Why the Technological System Will Destroy Itself (2nd Edition)

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> We were recently entertained by a naive fable of the happy arrival of the 'end of history,' of the overflowing triumph of an all-democratic bliss; the ultimate global arrangement had supposedly been attained. But we all see and sense that something very different is coming, something new, and perhaps quite stern.
>
> — Aletaandr Solzhenitsyn[1]

> Power is in nature the essential measure of right.
>
> — Ralph Waldo Emerson[2]

[1] From a speech delivered by Solzhenitsyn in Vaduz, Liechtenstein, Sept. 1993. Qyioted by Remnick, p. 21. Here Solzhenitsyn is referring to the famous article by Francis Fukuyama (see List of Works Cited).

[2] From "Self Reliance" (1841), in Emerson, p. 30. With this quote we do not mean to express a moral judgment about power in nature or elsewhere, but only an empirical fact about power.

Part I

Most of the arguments set forth elsewhere in this book are reasonably solid, but in the present chapter we go out on a limb both in making assumptions and in drawing inferences from them. We think our assumptions and inferences contain at least as much truth as they need to contain for the purpose of reaching certain probable conclusions about the future of human society, but we acknowledge that rational disagreement with our reasoning is possible. Two things, however, can be definitely asserted: first, that our assumptions and inferences are reasonably accurate as applied to the development up to the present time of large-scale, complex societies; second, that anyone who wants to understand the likely future development of modern society will have to give careful attention to problems of the kind that are raised by the arguments of this chapter.

Though we focus here on the processes of competition and natural selection[1] as they operate in complex societies, it is important to avoid confusing our viewpoint with the (now largely defunct) philosophy known as "Social Darwinism." Social Darwinism didn't merely call attention to natural selection as a factor in the development of societies; it also assumed that the winners in the contest of "survival of the fittest" were better, more desirable human beings than the losers were:

[T]he competitive struggle of business was viewed as a contest in which the survivors were the 'fittest'—not merely as businessmen, but as champions of civilization itself. Hence businessmen transformed their sense of material superiority into a sense of moral and intellectual superiority. ... Social Darwinism became a means of excusing as well as explaining the competitive process from which some emerged with power and some were ground into poverty.[2]

Here our purpose is merely to describe the role that natural selection plays in the development of societies. We do not mean to suggest any favorable value-judgment concerning the winners in the struggle for power.

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[1] See Kaczynski, Letter to David Skrbina: Oct.. 12, 2004, Part III. According to Orr, p. 80, "In... 'Darwin's Dangerous Idea,' [Daniel] Dennett proclaimed that natural selection... helps to explain... the twists and turns of human cultural change." I haven't seen Dennett's book and I don't know to what extent, if any, the present chapter parallels or contradicts his work.

[2] R. Heilbroner & A. Singer, pp. 26-27.

Part II

This chapter deals with self-propagating systems. By a self-propagating system (self-prop system for short) we mean a system that tends to promote its own survival and propagation. A system may propagate itself in either or both of two ways: The system may indefinitely increase its own size and/or power, or it may give rise to new systems that possess some of its own attributes.

The most obvious examples of self-propagating systems are biological organisms. Groups of biological organisms can also constitute self-prop systems; e.g., wolf packs or hives of honeybees. Particularly important for our purposes are self-prop systems that consist of groups of human beings. For example, nations, corporations, labor unions, churches, and political parties; also some groups that are not clearly delimited and lack formal organization, such as schools of thought, social networks, and subcultures. Just as wolf-packs and beehives are self-propagating without any conscious intention on the part of wolves or bees to propagate their packs or their hives, there is no reason why a human group cannot be self-propagating independently of any intention on the part of the individuals who comprise the group.

If A and B are systems of any kind (self-propagating or not), and if A is a functioning component of B, then we will call A a subsystem of B, and we will call B a supersystem of A. For example, in human hunt- ing-and-gathering societies, nuclear families[1] belong to bands, and bands often are organized into tribes. Nuclear families, bands, and tribes are all self-prop systems. The nuclear family is a subsystem of the band, the band is a subsystem of the tribe, the tribe is a supersystem of each band that belongs to it, and each band its a supersystem of every nuclear family that belongs to that band. It its also true that each nuclear family is a subsystem of the tribe and that the tribe is a supersystem of every nuclear family that belongs to a band that belongs to the tribe.

The principle of natural selection is operative not only in biology, but in any environment in which self-propagating systems are present. The principle can be stated roughly as follows:

Those self-propagating systems having the traits that best suit them to survive and propagate themselves tend to survive and propagate themselves better than other self-propagating systems.

This of course its an obvious tautology, so it tells us nothing new. But it can serve to call our attention to factor's that we might otherwise overlook.

[1] A "nuclear family" is the basic human family consisting of a woman, a man, and any juvenile offspring they may have.

We are about to advance several propositions that are not tautologies. We can't prove these propositions, but they are intuitively plausible and they seem consistent with the observable behavior of self-propagating systems as represented by biological organisms and human (formal or informal) organizations. In short, we believe these propositions to be true, or as close to the truth as they need to be for present purposes.

