Chapter 9

The Rise of Complex Societies

The collective survival strategy that our remote ancestors evolved over the past five million years or so the remains at the core of our modus operandi as a species down to the present day.

Most of us live in deeply interdependent "tribes" that are organized to pursue our basic survival and reproductive needs cooperatively. Whatever may be our perceptions, or our illusions, a complex modern society is, in essence, a collective survival enterprise. We depend for the satisfaction of our basic needs on an elaborate division (combination) of labor supported by an awesome and ever-growing repertoire of tools and technologies, some of which we owe to the inventiveness of long-ago ancestors. Although the course of human history has obviously been far from smooth, the dominant trend has been an expanding and thickening web of economic and cultural synergies – and Synergistic Selection. Let's take a brief look at this evolutionary dynamic.

The emergence of larger, more complex human societies during the Holocene Epoch, beginning around 12,000 years ago, was a multi-faceted process involving a suite of major changes, the elements of which can perhaps be distilled into four categories – *Settlements, Surpluses, Specialization, and Size*. A synergistic combination of more permanent encampments, an abundance of agricultural (and other) resources, an elaboration of different tasks and roles, and rapid population growth combined to create the foundation for the vastly larger and more productive economic systems of today.[1]

However, these important cultural developments were also undergirded and supported by an array of important pre-adaptations. Many years ago, the archeologist and science writer John Pfeiffer noted that the rise of complex societies seemed to be closely associated with what he referred to as evolutionary "hot spots."[2] These were locations that

possessed a rich combination of needed resources – concentrations of large game animals (or other protein sources like fish or shellfish), an abundance of edible plant materials, ample supplies of fresh water, plenty of firewood, and – as the agricultural revolution gained momentum – such things as a favorable growing climate, fertile soils, irrigation water, well-developed trading patterns, defensible terrain and, of course, an array of technologies.

Jared Diamond, in his path breaking study *Guns, Germs and Steel*, highlighted many of the cultural elements that were also instrumental to this momentous shift, including genetically-manipulated cereal grains and pulses, domesticated sheep, goats, and draft animals, irrigation systems, an array of specialized tools for plowing, harvesting, threshing, and grinding grains, cooking implements, food storage containers, record-keeping, defensive walls, and more.[3]

A Synergistic Package

Taken together, these elements created a synergistic new economic package that allowed for a sharp break with our egalitarian hunter-gatherer heritage – although this transition also seems to have happened in fits and starts.[4] Some of the earliest agricultural experiments were very modest and were later abandoned, or were overrun by enemies. Others seem to have been more of a hybrid between agriculture and hunting and gathering. There is, in fact, no definitive explanation for why this major cultural change occurred, but it is likely to have involved some combination of population growth, constraints on traditional food resources and consequent food shortages, plus new opportunities for growing and harvesting grains and vegetables, and the domestication and herding of animals.[5]

In any case, this package of cultural improvements resulted over time in changing the basic structure of human societies, as well as the relationships among its members.[6] Ironically, the very factors that contributed to our economic progress as a species also created opportunities for economic exploitation, social inequality, and political conflict. In effect, the egalitarian social contract that had sustained our hominin ancestors for millions of years was undermined, and this resulted

in a deep structural defect that has plagued modern human societies down to the present day.[7] (I will discuss this problem further below and will suggest some possible remedies in the final chapter.)

As various anthropologists have concluded, the shift toward hierarchical societies started even during the late Stone Age, when complex hunter-gatherer tribes such as the affluent Nootka and Tlingit of the Pacific Northwest and the Natufians of the Eastern Mediterranean, became sedentary and began to display more elaborate social divisions and disparities of wealth.[8] Permanent settlements had the advantage of eliminating the time and labor required for frequent migrations, but they also created opportunities for an accumulation of personal property. (Of course, they also created attractive targets for covetous neighbors.) Reliable surpluses and a sedentary life-style also provided the wherewithal for developing crafts specialists and, in time, political, military, and religious hierarchies.

