other through chemical signal molecules, in order to synchronize the activities of large groups of cells. [64] This communication enables bacteria to 'mount a co-operative response', in order to gain access to resources or defend against external threats. As a culture grows, signal molecules are released that attract other bacteria, until a specific population density is reached. Once a threshold has been passed, a coordinated change in bacterial behavior is initiated. [66]

Although it is necessary for bacterial cells to act in concert for the greater good of the population, there is a second form of QS regulation that increases the ability of an individual cell to survive. Gram-negative bacterial cells have 'neural regulatory networks that enable single bacterial cells to integrate environmental signals in order to "decide" whether or not to join a quorum. Individual bacteria can adapt to a changing environment by "integrating multiple external signals"'. [69] This is 'social networking in the microbial world', or a microbial polity. [6]

Life also discovered that there was an advantage in being able to move. Some bacteria have a flagellum, a propeller

that allows them to move towards the sun, towards food, or away from predators. If a creature can move consistently in the same direction, it is a good idea to have some sense organs in the front and its excretion in the back. Front and back, right and left, up and down, all start to make a difference in animal structure. In order to be able to see what is coming and do something about it, a nervous system and the ability to analyze information and direct action is required. This is a very long way towards developing legs, brains, opposable thumbs and all of those other components that define humans today.

All of these complex body parts require cells to become specialized in function and organization, such as between liver and muscle cells. The requirements to harmonize all of these types of cells and organs became extraordinarily complex. Each organism became a highly sophisticated polity in its own right, interacting with what lies beyond its membrane or skin. It must be porous. It must take in nutrients and excrete waste. It must distinguish with reasonable accuracy between what 'out there' is to its advantage and what is not. Each organism, in turn, becomes part of a larger system that includes so much else with which it must also become familiar.

Actions within the body must be coordinated, along with decisions about how to do it, when and where to move in response to information, memories about what these decisions have led to in the past, so that improvements in decision-making can occur. All this is part of a heritage that predates humans or mammals. Collecting information, policy analysis, decision-making, communicating decisions, executing decisions, and much else does not begin with human political systems. Sustained, ordered relations among the members of each organism indicate how deeply rooted the practice of polity is. However, polity goes even more deeply than this.

3.4. Chemical & Physical Polity

Polity reaches back to ordered, sustained relations among the biochemicals that made membranes, reproduction and metabolism possible. The first 'life' was not self-sustaining, undifferentiated, or isolated. It required a way to protect itself from external threats, a way to renew and then reproduce itself, and a way to gain access to nutrients and energy. It needed borders, as well as defensive and economic policies.

No one knows exactly how biochemicals came together to form components of the first prokaryote cells. *Abiogenesis* or *biopoesis* is the study of how amino acids can form via natural chemical reactions unrelated to life. It may be that 'black smokers' deep underwater provided the geothermal energy and the sulphur that became food for these first organisms. [24] It may be that RNA and then DNA developed from self-replicating chemical cycles, such as the Krebs cycle, in which carbon atoms join in ever larger numbers until the process begins again. It may be that lipids were available for use as membranes. [13, 34, 49] The first living cell was simple in comparison to later life forms, but much more complex than what had preceded them. The

ordered relationships among chemicals that led to and sustained the life of an organism had to also be able to be renewed in a new, similar cell through reproduction.

Chemical evolution indicates that molecules often can organize themselves into increasingly complex, sustained and ordered relationships. Molecular evolution refers to the development of DNA, RNA and proteins, as well as to molecular development before biological evolution began. Proteins, carbohydrates, amino acids, nucleic acids, lipids and other building blocks of life did not emerge full-blown in a cell after the formation of Earth. Before these could be combined in an ordered relationship called a cell, each had to be organized from simpler atomic components.