Proposition 1. In any environment that is sufficiently rich, self-propagating systems will arise, and natural selection will lead to the evolution of self-propagating systems having increasingly complex:, subtle, and sophisticated means of surviving and propagating themselves.

It needs to be emphasized that natural selection doesn't merely act in simple ways, as by making the legs of deer longer so that they can run faster or giving arctic mammals thicker coats of for so that they can stay warm. Natural selection can also lead to the development of complex structures such as the human eye or heart, and to systems of far greater complexity that still are not fully understood, such as the human immune system or nervous system. We maintain that natural selection can lead to equally complex and subtle developments in self-prop systems consisting of human groups.

Natural selection operates relative to particular periods of time. Lets start at some given point in time that we can call Time Zero. Those selfprop systems that are most likely to survive (or have surviving progeny) at five year's from Time Zero are those that are best suited to survive and propagate themselves (in competition[2] with other self-prop systems) during the five-year period following Time Zero. These will not necessarily be the same as those self-prop systems that, in the absence of competition during the five-year period, would be best suited to survive and propagate themselves during the thirty years following Time Zero. Similarly, those systems best suited to survive competition during the first thirty years following Time Zero are not necessarily those that, in the absence of competition during the thirty-year period, would be best suited to survive and propagate themselves for two hundred years. And so forth.

For example, suppose a forested region is occupied by a number of small, rival kingdoms. Those kingdoms that clear the most land for agricultural use can plant more crops and therefore can support a larger population than other kingdoms. This gives them a military advantage over their rivals. If any kingdom restrains itself from excessive forest-clearance out of concern for the long-term consequences, then that kingdom places itself at a military disadvantage and is eliminated by the more powerful kingdoms. Thus the region comes to be dominated by kingdoms that cut down their forests recklessly. The resulting deforestation leads eventually to ecological disaster and

[2] When we refer to "competition," we don't necessarily mean intentional or willful competition. Competition, as we use the term, is just something that happens. For example, plants certainly have no intention to compete with one another. It is simply a fact that the plants that most effectively survive and propagate themselves tend to replace those plants that less effectively survive and propagate themselves. "Competition" in this sense of the word is just an inevitable process that goes on with or without any intention on the part of the competitors.

therefore to the collapse of all the kingdoms. Here a trait that is advantageous or even indispensable for a kingdom's short term survival—recklessness in cutting trees—leads in the long term to the demise of the same kingdom.[3]

This example illustrates the fact that, where a self-prop system exercises foresight,[4] in the sense that concern for its own long-term survival and propagation leads it to place limitations on its efforts for short-term survival and propagation, the system puts itself at a competitive disadvantage relative to those self-prop systems that pursue short-term survival and propagation without restraint. This leads us to

Proposition 2. In the short term, natural selection favors self-propagating systems that pursue their own short-term advantage with little or no regard for long-term consequences.

A corollary to Proposition 2 is

Proposition 3. Self-propagating subsystems of a given supersystem tend to become dependent on the supersystem and on the specific conditions that prevail within the supersystem.

This means that between the supersystem and its self-prop subsystems, there tends to develop a relationship of such a nature that, in the event of the destruction of the supersystem or of any drastic acceleration of changes in the conditions prevailing within the supersystem, the subsystems can neither survive nor propagate themselves.

A self-prop system with sufficient foresight would make provision for its own or its descendants' survival in the event of the collapse or destabilization of the supersystem. But as long as the supersystem exists and remains more or less stable, natural selection favors those subsystems that take fullest advantage of the opportunities available within the supersystem, and disfavors those subsystems that "waste" some of their resources in preparing themselves to survive the eventual destabilization of the super-

[3] Something along these lines, but more complicated, probably happened among the ancient Maya. It's unlikely that the kind of competition we've described here was the sole cause of the collapse of the "Classic"Maya civilization, but it prob- ablywas at least a contributing factor and it **may** have been the most important factor. See: Diamond, pp. 157-177, 431. Sharer, pp. 355-57. NEB (2003), Vol. 7, "Maya," p. 970; Vol.15, "Central America," p. 665; Vol. 26, "Pre-Columbian Civilizations," p. 17. "Clean" historical examples are hard to fnd, because the causes of historical events tend to be complex and open to dispute; the Maya case illustrates this very well. For farther discussion, see Appendix Two, Part A.

[4] When we refer to the exercise of "foresight" or to the "pursuit" of advantage, our reference is not limited to conscious, intelligent foresight or to intentional pursuit of advantage. We include any behavior (interpreting that word in the broadest possible sense) that has the same effect as the exercise of foresight or the pursuit of advantage, regardless of whether the behavior is guided by any mechanism that could be described as "intelligence." (Compare note 6.) For example, any vertebrates that, in the process of evolving into land animals, had the "foresight" to "attempt" to retain their gills (an advantage if they ever had to return to water) were at a disadvantage due to the biological cost of maintaining organs that were useless on land. Hence they lost out in "competition" with those incipient land animals that "pursued" their short-term advantage by getting rid of their gills. By losing their gills, reptiles, birds, and mammals have become dependent on access to the atmosphere; and that's why whales today will drown if forced to remain submerged too long.

system. Under these conditions, self-prop systems will tend very strongly to become incapable of surviving the destabilization of any supersystem to which they belong.