Recent research and new analyses point to the conclusion that valuable material property – such as agricultural land, tools, jewelry, gold, and eventually money – coupled with the ability of a family to retain these valuables through inheritance practices, played a key role in generating extremes of wealth and poverty (and power) in emerging complex societies.[9]

The Chumash Example

One well-studied example of this transition is described in detail by the anthropologists Kent Flannery and Joyce Marcus in their in-depth study, *The Creation of Inequality*. For more than 5,000 years, the Chumash, a population of Native Americans inhabiting parts of the Southern California coast and the Channel Islands, had thrived as nomadic foragers. They subsisted mainly on coastal marine resources, along with acorn groves and piñon nuts. Their small bands were also politically egalitarian.[10]

However, a radical change occurred between 700 and 500 A.D., when the Chumash invented ocean-going plank canoes, along with a sophisticated caulking system, that could hold up to 12 crewmen and a ton of cargo and travel as far out to sea as 65 miles. This important new

technology now gave the Chumash access to an abundance of large, deep-water fish, like giant tuna and swordfish, which enabled them to feed larger, settled communities of about 150-250 people.

This new-found abundance in turn supported the development of a crafts industry and an extensive pattern of regional trade in such things as seashells, finished beads, ornaments, and highly valued flint stones and animal hides. Over time, some of the Chumash canoe captains (who owned the vessels, or at least monopolized them) were able to amass significant personal wealth and prestige, as well as multiple wives, and were able to pass their wealth and status along to their sons, or sometimes to close relatives. (The captains also typically served as war leaders and ceremonial chiefs and extracted tribute from their followers.) In time, the other Chumash tribesmen, especially the craftsmen, became heavily dependent on the canoe captains and socially subservient.

A Change in the "Social Logic"

Flannery and Marcus conclude that the structural/political shift to a hierarchical society among the Chumash was not dictated entirely by technological and economic developments. It was ultimately the result of a change in what the authors refer to as the "social logic" of a society – the basic ideology that is used to justify various social practices, especially those relating to wealth, rank, and hereditary privilege. Stories are fabricated to rationalize a desired social pattern or outcome for the wealthy. (A modern-day equivalent is the obviously self-serving political mantra that billionaires are the prime "job creators" in our societies.) Flannery and Marcus point out that a hierarchical society can only arise after changes in the social logic undermine the traditional social structure (the reverse dominance hierarchy, in Boehm's term).[11] "Each escalation of inequality required some overcoming of resistance."[12] To underscore this point, the authors cite examples of evolving societies where ambition, personal achievement, and social prestige did not result in the emergence of extreme material inequality or a hereditary hierarchy.

Far more common, unfortunately, were economic transitions that allowed for various elites to become self-aggrandizing and self-perpetuating. This was evidently the case even in some of the earliest

agricultural villages that began to appear roughly 10,000 years ago in Mesopotamia. These villages, numbering perhaps 200-300 people, were typically comprised of various extended families. Each family lived in a separate mud-brick residential compound with as many as 15-20 rooms and several individual family hearths. They also seem to have had an elaborate division (combination) of labor and engaged in extensive trade with other settlements, where they could exchange their abundant agricultural surpluses (some villages had two harvests a year) for a variety of items, notably including brides that helped to cement alliances between trading partners.[13]

Growing Economic Inequalities

In many of these villages, it seems there were marked economic inequalities between families. Some of the residential compounds were much more elaborate, with larger rooms, large interior courtyards, and more abundant private storage rooms, as well as an accumulation of what archeologists refer to as "sumptuary goods" – items that connote luxury rather than utility. These included such things as painted pottery, statuettes, jewelry, and the like. Whether or not these affluent families also exerted a leadership role in their villages is unknown. (These early settlements were typically defended by perimeter ditches, walls, and watchtowers, with hand held slings and rocks serving as defensive weapons.)