Various types of atoms are able to share electrons, thus binding them together into a bi-atomic or multi-atomic unit called a molecule. This ability to share electrons permitted the development of many combinations of carbon, hydrogen, oxygen, nitrogen and other elements long before there were cells. Once combined, many of these molecules went on to form more complex relationships with other molecules. When two hydrogen atoms combine with an oxygen atom, a molecule is formed that has new properties that neither atom had in isolation – wetness... at least within certain temperatures, water is wet.

Can it be meaningfully said that molecules are polities? They have sustained, ordered relationships among their members (atoms). The electromagnetic explanations for the relationships between atoms, within molecules, are part of the story about how humans' brains and decision-making work. But what really is the chemistry of politics? How does the field of chemistry help to better understand polity?

Is polity rooted in the most basic forms of matter, derived from the origins of the universe? Is what cannot be divided further a sustained, patterned relationship? Or is it a matter of isolation, separation, and non-responsiveness? Ever since the time of the philosopher Democritus in ancient Greece, many have sought the ultimate building block, the unit that cannot be divided further, the *ἄτομος* (atomos). What is an atomistic polity? At the simplest level, is there division, separation, unconnected fragments, or even antagonistic bits? Is the ultimate state of nature atomistic in this sense? At the base of nature, are there just the acts and interests of individual units? Is human nature consistent with such a nature at its most fundamental level? Are any attempts at community and cooperation merely a veneer that must somehow be pasted over a far more fundamental reality of separation and isolation? What politically can be learned from an atom?

It is clear that some atoms are very sustainable. While C^{15} may last no more than a couple seconds, a C^{12} atom will probably stay intact for longer than the universe has so far existed. Either way, the atom is not the uncuttable, simplest element. Each atom is itself a polity – a sustained, patterned relationship – due to the electromagnetism between electrons, and between protons and neutrons. But what exists inside the atom's nucleus, among its protons and neutrons? Is there at this level separation or polity?

The simplest atom, hydrogen, is composed of an

electromagnetic relationship between one proton and one electron. That single proton is composed of a relationship between two up quarks and one down quark. The relationship among these three quarks is structured by the strong force. The two different types of quarks do not unite to form one blob; they each maintain their relatively long distance from each other in constant movement. Reality is not ultimately at rest; it is spinning all the time. It incorporates differences between units. And it is defined by sustained, structured relationships. The strong force that structures the relationships among quarks is aptly named, as it is the most powerful of the four fundamental forces. As a result of it, the quarks in protons are tightly bound together, which is why nuclear fission and fusion involve extraordinary amounts of energy. The strong force also holds a neutron together. Each proton, each neutron and each atom may thus be seen as a sustained, patterned relationship of members – a very simple polity.

Are there units even more fundamental than quarks? Some theoreticians suggest that there may be vibrations in many more than four dimensions in the shape of strings or loops. So far, there is no way to measure or observe such vibrations, and the relationship between them and baryonic or normal matter will still need to be better defined.

3.5. Transition to Even More Complex Politics

It is worthwhile to note that polity does not mean a lack of conflict and emergent complexity is not uniform or steady. The development of increasingly complex politics entails struggle as well as cooperation within sustained and patterned relationships. Astrophysicists discuss how the annihilation of matter and anti-matter took place soon after the Big Bang, when one particle out of a billion and one particles of matter survived. Why was one particle left over? No one yet knows, but the survivors of the mass destruction went on to form everything that can be seen today.

Similarly, biologists talk about how prokaryote cells regularly consumed each other in a life and death struggle to eat or be eaten. That is until a prokaryote ate a mitochondrial cell, only to have it remain alive and form a cooperative relationship within it, perhaps giving birth to the first eukaryote cell. After that, there exists plenty of conflict between and within species, as well as five major mass-extinctions. After each disaster resulted in the death of a great many species, new opportunities opened up for other species. While there has been no consistently steady development of cooperative complexity, there are more complex polities that have evolved over great periods of time.

Very often in the study of politics, students are most interested in conflict. International political history has often been the record of war. National politics are often strikingly conflictual. Even elections have warlike terminology, although it is better that electoral campaigns replace military ones. Still, more complex polities have been made possible after the destructive periods of wars. A unified nation replaced the separate colonies after the American Revolution.