Like the other propositions put forward in this chapter, Proposition 3 has to be applied with a dose of common sense. If the supersystem in question is weak and loosely organized, or if it has no more than a modest effect on the conditions in which its subsystems exist, the subsystems may not become strongly dependent on the supersystem. Among hunter-gatherers in some (not all) environments, a nuclear family would be able to survive and propagate itself independently of the band to which it belongs. Because tribes of hunter-gatherers are loosely organized it seems certain that in most cases a hunting-and-gathering band would be able to survive independently of the tribe to which it belongs. Many labor unions might be able to survive the demise of a confederation of labor unions such as the AFL-CIO, because such an event might not fundamentally affect the conditions under which labor unions have to function. But labor unions could not survive the demise of modern industrial society, or even the demise merely of the legal and constitutional framework that makes it possible for labor unions as we know them to operate. Nor would many present-day business enterprises survive without modern industrial society. Domestic sheep, if deprived of human protection, would soon be killed off by predators. And so forth.

Clearly a system cannot be effectively organized for its own survival and propagation unless the different parts of the system can promptly communicate with one another and lend aid to one another. In order to operate effectively throughout a given geographical region, a self-prop system must be able to receive prompt information from, and take prompt action within, every part of the region.[5] Consequently,

Proposition 4. Problems of transportation and communication impose a limit on the size of the geographical region over which a selfprop system can extend its operations.

Human experience suggests:

Proposition 5. The most important and the only consistent limit on the size of the geographical regions over which self-propagating human groups extend their operations is the limit imposed by the available means of transportation and communication. In other words, while not all self-propagating human groups tend to extend their operations over a region of minimum size, natural selection tends to produce some self-propagating human groups that operate over regions approaching the maximum size allowed by the available means of transportation and communication.

Propositions 4 and 5 can be seen operating in human history. Primitive bands or tribes usually have territories that they "own," but these are relatively small because human feet are the only means of transportation available to these societies. However, primitives who have numerous horses and live in open country over which horses can

[5] The term "prompt" as used here is relative to the circumstances in which the self-prop system exists and the rapidity with which events that are important to it can be expected to occur. A hunting-and-gathering band might keep itself adequately informed about the condition of its territory even if it visited parts ofit only once a year. At the other extreme, an advanced technological society needs almost instant long-distance communications.

travel freely, like the Plains Indians of North America, can hold much larger territories. Pre-industrial civilizations built empires that extended over vast distances, but these empires actively created, if they did not already have, relatively rapid means of transportation and communication.[6] Such empires grew to a certain geographical size, after which they stopped growing and, in many cases, became unstable; that is, they tended to break up into smaller political units. It is probable that these empires stopped growing and became unstable because they were at the limit of what was possible with the existing means of transportation and communication.[7]

Today there is quick transportation and almost instant communication between any two parts of the world. Hence,

Proposition 6. In modern times, natural selection tends to produce some self-propagating human groups whose operations span the entire globe. Moreover, even if human beings are some day replaced by machines or other entities, natural selection will still tend to produce some self-propagating systems whose operations span the entire globe.

Current experience strongly confirms this proposition: We see global "superpowers," global corporations, global political movements, global religions, global criminal networks. Proposition 6, we argue, is not dependent on any particular traits of human beings but only on the general properties of self-prop systems, so there is no reason to doubt that the proposition will remain true if and when humans are replaced by other entities: As long as rapid, worldwide transportation and communication remain available, natural selection will tend to produce or maintain self-prop systems whose operations span the entire globe.

Let's refer to such systems as global self-prop systems. Instant worldwide communications are still a relatively new phenomenon and their fall consequences have yet to be developed; in the fature we can expect global self-prop systems to play an even more important role than they do today.

Proposition 7. Where (as today) problems of transportation and communication do not constitute effective limitations on the size of the geographical regions over which self-propagating systems operate, natural selection tends to create a world in which power is mostly concentrated in the possession of a relatively small number of global self-propagating systems.

This proposition too is suggested by human experience. But it's easy to see why the proposition should be true independently of anything specifically human: Among global self-prop systems, natural selection will favor those that have the greatest power; global or other large-scale self-prop systems that are weaker will tend to be eliminated

[6] See Appendix Two, Part B.

[7] The maximum geographical size of pre-industrial empires was determined not only by factors of transportation and communication, but also by organizational factors such as bureaucratization. However, for any given level of organization, it appears that empires tended to grow to the maximum size permitted at that level by the existing means of transportation and communication. See Taagepera, pp. 121-23.

or subjugated. Small-scale selfprop systems that are too numerous or too subtle to be noticed individually by the dominant global self-prop systems may retain more or less autonomy, but each of them will have influence only within some very limited sphere. It may be answered that a coalition of small-scale self-prop systems could challenge the global self-prop systems, but if small-scale self-prop systems organize themselves into a coalition having worldwide influence, then the coalition will itself be a global self-prop system.