In any case, as larger agricultural societies with populations numbering in the thousands began to appear in Mesopotamia, the so-called Big Men and chiefs that emerged over time began to develop hierarchies of political control and tax systems (and systems of conscripted "corvée labor" for public works) backed by coercive force. The once tight-knit, closely cooperating small communities expanded into much larger, more impersonal population centers – perhaps encompassing several neighboring villages organized around markets and trade – with many different economic enterprises, many specialized roles, and many potential conflicts of interest.

When the farmers and craftsmen who produced the food and other valuable items obtained equivalent benefits in return, including protection

from external enemies, internal law and order, and the wherewithal to acquire desirable products from other specialists, this new division (combination) of labor – and property – was likely to have been perceived as equitable. Many early civilizations, particularly when they were still young, seemed to enjoy a degree of shared affluence and internal peace.[14]

But all too often this changed over time as various leaders and economic elites became increasingly exploitative. As the anthropologist Bruce Trigger points out in his magisterial synthesis, *Understanding Early Civilizations*, "A defining feature of all early civilizations was the institutionalized appropriation by a small ruling group of most of the wealth produced by the lower classes."[15]

In other words, the reverse dominance hierarchies that had long ensured against great disparities of power (and wealth) in traditional hunter-gatherer societies had broken down.[16] Voluntary consent gave way to top-down coercive force, and the traditional pattern of informal social controls and conflict-resolution was replaced over time by formal law codes, religious edicts, aggressive policing, and harsh punishments. (Many of these states also began to build public temples, monuments, palaces, and, eventually, armories and treasuries – the trappings of hierarchical societies everywhere.)

The Uruk Example

This radically new social structure can be observed even in some of the first-generation states that appeared about 5,700 years ago in what is today Iraq and southern Iran. Uruk, for example, represented an amalgamation of numerous villages with an urban center that ultimately grew to cover some 1.5 square miles with perhaps 20,000 inhabitants. Uruk was sustained by its rich alluvial soils and a network of irrigation canals supported by a highly productive agricultural system. This led to an elaborate division/combination of labor, including various administrative specialists, many different kinds of craftsmen, personal servants, and even slaves.

But most significant, Uruk also became a hereditary kingdom, with four distinct levels of social ranking.[17] The traditional reverse dominance hierarchy had, in effect, reverted to something akin to the

typical primate pattern, although it was, of course, much more elaborately structured. An institutionalized successor to the traditional, egalitarian hunter gatherer political model – modern democracy – would not (formally) arise until 5,000 years later in classical Athens.[18]

Theories of "Civilization" and the State

Theorizing about the rise of large scale civilization and the emergence of the political machinery of the "state" over the past 6,000 years can be traced back at least to Plato's great dialogue, the *Republic*, and, more recently (and in more detail) to Herbert Spencer in the nineteenth century. Spencer posited a dualistic process of technological innovations and the elaboration of a division of labor (internal cooperation) coupled with warfare between societies (external conflict), although he also viewed Malthusian population pressures as a "proximate cause" and increased energy production as a key enabler.[19] "As societies progress in size and structure, they work on one another, now by their war-struggles and now by their industrial intercourse, profound metamorphoses."[20]

Unfortunately, Spencer's dualistic theory suffered a fate that was similar to the rejection of Lamarckism in biology. The rise of the social sciences as formal academic disciplines in the early years of the twentieth century was accompanied by a pronounced ideological tilt. Socialism was very much in the air in those days, and Spencer's flirtation with what later came to be associated with social Darwinism and his emphasis on the role of warfare in societal evolution became repugnant to many social scientists of that era. Spencer's encyclopedic, multi-volume theoretical edifice eventually came to be viewed as politically toxic and was banished from academic curriculums. "Who now reads Spencer?" intoned the prominent sociologist of that period, Talcott Parsons. "Spencer is dead."[21]

What ultimately replaced Spencer's complex dualism was a variety of prime mover theories. Perhaps the most influential of these theories was Karl Marx's deterministic vision of an "iron law" of history – a dialectical interaction between economic development and class conflict, with capitalism and private property as the ultimate villains and the state as a "handmaiden" of the capitalist ruling class.