The Second World War, which cost humanity seventy million lives, also left a legacy of rocket technology. This, and the Cold War's motivation to send a rocket to the moon, provided the picture of the rising earth over the moon's horizon that has so captured the imagination of humanists.

After the Cold War and the fall of the Berlin Wall in 1989, many saw a period of optimistic globalism and the 'End of History', in which national borders were sometimes thought to be *passé*. Economic rationality and trade were considered harbingers of global polity. Then, after 9/11 and the 'War on Terrorism', many feared that politics was best characterized by a 'Clash of Civilizations'. Are Christendom, the Islamic world, the Confucian and Chinese world, and others locked in conflict? Are states battling non-state actors for dominance?

Is there any reason to hope for a way to create a transition to a more complex politics polity beyond the schisms of nationality, race, class, gender, and religion? Does the study of the emergence of politics from polity provide a scientifically based narrative that can help establish a more complex politics? Does it describe a process that is playing itself out? Can humans develop the most complex sustained, patterned relations that they have ever had? Will humans deepen their sense and practice of connectedness with each other and with the nature from which they have emerged and still depend?

In the long run, many find little reason for optimism. Over 99% of all species that have ever existed are now extinct, and the rate of extinction due to human activities has quickened over the past century. Humans in their current form have existed for only 200,000 years or so. It is not hard to imagine that humanity will become extinct in less time than that. If conditions become wildly fortunate, maybe humanity will survive for a few million years. But it is a virtual certainty that humans will be gone long before the earth is consumed by a red giant of a sun some 5 billion years from now. With earth and the rest of the solar system gone then, the universe will continue to expand until it all dissipates into a Big Chill. In the long run, entropy will overtake increasing complexity. Maybe there will be other universes, but the one for which there is evidence now will die.

In the short run, over the next decades and centuries, the question remains if entropy, conflict, a lack of imagination or other problems will thwart the emergence of even more complex, sustainable political structures.

4. Conclusions

Drawing on the evidence that has been investigated by the natural sciences and the deep past permits the reframing of a number of political topics, such as nationality, race, gender, and globalization. An analysis of emergent complexity demonstrates how relationships have become increasingly sophisticated, reaching their most complex physical form in the human brain and producing increasingly sophisticated polities. From kinship to settled villages to nation and empires and now to global relationships, the current emergent

complexity of polity is rooted in pre-human nature. This is a valuable way of using science to discuss the political.

The transition from industrial to digital society has led to more complex relationships between more people than have ever existed. The electrical communication between billions of humans rivals the electrical communication between the 100 billion cells in each human brain. Humanity is fumbling toward a new and more complex polity without central direction but with patterns that reach back 13.82 billion years. Humans' current polity is made up of components that are billions or millions of years old. The current transition towards the most complex set of political relationships that have ever existed are best understood – and fostered by – by a study of the context offered by the natural sciences and the deep past.