We can speak of the "world-system," meaning all things that exist on Earth, together with the functional relations among them. The world-system probably should not be regarded as a self-prop system, but whether it is or not is irrelevant for present purposes.

To summarize, then, the world-system is approaching a condition in which it will be dominated by a relatively small number of extremely powerful global self-prop systems. These global systems will compete for power—as they must do in order to have any chance of survival—and they **will** compete for power in the short term, with little or no regard for longterm consequences (Proposition 2). Under these conditions, intuition tells us that desperate competition among the global self-prop systems will tear the world-system apart.

Let's try to formulate this intuition more clearly. For some hundreds of millions of years the terrestrial environment has had some degree of stability, in the sense that conditions on Earth, though variable, have remained within limits that have allowed the evolution of complex lifeforms such as fishes, amphibians, reptiles, birds, and mammals. In the immediate future, all self-prop systems on this planet, including self-propagating human groups and any purely machine-based systems derived from them, will have evolved while conditions have remained within these limits, or at most within somewhat wider ones. By Proposition 3, the Earth's self-prop systems will have become dependent for their survival on the fact that conditions have remained within these limits. Large-scale self-prop human groups, as well as any purely machine-based self-prop systems, will be dependent also on conditions of more recent origin relating to the way the world-system is organized; for example, conditions relating to economic relationships. The rapidity with which these conditions change must remain within certain limits, else the self-prop systems will not survive.

This doesn't mean that all of the world's self-prop systems will die if future conditions, or the rapidity with which they change, slightly exceed some of these limits, but it does mean that if conditions go far enough beyond the limits many self-prop systems are likely to die, and if conditions ever vary wildly enough outside the limits, then, with near certainty, all of the world's more complex self-prop systems will die without progeny.

With several self-prop systems of global reach, armed with the colossal might of modern technology and competing for immediate power while exercising no restraint from concern for long-term consequences, it is extremely difficult to imagine that conditions on this planet will not be pushed far outside all earlier limits and batted around so erratically that for any of the Earth's more complex self-prop systems, including complex biological organisms, the chances of survival will approach zero.

Notice that the crucial new factor here is the availability of rapid, worldwide transportation and communication, as a consequence of which there exist global self-prop systems. There is another way of seeing that this situation will lead to radical disruption of the world-system. Students of industrial accidents know that a system is most likely to suffer a catastrophic breakdown when (i) the system is highly complex (meaning that small disruptions can produce unpredictable consequences), and (ii) tightly coupled (meaning that a breakdown in one part of the system spreads quickly to other parts).[8] The world-system has been highly complex for a long time. What is new is that the world-system is now tightly coupled. This is a result of the availability of rapid, worldwide transportation and communication, which makes it possible for a breakdown in any one part of the world-system to spread to all other parts. As technology progresses and globalization grows more pervasive, the world-system becomes ever more complex and more tightly coupled, so that a catastrophic breakdown has to be expected sooner or later.

It will perhaps be argued that destructive competition among global self-prop systems is not inevitable: A single global self-prop system might succeed in eliminating all of its competitors and thereafter dominate the world alone; or, because global self-prop systems would be relatively few in number, they could come to an agreement among themselves whereby they would refrain from all dangerous or destructive competition. However, while it is easy to talk about such an agreement, it is vastly more difficult actually to conclude one and enforce it. Just look: The world's leading powers today have not been able to agree on the elimination of war or of nuclear weapons, or on the limitation of emissions of carbon dioxide.

But let's be optimistic and assume that the world has come under the domination of a single, unified system, which may consist of a single global self-prop system victorious over all its rivals, or may be a composite of several global self-prop systems that have bound themselves together through an agreement that eliminates all destructive competition among them. The resulting "world peace" will be unstable for three separate reasons.

First, the world-system will still be highly complex and tightly coupled. Students of these matters recommend designing into industrial systems such safety features as "decoupling," that is, the introduction of "barriers" that prevent malfunctions in one part of a system from spreading to other parts.[9] Such measures may be feasible, at least in theory, in any relatively limited subsystem of the world-system, such as a chemical factory, a nuclear power-plant, or a banking system, though Perrow is not optimistic that even these limited systems will ever be consistently redesigned throughout our

[8] "Of toxic bonds and crippled nuke plants," The WeekJan.. 28, 2011, p. 42 (using the term "tightly linked" in place of "tightly coupled"). Harford, p. 27. See also Perrow, Normal Accidents, pp. 89-100; "Black Swans," The U'i?ek, April 8, 2011,p.13.

[9] Harford, p. 27. The Week, April 8, 2011, p. 13.

society to minimize the risk of breakdowns within the individual systems.[10] In regard to the world-system as a whole, we noted above that it grows ever more complex and more tightly coupled. To reverse this process and "decouple" the world-system would require the design, implementation, and enforcement of an elaborate plan that would regulate in detail the political and economic development of the entire world. For reasons explained at length in Chapter One of this book, no such plan will ever be carried out successfully.