As the twentieth century progressed, a number of other prime mover theories were also proposed. One of the earliest and best known of these was anthropologist V. Gordon Childe's thesis that the emergence of complex, large-scale societies could be attributed, at bottom, to agricultural surpluses.[22] His colleague Karl Wittfogel advanced a variation on this theme that was known as the "hydraulic hypothesis." Wittfogel postulated that the development of large-scale irrigation systems in Mesopotamia and China gave rise to bureaucratic controls, political stratification, and, in time, to what he termed "oriental despotism."[23]

Population Pressures

Another supposed prime mover – a resuscitated Spencerian theme without attribution – was population pressures. This theory was promoted by several theorists, but its most visible champion was the anthropologist Mark Nathan Cohen in a closely-reasoned, book-length argument. Characterizing population growth as the "cause of human progress," Cohen asserted that population pressure has been an "inherent" and "continuous" causal agency in cultural evolution over time.[24]

Among the various objections that have been raised to this theory is the fact that there are cases in which population pressures were mitigated by increased trade or an intensification of subsistence technologies, or even population control measures. The prior question is why populations can grow in some circumstances and not in others. It is not a given. In fact, there are numerous cases in which chiefdoms and states failed to emerge from a circumscribed context – when the environmental vice was in fact too tight for further expansion. Conversely, there is a very long list of unstable states that ultimately collapsed.[25]

Another resurrected Spencerian theme – improvements in energy production – was elevated into a prime mover theory by the anthropologist Leslie White in the 1950s. His "basic law of [cultural] evolution," in his words, was that "culture advances as the amount of energy harnessed per capita per year increases, or as the efficiency or economy of the means of controlling energy is increased, or both."[26] We cannot control the course of cultural change, White concluded, "but we can learn to predict it."[27]

Warfare as the Prime Mover

Perhaps the most strident of the modern-day prime mover theories about the rise of civilization is our old friend the warfare hypothesis. The evolutionary biologist Richard Alexander, for instance, developed a Darwinian, inclusive fitness explanation. He characterized war as a form of reproductive competition by other means and invoked the idea of an autocatalytic arms race. "At some point in our history the actual function of human groups – their significance for their individual members – was protection from the predatory effects of other human groups.... I am suggesting that all other adaptations associated with group living, such as cooperation in agriculture, fishing or industry, are secondary..."[28]

Another proponent of the warfare school of cultural evolution was the anthropologist Robert Carneiro. His theory was a bit more subtle (it relied on a functional argument rather than a presumed instinctual urge), but it too was monolithic. "Force, and not enlightened self-interest, is the mechanism by which political evolution has led, step by step, from autonomous villages to states." Although state-level political systems were invented independently several times, warfare was in every case the prime mover, Carneiro claimed. To support his thesis, he examined 21 instances of state development, ranging in time from 3000 B.C., to the nineteenth century A.D., and found that coercive force was a factor in every case and that outright conquest was involved in about half of them.[29] He blamed this dynamic ultimately on Spencerian population pressures – what he called "environmental circumscription."[30]

"The Fires of War"

An updated, more elaborate version of this theory has recently been advanced by ecologist Peter Turchin and his colleagues.[31] Turchin's thesis is that complex human societies were "forged in the fires of war." He systematically examined the historical records related to some 60 empires

that have evolved over the past 5,000 years and found that 90 percent of them were located within or adjacent to arid steppe areas, or borderland steppe frontiers. Warfare in these areas was endemic, and the rise of complex states and early empires was closely associated with intense lethal competition between nomadic pastoralists and settled farmers, groups that were economically and culturally very different from one another.