References

- [1] Alvarez, W. (2014). We are stardust Concentrated by earth! *Expositions: Interdisciplinary Studies in the Humanities*, 8(1). Retrieved from <http://expositions.journals.villanova.edu/issue/view/130>
- [2] Alvarez, W. (2017). *A most improbable journey: A big history of our planet and ourselves*. New York: W. W. Norton & Company.
- [3] American Historical Association, Brief History of the AHA, <http://www.historians.org/about-aha-and-membership/aha-history-and-archives/brief-history-of-the-aha>, accessed September 22, 2017.
- [4] Anderson, Benedict. *Imagined Communities: Reflections on the Origin and Spread of Nationalism*, 2nd. ed. London: Verso, 1991.
- [5] Aristotle. *Politics* at <http://classics.mit.edu/Aristotle/politics.1.one.html>, accessed September 21, 2017.
- [6] Atkinson, Steve; Chien-Yi Chang, R. Elizabeth Sockett, Miguel Cámara, Paul Williams. 'Quorum Sensing in *Yersinia enterocolitica* Controls Swimming and Swarming Motility'. *Journal of Bacteriology* vol. 188, no. 4, February 2006, pp. 1451–61.
- [7] Bickerton, D. (2009). *Adam's Tongue: How Humans Made Language, How Language Made Humans*. New York, NY: Hill and Wang.
- [8] Brown, C. S. (2007). *Big history: From the Big Bang to the present*. New York: New Press: Distributed by W. W. Norton.
- [9] Carroll, Sean. (2017). *The Big Picture: On the Origins of Life, Meaning, and the Universe Itself*. New York, Dutton.
- [10] Chaisson, E. (2006). *Epic of evolution: Seven ages of the cosmos*. New York: Columbia University Press.
- [11] Christian, D. (2004). *Maps of time: An introduction to big history*. The California World History Library. Berkeley: University of California Press.
- [12] Christian, D., Brown, C. S., & Benjamin, C. (2014). *Big history: Between nothing and everything*. New York, NY: McGraw Hill Education.