Second, prior to the arrival of "world peace" and for the sake of their own survival and propagation, the self-prop subsystems of a given global self-prop system (their supersystem) will have put aside, or at least moderated, their mutual conflicts in order to present a united front against any immediate external threats or challenges to the supersystem (which are also threats or challenges to themselves). In fact, the supersystem would never have been successful enough to become a global self-prop system if competition among its most powerful self-prop subsystems had not been moderated.

But once a global self-prop system has eliminated its competitors, or has entered into an agreement that frees it from dangerous competition from other global self-prop systems, there will no longer be any immediate external threat to induce unity or a moderation of conflict among the selfprop subsystems of the global self-prop system. In view of Proposition 2—which tells us that self-prop systems will compete with little regard for long-term consequences—unrestrained and therefore destructive competition will break out among the most powerful self-prop subsystems of the global self-prop system in question.[11]

Benjamin Franklin pointed out that "the great affairs of the world, the wars, revolutions, etc. are carried on and effected by parties." Each of the "parties," according to Franklin, is pursuing its own collective advantage, but "as soon as a party has gained its general point"—and therefore, presumably, no longer faces immediate conflict with an external adversary—"each member becomes intent upon his particular interest, which, thwarting others, breaks that party into divisions and occasions ... confosion. "[12]

History does generally confirm that when large human groups are not held together by any immediate external challenge, they tend strongly to break up into factions that compete against one another with little regard for long-term consequences.[13] What we

[10] Perrow, Next Catastrophe, Chapt. 9. See TheAtlantic,Jan.!Feb. 2015, p. 25, col. 1 (our big banks are "still too interconnected").

[11] This argument of course assumes that the most powerful self-prop subsystems will be "intelligent" enough to distinguish between a situation in which their supersystem is subject to an immediate external threat, and a situation in which their supersystem is not subject to such a threat. The assumption, however, will surely be correct in the contexts that are relevant for our purposes.

[12] Silverman, p. 103. (Punctuation, capitalization, and so forth have been modernized here for the sake of readability.) Compare Alinsky, p. 149 (the struggle for power among powerful groups "permits only temporary truces, and only when [the powerful groups are] equally confronted by a common enemy").

[13] See Appendix Two, Part C.

are arguing here is that this does not apply only to human groups, but expresses a tendency of self-propagating systems in general as they develop under the influence of natural selection. Thus, the tendency is independent of any flaws of character peculiar to human beings, and the tendency will persist even if humans are "cured" of their purported defects or (as many technophiles envision) are replaced by intelligent machines.

Third, let's nevertheless assume that the most powerful self-prop subsystems of global self-prop systems will not begin to compete destructively when the external challenges to their supersystems have been removed. There yet remains another reason why the "world peace" that we've postulated will be unstable.

By Proposition 1, within the "peaceful" world-system new self-prop systems will arise that, under the influence of natural selection, will evolve increasingly subtle and sophisticated ways of evading recognition—or, once they are recognized, evading suppression—by the dominant global self-prop systems. By the same process that led to the evolution of global self-prop systems in the first place, new self-prop systems of greater and greater power will develop until some are powerful enough to challenge the existing global self-prop systems, whereupon destructive competition on a global scale will resume.

For the sake of clarity we have described the process in simplified form, as if a world-system relatively free of dangerous competition would first be established and afterward would be undone by new selfprop systems that would arise. But it's more likely that new self-prop systems will be arising all along to challenge the existing global self-prop systems, and will prevent the hypothesized "world peace" from ever being consolidated in the first place. In fact, we can see this happening before our eyes.[14] The most crudely obvious of the (relatively) new self-prop systems are those that challenge law and order head on, such as terrorist networks and hackers' groups,[15] as well as frankly criminal enterprises[16] that make no pretense of idealistic motives. Drug cartels have disrupted the normal course of political life in Mexico;[17] terrorists did the same in the United States with the attack of September 11, 2001, and they are continuing to do so, much more drastically, in countries like Iraq. Self-prop

[14] See Appendix Two, Part D.

[15] E.g., Anonymous and the now-defunct LulzSec. The EconomistJune 18, 2011, pp. 67-68; Aug;. 6, 2011, pp. 49-50. Saporito, pp. 50-52, 55. Acohido, "Hactivist group." p. IB, and "LulzSecs gone,"p. IB.

[16] E.g., Scandinavian biker gangs apparently have proven very difficult for the authorities to control. The U'i?ek, Aug;. 20, 2010, p. 15. Authorities seem almost helpless against Chinese gangs that produce technologically sophisticated fake IDs that are good enough to fool even experts. USA Today,]une 11, 2012, p. lA; Aug;. 7, 2012, p. 4A. Cybergangs that use the Internet for criminal purposes are technologically sophisticated and hard to stop. Acohido, "Hackers mine ad strategies,"p. 2B. Leger & Arutunyan, pp. lA, 7A. USA Today, Aug.. 29, 2013, p.2B.

[17] See notes 66, 70 to Chapter Three. Also: The U'i?ek, May 21, 2010, p. 8; May 28, 2010, p. 6; Aug. 13, 2010, p. 6; Dec. 24, 2010-Jan. 7, 2011,p. 20. USA Today, Nov. 22, 2013, p. 8A.

systems of the purely lawless type even have the potential to take control of important nations, as drug cartels arguably have come close to doing in Kenya.[18] Political "machines" are not necessarily to be classified as criminal enterprises, but they ordinarily are more or less corrupt and tainted with illegal activity,[19] and they do challenge, or even take over, the "legitimate" structure of government.