Turchin stresses that larger numbers, coupled with technological advances like horse-drawn chariots and mounted archers with composite bows, played an important part in this competitive dynamic, and he sees this as being consistent with multi-level (group) selection theory in evolutionary biology. He notes that genocidal wars have been much more common between culturally distinct groups. Turchin also believes that hierarchical organization was necessary for the successful execution of large-scale warfare, and that this accelerated the rise of hierarchical political systems. Turchin argues that there is a consistent pattern in this historical trend, and that it provides compelling evidence for a war-related explanation of civilization and the state.

It is unquestionably true that organized warfare has been a major influence in the evolution of complex societies. Just as (I believe) collective violence played an important part in our emergence as a species (recall Chapters Seven and Eight), it has also been deeply implicated in the evolution of larger civilizations. However, warfare is a complex phenomenon with many potential causes and many different consequences. Wars cannot simply be treated as the expression of an instinctual urge or uncontrollable population pressures, much less a mindless competitive dynamic. There are too many exceptions and too many problems with any monolithic theory.

For instance, why is it that some quite warlike societies – like the Yanomamö of Venezuela or the Dani of New Guinea – did not evolve into nation states? Why did some societies achieve statehood and then subsequently collapse or even disappear? It seems that, in some cases, climate change was the principle villain. And why did the first pristine states appear during a very small slice of time in the broader epic of evolution, within a few thousand years of one another at most? Nor is warfare always correlated with population pressures. Again, a prior

question is why do some populations grow while others do not? There is even evidence of cases where population pressures and warfare were the result of economic and political integration rather than the reverse, with the proximate cause being ambitious (and/or paranoid) monarchs making war on one another, with popular support.[32] Because wars can be very risky, and costly, the central question is, what are the perceived (net) benefits? The potential payoffs must have been key drivers (as discussed in Chapter Eight).

Economic Determinism Revisited

Indeed, Turchin's modernized warfare hypothesis has been challenged by a revitalized and more elaborate version of Childe's agricultural hypothesis. Economists John Gowdy and Lisi Krall assert that the underlying cause of our "ultrasociality" and the rise of complex modern states was the agricultural revolution and the economic benefits derived from it.[33] They stress the increasing economic returns (synergies) from large-scale agricultural production, which supported larger groups and a more complex division of labor. This in turn created political "management" challenges, and, ultimately, resulted in a radical change in the social structure of these expanding societies.

Agriculture certainly created new opportunities for resource exploitation and trade, but it also greatly intensified competition between groups. Population growth and an "expansionary dynamic" (as Gowdy and Krall call it) resulted from these economic developments, not the other way around.[34]

From Tin Pans to Water Pumps

There is one other frequently touted candidate for prime mover in cultural evolution that should also be mentioned – technology itself. Surely, nobody would dispute the fact that technology has played a major part in

shaping modern societies over the past 10,000 years, with synergies that are readily quantifiable. The economic synergies that derive from new technologies can be seen in microcosm in the story of the great California Gold Rush. Over a five-year period, from 1848-1853, gold-mining techniques, in effect, recapitulated our entire technological phylogeny up to that time.[35]

Contrary to the mythology that has grown up around this renowned historical episode, most of the California gold mining activity was not done by individual prospectors – the legendary "sourdoughs" wading in mountain streams with tin pans. Within the first year, individual panning was largely supplanted by three-man teams using shovels and "rocker boxes," an innovation that increased the quantity of material that could be processed in a day from ten or fifteen buckets to more than 100 buckets, or at least twice as much per man. Shortly thereafter the wooden sluice made its appearance. Although it required six- to eight-man teams, a sluice could handle 400-500 buckets of material per day, or about twice again as much per man as the rocker box. Finally, when hydraulic mining was introduced in 1853, teams of 25 or more men were required to process the materials and manage the water pumps, hoses, wagons, etc., that were utilized to blast away the faces of entire hillsides. Meanwhile, the amount of material processed daily jumped to 100 tons or more. (This episode also illustrates the fact that almost every advance in technology creates a new imperative for social cooperation and organization.)