- [13] Deamer, D. W. (2011). *First life: Discovering the connections between stars, cells, and how life began*. Berkeley: University of California Press.
- [14] Doody, John, Kevin L. Hughes, Kim Paffenroth, eds., (2005) *Augustine and Politics*. Lexington Books
- [15] Ferro, Marc. *The Use and Abuse of History: Or How the Past Is Taught to Children*. London: Routledge, 2003.
- [16] Esteban Sarmiento, G. J. Sawyer, and Richard Milner, (2007). *The Last Human: A Guide to Twenty-Two Species of Extinct Humans*. Yale University Press, New Haven.
- [17] Gellner, Ernest. *Nations and Nationalism*. Ithaca: Cornell University Press, 1983. Hobsbawm, Eric. *Nations and Nationalism since 1780*. Cambridge: Cambridge University Press, 1992.
- [18] Greene, B. (2000). *The elegant universe: Superstrings, hidden dimensions, and the quest for the ultimate theory*. New York: Vintage Books.
- [19] Greene, B. (2011). *The hidden reality: Parallel universes and the deep laws of the cosmos*. New York: Alfred A. Knopf.
- [20] Gustafson, Lowell. (2009). "Speaking Up: The Origins of Language." <https://www.youtube.com/watch?v=H2Ma7dxu0O0>, Falvey Library Lecture Series, Villanova University.
- [21] Hamilton, C., Bonneuil, C., & Gemenne, F. (2015). *The anthropocene and the global environmental crisis*. Abingdon, Oxon: Routledge.
- [22] Hartnett, Stephen J., Lisa B. Keranen, and Donovan Conley, eds. (2017) *Imagining China: Rhetorics of Nationalism in an Age of Globalization*. Rhetoric and Public Affairs Series. East Lansing, Michigan: Michigan State University Press.
- [23] Hastings, Derek. (2017) *Nationalism in Modern Europe: Politics, Identity and Belonging since the French Revolution*. London; New York: Bloomsbury Academic.
- [24] Hazen, R. M. (2005). *Genesis: The scientific quest for life's origin*. Washington, DC: Joseph Henry Press.
- [25] Hazen, R. M. (2012). *The story of earth: The first 4.5 billion years, from stardust to living planet*. New York: Viking.
- [26] Herb, Guntram Henrik, and David H. Kaplan, eds. (2018) *Scaling Identities: Nationalism and Territoriality*. Lanham, Maryland: Rowman & Littlefield.
- [27] Hird, Myra. (2009). *The Origins of Sociable Life: Evolution after Science Studies*, Basingstoke: Palgrave Macmillan.
- [28] Hoffmann, P. M. 2012. *Life's Ratchet: How Molecular Machines Extract Order From Chaos*. New York, NY: Basic Books.
- [29] Hutchinson, John. (2017) *Nationalism and War*. New York, NY: Oxford University Press.
- [30] Johanson, D. C. and B. Edgar. (2006). *From Lucy to Language*. New York, NY: Simon and Schuster.
- [31] Kenneally, C. (2007). *The First Word: The Search for the Origins of Language*. New York, NY: Viking.
- [32] Kohl, Fawcett (eds.), *Nationalism, Politics and the Practice of Archaeology*, Cambridge University Press (1996).
- [33] Krauss, Lawrence M. (2017). *The Greatest Story Ever Told--So Far*. New York, Atria Books.
- [34] Lane, Nick. (2016). *The Vital Question: Energy, Evolution, and the Origins of Complex Life*. New York, W. W. Norton & Company.
- [35] Lederman, L. M., & Hill, C. T. (2011). *Quantum physics for poets*. Amherst, N. Y.: Prometheus Books.
- [36] Lederman, L. M., & Teresi, D. (2006). *The god particle: If the universe is the answer, what is the question?* Boston: Houghton Mifflin.
- [37] New Mexico Museum of Space History, a Division of the New Mexico Department of Cultural Affairs. Alexei A. Leonov, The first man to walk in space, <http://www.nmspacemuseum.org/halloffame/detail.php?id=17>, accessed September 21, 2017.
- [38] Oppenheimer, S. (2003). *The real eve: Modern Man's Journey out of Africa*. New York, N. Y.: Carroll & Graf.
- [39] Pross, A. (2012). *What is life?: How chemistry becomes biology*. Oxford: Oxford University Press.
- [40] Reiter, Russel J., Ahmet Korkmaz, Shuran Ma, Sergio Rosales-Corral, Dun-Xian Tan. (2012). "Melatonin protection from chronic, low-level ionizing radiation." *Mutation Research/Reviews in Mutation Research*, Volume 751, Issue 1, July–September 2012, Pages 7–14.
- [41] Ridley, Matt. (2003). *The Red Queen: Sex and the Evolution of Human Nature*. Harper Perennial, New York.
- [42] Rigveda, First Mandal, 13/9, quoted at <http://www.neelkanthdhaam.org/rigveda1.html>, accessed September 21, 2017.
- [43] Sagan, Carl. (1977). *Pale Blue Dot: A Vision of the Human Future in Space*. Reprint Edition. Ballantine Books, New York.
- [44] Schurr T. G. 2014. Human genetic diversity in a global context. In: Spooner BL, editor. *Globalization: The Crucial Phase*, Philadelphia: University of Pennsylvania Press, pp. 71-114.
- [45] Schurr T. G. (2015) Tracing Human Movements from Siberia to the Americas: Insights from Genetic Studies. In: Frachetti M., Spengler III R. (eds) *Mobility and Ancient Society in Asia and the Americas*. Springer, Cham.
- [46] Schwägerl, C. (2014). *The anthropocene: The human era and how it shapes our planet*. Santa Fe, NM: Synergetic Press.
- [47] Shubin, Neil. 2013. *The Universe Within: Discovering the Common History of Rocks, Planets, and People*. New York, NY: Pantheon Books.
- [48] Shubin, Neil. (2008). *Your Inner Fish: A Journey into the 3.5-Billion-Year History of the Human Body*. New York, Vintage.
- [49] Smith, Eric and Harold J. Morowitz. (2016). *The Origin and Nature of Life on Earth: The Emergence of the Fourth Geosphere*, Cambridge, Cambridge University Press.
- [50] Singh, Simon. (2004). *Big Bang: The origin of the universe*. New York: Fourth Estate.
- [51] Smith, Anthony D. *The Ethnic Origins of Nations*. Oxford: Blackwell Publishers, 1988.