Probably more significant for the present and the near future are emerging self-prop systems that use entirely legal methods, or at least keep their use of illegal methods to the minimum necessary for their purposes, and justify those methods with a claim, not totally outrageous, that their actions are necessary for the fulfillment of some widely accepted ideal such as "democracy," "social justice," "prosperity," "morality," or religious principles. **In** Israel, the ultra-orthodox sect—strictly legal—has become surprisingly powerful and seriously threatens to subvert the values and objectives of the hitherto secular state.[20] The great corporations, as we know them today, are a relatively recent (and perfectly legal) development; in the U.S. they date only from the latter half of the 19th century.[21] New corporations are continually being formed, and some grow powerful enough to challenge the older enterprises. During the last several decades many corporations have become international, and their power has begun to rival that of nation-states.[22]

A subordinate system that a government creates for its own purposes can turn into a self-prop system in its own right, and may even become dominant over the government. Thus, bureaucracies commonly are concerned more with their own power and security than with the fulfillment of their public responsibilities. "(Every. .. bureaucracy develops a tendency to preserve itself, to fatten itself parasitically. It also develops a tendency to become a power in and of itself, autonomous, over which governments lose all real control."[23] In the Soviet Union, the bureaucracy became the dominant power.[24] A nation's military establishment often acquires a considerable degree of autonomy and

[18] Kenya has been called a "narco-state," The U'i?ek,]an. 14, 2011, p. 18, and there is plenty of evidence that this is not far from the truth. Gastrow, Dec. 2011, Chapt. One, especially pp.24, 26, 28-34.'Available information does not... justify categorizing Kenya as a captured or criminalized state, but the country is clearly on its way to achieving that... status." Gastrow, Sept. 2011,p. 10.The drug gangs involved operate internationally and have massively corrupted the governments of other African countries, such as Guinea-Bissau. O'Regan,p. 6.

[19] See Patterson, pp. 9-10, 63.

[20] Vick,pp.46-51. The Economist, Dec. 10, 2011, p. 51.

[21] R. Heilbroner &A. Singer, pp. 58-60.

[22] Ibid., pp. 232-33, 239. Rothkopf, p. 44. Foroohar, "Companies Are The New Countries,"p.21. Corporations are also a dominant force within the U.S. political system, because their wealth enables them to offer politicians campaign contributions that in practice function as bribes. See The Week, Feb.25, 2011,p. 16.

[23] Carrillo, pp. 77-78. "U.S. Supreme Court Justice William O. Douglas told [President] Franklin Roosevelt that government agencies more than ten years old should be abolished. After that point, they become more concerned with their image than with their mission." David Brower, "Foreword," in Wilkinson, p. ix. See also Keefe, p.42, quoting Max Weber on bureaucracies' "pure interest:... in power."

[24] See Carrillo, pp. 207-08.

then supplants the government as the dominant political force in the country. Nowadays the undisguised military coup seems less popular than it once was, and politically sophisticated generals prefer to exercise their power behind the scenes while allowing a facade of civilian government to function. When the generals find it necessary to intervene overtly they claim to be acting in favor of "democracy" or some such ideal. This type of military dominance can be seen today in Pakistan and Egypt.[25]

Two competing, entirely legal self-prop systems that have arisen in the U.S. during the last few decades are the politically correct left and the dogmatic right (not to be confused with the liberals and conservatives of earlier times in America).This book is not the place to speculate about the outcome of the struggle between these two forces; suffice it to say that in the long run their bitter conflict may do more to prevent the establishment of a lastingly peaceful world order than all the bombs of Al Theda and all the murders of the Mexican drug gangs.

People who find it difficult to face harsh realities will hope for a way to design and construct a world-system in which the processes that lead to destructive competition will not occur. But in Chapter One we've explained why no such project can ever be successfully carried out in practice. It may be objected that a mammal (or other complex biological organism) is a self-prop system that is a composite of millions of other self-prop systems, namely, the cells of its own body. Yet (unless and until the animal gets cancer) no destructive competition arises among cells or groups of cells within the animal's body. Instead, all the cells loyally serve the interests of the animal as a whole. Moreover, no external threat to the animal is necessary to keep the cells faithful to their duty. 'There is (it may be argued) no reason why the world-system could not be as well organized as the body of a mammal, so that no destructive competition would arise among its self-prop subsystems.