It's important to emphasize, however, that technology is not some exogenous, monolithic "force" or "mechanism". It's another example of an umbrella concept that embraces an immense array of synergistic phenomena. Some technologies involve simply deploying specialized knowledge and skills, like the use of dung as a fertilizer, or rotating crops. Others involve the manipulation of natural objects, like the selective breeding of plants and animals, or the diversion of water for the irrigation of crops. Physical structures like dams, walls, fences, and weirs are also important technologies and have played a significant role in human evolution. But most important, every new technology is embedded in a specific natural and cultural environment; it's catalyzed and thrives within a given economic, social and political context. The causes are often very complex – and synergistic. As Matt Ridley points out in his insightful

book about how prosperity evolves, a major technological innovation is typically a "collective phenomenon."[36]

"Down with Prime Movers!"

Technological innovations have obviously been important drivers in our recent cultural evolution. But so were all the other factors that were singled out in the theories cited above – agricultural surpluses, population growth, warfare and conquests, and even fossil fuels. For example, the Industrial Revolution in England in the eighteenth and nineteenth centuries was literally powered by the discovery of abundant underground sources of coal coupled with the development of new mining and processing techniques that made it possible to extract coal much more cheaply and consume it more efficiently.[37] (More detail about the Industrial Revolution can be found in an outtake at my website www.complexsystems.org.)

Perhaps Herbert Spencer's dualistic theory – which emphasized the interplay between internal economic development and external competition and conflict is closer to the right answer in this theoretical debate. As biologist David Sloan Wilson has expressed it, "Almost every school of thought has a baby and a bathwater." The question is: "What's worth keeping and what's worth throwing out."

In a major, book-length critique of cultural evolution theory back in the 1970s, the prominent anthropologist Elman Service came to this emphatic conclusion: "Down with prime movers!"[38] There is no "magic formula" that will explain human evolution, he wrote. However, there is one common theme – a "common denominator" in all the theories described above, namely, synergy.

Synergy Goes to War (Again)

Consider, for example, the warfare hypothesis. Earlier (in Chapter Eight) I pointed out that collective violence is commonplace in the natural world and almost always has a specific purpose: predation, defense against predators, the acquisition of needed resources (food patches, nest-sites,

water supplies, raw materials, territories, even mates), and the defense of these resources against other groups and species.[39]

However, the occurrence of collective violence – in nature and human societies alike – is facilitated by synergies of various kinds, which shape the calculus of bioeconomic benefits, costs and risks. Synergy is a necessary (though not sufficient) causal agency in collective violence. Among other things, there can be (1) synergies of scale, (2) cost and risk sharing, (3) a division (combination) of labor, (4) functional complementarities, (5) information sharing and collective intelligence, and, not least (6) tool and technology "symbioses". Although there are exceptions (and some significant qualifiers), collective violence is, by and large, an evolved, synergy-driven instrumentality, in nature and human societies alike.

Yet if warfare has had a major influence in our cultural evolution, it is clearly insufficient as an all-purpose explanation for the evolution of complex modern societies. We should move beyond our tendency to simplify the complexities of cultural evolution and resist the impulse to seek simplistic explanations – or scapegoats. Synergy is, above all, a concept that compels us to look for packages of interacting causal influences. (Indeed, the influence of political, legal, linguistic, even religious elements in shaping the process of state formation has been highlighted by various social scientists of late.)[40] The Synergism Hypothesis provides a theoretical bridge that can connect and integrate the various prime mover theories. In sum, the evolution of larger, more complex societies over time has been driven by a proximate dynamic of Synergistic Selection.[41]

An Autocatalytic Process?