- [52] Spier, Fred. (2015). *Big history and the future of humanity*. Chichester, West Sussex, UK: John Wiley & Sons Inc.
- [53] Steinhardt, P. J., & Turok, N. (2007). *Endless universe: beyond the Big Bang*. New York: Doubleday.
- [54] Suny, Ronald Grigor. "Constructing Primordialism: Old Histories for New Nations", *The Journal of Modern History*, 73, 4 (Dec, 2001): 862-896.
- [55] Tucker, Mary Evelyn and John Grim, editors. (2009). *The Christian Future and the Fate of Earth*. Maryknoll, NY, Orbis Books.
- [56] Tucker, Mary Evelyn and John Grim, editors. (2014). *Thomas Berry: Selected Writings on the Earth Community*. Maryknoll, NY, Orbis Books.
- [57] Tyson, N. deG., & Goldsmith, D. (2004). *Origins: fourteen billion years of cosmic evolution*. New York: W. W. Norton & Co.
- [58] United Nations, Department of Economic and Social Affairs, Population Division. "World Migration in Figures: A joint contribution by UN-DESA and the OECD to the United Nations High-Level Dialogue on Migration and Development, 3-4 October 2013," <http://www.oecd.org/els/mig/World-Migration-in-Figures.pdf>, accessed September 21, 2017.
- [59] Vince, G. (2014). *Adventures in the anthropocene: A journey to the heart of the planet we made*. Minneapolis, Minnesota: Milkweed Editions.
- [60] Waal, F. B. M. de. *Chimpanzee Politics: Power and Sex among Apes*. 25th anniversary ed. (2007). Baltimore, Md.: Johns Hopkins University Press.
- [61] Waal, F. B. M. d. (2005). *Our Inner Ape: A Leading Primatologist Explains Why We Are Who We Are*. New York, NY: Riverhead Books.
- [62] Waal, F. B. M. d. (1989). *Peacemaking Among Primates*. Cambridge, MA: Harvard University Press.
- [63] Wade, N. (2006). *Before the Dawn: Recovering the Lost History of Our Ancestors*. New York, NY: Penguin Press.
- [64] Waters, Christopher; Bonnie Bassler, 'Quorum Sensing: Cell-to-Cell Communication in Bacteria', *Annual Review of Cell and Developmental Biology* vol. 21, November 2005, pp. 319-46.
- [65] Wien, Peter. (2017) *Arab Nationalism: The Politics of History and Culture in the Modern Middle East*. London\&u8239; New York: Routledge, Taylor & Francis Group.
- [66] Williams, Paul; Klaus Winzer, Weng Chan, Miguel Cámara. 'Look Who's Talking: Communication and Quorum Sensing in the Bacterial World.' *Philosophical Transactions of the Royal Society of London, Series B, Biological Sciences* vol. 362, no. 1483, 29 July 2007, pp. 1119-34.
- [67] Wilson, E. O. (1975). *Sociobiology: The new synthesis*. Cambridge, Mass.: Belknap Press of Harvard University Press.
- [68] Wilson, E. O. (2012). *The social conquest of earth*. New York: Liveright Pub. Corporation.
- [69] Withers, Helen; Simon Swift, Paul Williams. 'Quorum Sensing as an Integral Component of Gene Regulatory Networks in Gram-Negative Bacteria.' *Current Opinion in Microbiology* vol. 4, no. 2, 1 April 2001, pp. 186-93.
- [70] Wittgenstein Centre for Demography and Global Human Capital, "Global Migration Data Sheet 2005-10," http://www.global-migration.info/VID_Global_Migration_Datasheet_web.pdf, accessed September 21, 2017.
- [71] Yavelow, Jonathan. (2013). *Star Gazing to Sustainability: Appreciating the Scientific Process*. Kendall-Hunt, Dubuque, IA.
- [72] Zalasiewicz, Jan; Mark Williams, Alan Haywood, Michael Ellis, 'The Anthropocene: A New Epoch of Geological Time?' *Philosophical Transactions of the Royal Society A-Mathematical Physical and Engineering Sciences* Vol. 369, 31 January 2011, pp. 835-41.
- [73] Zimmer, Carl, 'Can Answers to Evolution be Found in Slime?' *New York Times*, 3 October 2011. http://www.nytimes.com/2011/10/04/science/04slime.html?pa_gewanted=all, accessed September 21, 2017.