But the body of a mammal is a product of hundreds of millions of years of evolution through natural selection. This means that it has been created through a process of

[25] Pakistan: Time,May23,2011,p.41. The Wfek,Nov.26,2010,p. 15. The Economist, Feb. 12,2011,p. 48; Feb. 26, 2011,p. 65 ("General Ashfaq Kayani ... [is] widely seen as the most powerful in [Pakistan]"); April 2, 2011, pp. 38-39; May 21, 2011, p. 50 ("India's most senior security officials say that Pakistan is stiff, in essence, a state run by its army"); June 18, 2011, p. 47 (calling Pakistan's army "the country's dominant institution"); July 30, 2011,p. 79. USA Today, May 13, 2013,p. SA ("Despite protests over vote-rigging..., observers heralded Pakistan's elections as a historic democratic exercise in a nation known for military takeovers " But: "Athar Hussain, director of the Asia Research Center at the London School of Economics, said ... 'The army will still remain one of the most powerful forces in Pakistan'...").

Recent (since 2011) events in E^gypt have been massively publicized, and it should be obvious to the reader that the army is calling the shots in that country. As an example, we quote USA Today, Aug. 16, 2013, p. lA:

"E^>t's military ousted [Mohammed] Morsi on July 3 (2013] after millions protested Morsi's policies as a new dictatorship oflslamists... EEgyptian military chief Abdel Fatah al-Sisi has criticized [President] Obama for refusing to endorse the ouster of Morsi... .The Obama administration has not called the ouster a 'military coup'..."

See also ibid., pp. SA, 6A, and ibid., Oct. 30, 2013, p. 7A ("In a political vacuum, [E ^>t's] top army chiefhas edge").

trial and error involving many millions of successive trials. If we suppose the duration of a generation to be a period of time !:!.., those members of the first generation that contributed to the second generation by producing offspring were only those that passed the test of selection over time A. Those lineages[26] that survived to the third generation were only those that passed the test of selection over time 2/:i. Those lineages that survived to the fourth generation were only those that passed the test of selection over time 3/:i. And so forth. Those lineages that survived to the Nth generation were only those that passed the test of selection over the time-interval (N-1)!:i as well as the test of selection over every shorter time-interval. Though the foregoing explanation is grossly simplified, it shows that in order to have survived up to the present, a lineage of organisms has to have passed the test of selection many millions of times and over all time-intervals, short, medium, and long. To put it another way, the lineage has had to pass through a series of many millions of flters, each of which has allowed the passage only of those lineages that were "fittest" (in the Darwinian sense) to survive over time-intervals of widely varying length. It is only through this process that the body of a mammal has evolved, with its incredibly subtle and complex mechanisms that promote the survival of the animal's lineage at short, medium, and long term. These mechanisms include those that prevent destructive competition among cells or groups of cells within the animal's body.

Also highly important is the large number of individuals in each generation of a biological organism. A species that has had a close brush with extinction may at some point have been reduced to a few thousand individuals, but any mammalian species, through almost all of its evolutionary history since its first appearance as a multi-celled organism, has had millions of individuals in each generation from among which the "fittest" have been selected.

But once self-propagating systems have attained global scale, two crucial differences emerge. The first difference is in the number of individuals from among which the "fittest" are selected. Self-prop systems sufficiently big and powerful to be plausible contenders for global dominance will probably number in the dozens, or possibly in the hundreds; they certainly will not number in the millions. With so few individuals from among which to select the "fittest," it seems safe to say that the process of natural selection will be inefficient in promoting the fitness for survival of the dominant global self-prop systems.[27] It should also be noted that among biological organisms, species that consist of a relatively small number of large individuals are more vulnerable to

[26] For the sake of simplicity we defne a lineage to be any sequence of organisms Oi, O**2,** O3, **...** On such that O2 is an offspring ofOi, O3 is an offspring of 0**2,** O_4 is an offspring of O3**,** and so on down to On. We say that such a lineage has survived to the Nth generation. But if On produces no offspring, then the lineage does not survive to generation N + 1. For example, ifJohn is the son of Mary and George is the son of John and Laura is the daughter of George, then Mary- John-George-Laura is a lineage that survives to the fourth generation. But if Laura produces no offspring, then the lineage does not survive to the fifth generation.

[27] See Appendix Two, Part E.

extinction than species that consist of a large number of small individuals.[28] Though the analogy between biological organisms and self-propagating systems of human beings is far from perfect, still the prospect for viability of a world-system based on the dominance of a few global self-prop systems does not look encouraging.

The second difference is that in the absence of rapid, worldwide transportation and communication, the breakdown or the destructive action of a small-scale self-prop system has only local repercussions. Outside the limited zone where such a self-prop system has been active there will be other self-prop systems among which the process of evolution through natural selection will continue. But where rapid, worldwide transportation and communication have led to the emergence of global self-prop systems, the breakdown or the destructive action of any one such system can shake the whole world-system. Consequently, in the process of trial and error that is evolution through natural selection, it is highly probable that after only a relatively small number of "trials" resulting in "errors," the world-system will breakdown or will be so severe1y disrupted that none of the world larger or more complex self-prop systems will be able to survive. Thus, for such self-prop systems, the trial-and-error process comes to an end; evolution through natural selection cannot continue long enough to create global self-prop systems possessing the subtle and sophisticated mechanisms that prevent destructive internal competition within complex biological organisms.