From an evolutionary perspective, the convulsive growth and radical transformation of human societies over the past 250 years (or about twelve human generations) has been nothing short of phenomenal, and unprecedented. It seems as if the gradual process of cultural innovation and technological development that characterized human evolution for millions of years has now become autocatalytic; a vast, interactive ratchet

effect is at work as new technologies feed on one another. The list of our major inventions to date is astonishing: steam power, railroads, steamships, electricity (and a plethora of electrical tools and appliances), telegraphs and telephones, automobiles, farm tractors (and sophisticated farm machinery), aircraft and helicopters, nuclear power, radio and television, container ships, space rockets, computers, the internet, factory automation, robots, drones, and much more. What has facilitated this process is, of course, an economic (and political) system that offers large incentives for creativity and entrepreneurship, and mass markets that will reward these initiatives – in other words, a proximate dynamic of Synergistic Selection. This is the positive side of modern capitalism.

Among the many consequences of this seismic technological shift is the emergence of a vast global society that is a marvel to behold. Over the course of the past half century, we have become almost completely interconnected and increasingly interdependent in terms of food production, resource acquisition, manufacturing, transportation, communications, education, health care, and even in our sports and entertainment.

Consider, for instance, the transformative role of container ships. After shipping containers were introduced in the 1950s, the time required for overseas transport plunged by about 85 percent and the cost per ton declined by 35 percent. Sixty years later, our global container ship infrastructure is valued at $4 trillion. It includes about 450 ports and some 5,000 thousand huge container ships that (currently) move more than 1.6 billion metric tons of cargo every year, roughly five times as much as the 330 million tons in 1950.[42]

A Population Explosion

Perhaps the most significant outcome of our collective inventiveness and technological prowess is that it has subsidized a huge population explosion. At the end of the Great Famine and Black Death in 1350, the global human population was estimated to be about 370 million. Since then, the population has increased at an accelerating rate. It reached 1 billion in 1804, 2 billion in 1927, 4 billion in 1974, and 7 billion in 2011-

2012. Although the rate of increase is now slowing, it is expected that the global population will grow by another 2-3 billion by 2050.[43] Humanity is reaching a climax phase, not unlike what has happened to other species. We are about to hit a ceiling at the very time when major climate changes are already underway. We are confronting the prospect of another major transition in our evolution.

What is most troubling – no, alarming – about our current predicament is that we do not have the cybernetic/political machinery to deal with this emerging crisis. As noted earlier, there is a deep and ominous structural flaw in modern societies that did not exist among our hunter-gatherer ancestors. The traditional reverse dominance hierarchy in humankind has devolved into various forms of exploitative hierarchical systems, for the most part. In the last chapter, I will focus on the existential challenges we face going forward and will suggest three urgently-needed societal changes.

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[1] There is a debate among social scientists about how to define social complexity that is comparable to the terminological debate among evolutionary biologists. A synthetic approach recently suggested by a group of social scientists included such factors as population size, territory size, settlement density, economic specialization, trade networks, management mechanisms, the number of levels of hierarchical control, and more. See Richerson and Christiansen, eds. 2013, pp. 87-116.

[2] Pfeiffer 1977.

[3] Diamond 1997. For a recent discussion of the role of technology in human evolution, see Boyd *et al*. 2013.

[4] See especially Bogucki 1999; Mithen 2003.

[5] Richerson *et al*. (2001) argue that agriculture became "compulsory" in the Holocene as a result of a "competitive ratchet" driven by competition between groups in the context of population pressures. See also Sterelny 2013; also, the analysis of Winterhalder and Kennett (2009) that utilizes the economic concepts of risk, discounting, economies of scale, and transaction costs. Social networks and more elaborate patterns of exchange may also have played a significant role. See Apicella *et al*. 2012.

[6] See especially the analysis in Gowdy and Krall 2014.

[7] An analysis of this transition can be found in Flannary and Marcus 2012. What seems to hold the social contract together in complex societies, despite the extreme differences in wealth and poverty, is some combination of economic interdependence, orderly exchange

(markets), the need for a common defense, social and cultural/communal bonds, coercion (there is no available alternative) and policing.

[8] See especially Fagan 1998; also, Flannery and Marcus 2012.

[9] See the special issue of *Current Anthropology* in 2010 devoted to this subject. (For citations, see the outtake at my website.) See also the analysis of the "endowment effect" in facilitating the evolution of private property in various species by Gintis 2007.

[10] Flannery and Marcus 2012, pp. 67-71. Their example was derived from an in-depth study by archeologist Jeanne Arnold and her co-workers. Many details also come from eye witness accounts by early eighteenth century Spanish colonists.

[11] Boehm 1993, 1999. Recall that Boehm's term refers to coalitions that actively contain and suppress aggressive individuals. See also Brown 1991.

[12] Flannery and Marcus 2012, p. 563.

[13] *Ibid.* Recent DNA studies have revealed that the earliest farming communities arose independently. Only much later did they interact (and interbreed). See especially http://www.nytimes.com/2016/10/18/science/ancient-farmers-archaeology-dna.html?action=click&contentCollection=science&region=rank&module=package&version=highlights&contentPlacement=1&pgtype=sectionfront (accessed 18 October 2016).

[14] A notable example is the Indus River civilization known as the Harappans, from about 4500 to 4000 years ago, which evidently never had a centralized ruling class or extremes of wealth and poverty. See Maisels 1999.

[15] Trigger 2003, p. 375.

[16] Boehm 1993, 1999. Sterelny (2013) argues that a shift from reliance on "social capital" (skills) to "material capital" (land) played a key role. But so did the transformation of the economic system from one that was based on collective action to one that was based on exchange and reciprocity among different specialists.

[17] See Flannery and Marcus 2012.

[18] For a brief history, see https://en.wikipedia.org/wiki/History_of_democracy (last modified 30 October 2105).

[19] Spencer 1852, 1897.

[20] Spencer 1897, vol. 1, 1 pp. 14-15.

[21] Parsons 1949/1937, p. 3.

[22] Childe 1951/1936.

[23] Wittfogel 1957.

[24] Cohen 1977.

[25] See especially Jared Diamond's (2005) book length treatment. Also, see Corning 2005, Ch. 7.

[26] White 1959, p. 56.

[27] White 1949, p. 39.

[28] Alexander 1987.

[29] Carneiro 1981; also, Carneiro 1978.

[30] Carneiro 1970. An example of this dynamic can be found in the history of the Zulu nation. (For citations, see the outtake at my website.)

[31] Turchin 2009, 2011, 2016; Turchin and Gavrilets 2009.

[32] See Corning 2005, ch.7; also, Corning 2007a.

[33] Gowdy and Krall 2014, 2015.

[34] A variation on this theme is physical chemist Ugo Bardi's (2014) theory that the rise of complex states was driven by a quest for mineral resources – gold, iron, bronze, etc. Yes, but first you must feed the population.

[35] This material was obtained personally from displays at the Gold Mining Museum, Angels Camp, California, September 2004.

[36] Ridley 2010, p. 4.

[37] See http://en.wikipedia.org/wiki/Industrial_Revolution (last modified 10 November 2014).

[38] Service 1971, p. 25.

[39] See also Corning 2007a.

[40] Political scientist Roger Masters (2008), in a systematic analysis of state formation, identified a number of important contributing factors, from a favorable environment to exceptional leaders, ethnic and religious commonalities, a common language, writing and record keeping, monetary systems, mutually beneficial economic activities, and, of course, military conquest. See also Richerson and Christiansen, eds. 2013.

[41] To be clear, this theory does not make a claim to explain every aspect of culture, and cultural change. It applies to functional improvements over time in the "means of production" and reproduction – the "collective survival enterprise." (For additional discussion of this issue, see the outtake at my website.). Also, see Corning 1983, 2005; Plotkin 2010; Mesoudi 2011; Richerson *et al*. 2016.

[42] See https://en.wikipedia.org/wiki/Container_ship (last modified 19 July 2015); also see http://www.worldshipping.org/about-the-industry/liner-ships/container-vessel-fleet (accessed 24 July 2015); https://www.statista.com/topics/1367/container-shipping/ (accessed 26 March 2017).

[43] https://en.wikipedia.org/wiki/World_population (last modified 23 July 2015).