Meanwhile, fierce competition among global self-prop system swill have led to such drastic and rapid alterations in the Earth's climate, the composition of its atmosphere, the chemistry of its oceans, and so forth, that the effect on the biosphere will be devastating. In Part IV of the present chapter we will carry this line of inquiry further: We will argue that if the development of the technological world-system is allowed to proceed to its logical conclusion, then in all probability the Earth will be left a dead planet:—a plane ton which nothing will remain a live except, maybe, some of the simplest organisms—certain bacteria, algae, etc.—that are capable of surviving under extreme conditions.

The theory we've outlined here provides a plausible explanation for the s o-called Fermi Paradox. It is believed that there should be numerous planets on which technologically advanced civilizations have evolved, and which are not so remote from us that we could not by this time have detected their radio transmissions. The Fermi Paradox consists in the fact that our astronomers have never yet been able to detect any radio signals that seem to have or originated from an intelligent extraterrestrial source.[29]

According to Ray Kurzweil, one common explanation of the Fermi Paradox is "that a civilization may obliterate itself once it reaches radio capability." Kurzweil continues: "This explanation might be acceptable if we were talking about only a few such civilizations , but [if such civilizations have been numerous], it is not credible to believe that

[28] Sodhi, Brook &Bradshaw, pp. 515,517,519. Benton, p. vii.
[29] Kurzweil, pp. 344-49.

every one of them destroyed itself."[30] Kurzweil would be right if the self-destruction of a civilization were merely a matter of chance. But there is nothing implausible about the foregoing explanation of the Fermi Paradox if there is a process common to all technologically advanced civilizations that consistently leads them to self-destruction. Here we've been arguing that there is such a process.

[30] Ibid., p. 348. Kurzweil refers to an estimate that there should be "billions"of technologically advanced civilizations within the range of our observation, but he plausibly argues that the assumptions on which this estimate is based are highly uncertain and probably overoptimistic (this writer would say wildly overoptimistic). Ibid., pp. 346-47, 357. On the other hand, since Kurzweil wrote in 2005 there have been numerous media reports of discoveries that indicate an abundance of planets, not so far from Earth, on which, as far as anyone can tell, life could have evolved. E.g.: The Week, June 3, 2011, p. 21; Sept. 30, 2011, p. 23; Jan. 27, 2012, p. 19. Time, June 6, 2011, p. 18. The Economist, Dec. 10, 2011, p. 90. USA Today, Feb. 7, 2013, p. 5A; April 19-21, 2013, p.7A; Nov.. 5,2013, p. 5A; May 3,2016, pp. 1A,3A; May 11,2016, p. 8A. Lieberman, pp.36-39. So anexplanation is needed for the fact that our astronomers have detected no indication of any extraterrestrial civilizations at **al**l. See Kurzweil, p. 357. It should be noted that in this connection Kurzweil egregiously misuses the "anthropic principle." Ibid.

Part III

Our discussion of self-propagating systems merely describes in general and abstract terms what we see going on all around us in concrete form: Organizations, movements, ideologies are locked in an unremitting struggle for power. Those that fail to compete successfully are eliminated or subjugated.[1] The struggle is almost exclusively for power in the short term;[2] the competitors show scant concern even for their own long-term survival,[3] let alone for the welfare of the human race or of the biosphere. That's why nuclear weapons have not been banned, emissions of carbon dioxide have not been reduced to a safe level, the Earth's resources are being exploited at an utterly reckless rate, and no limitation has been placed on the development of powerful but dangerous technologies.

The purpose of describing the process in general and abstract terms, as we've done here, is to show that what is happening to our world is not accidental; it is not the result of some chance conjunction of historical circumstances or of some flaw of character peculiar to human beings. Given the nature of self-propagating systems in general, the destructive process that we see today is made inevitable by a combination of two factors: the colossal power of modern technology and the availability of rapid transportation and communication between any two parts of the world.

Recognition of this may help us to avoid wasting time on naive efforts to solve our current problems. For example, on efforts to teach people to conserve energy and resources. Such efforts accomplish nothing whatever.

It seems amazing that those who advocate energy conservation haven't noticed what happens: As soon as some energy is freed up by conservation, the technological world-system gobbles it up and demands more. No matter how much energy is provided, the system always expands rapidly until it is using all available energy, and then it

[1] From our remarks about Social Darwinism in Part I of this chapter, it should be clear that our intention here is not to exalt competition or portray it as desirable. We aren't making value-judgments in that regard. Our purpose is only to set forth the relevant facts, however unpleasant those facts may be.

[2] E.g;.: "As [Barbara] Tuchman put it ... , 'Chief among the forces affecting political folly is lust for power... .'"Diamond, p. 431.

[3] E.g.: "Governments... regularly operate on a short-term focus: they... pay attention only to problems that are on the verge of explosion. For example, a friend of mine who is closely connected to the current [George W. Bush] federal administration in Washington, D.C., told me that,when he visited Washington for the first time after the 2000 national elections, he found that our government's new leaders had what he termed a '90-day focus': they talked only about those problems with the potentiat to cause a disaster within the next 90 days." Ibid., p. 434.

demands still more. The same is true of other resources. The technological world-system infallibly expands until it reaches a limit imposed by an insufficiency of resources, and then it tries to push beyond that limit regardless of consequences.

This is explained by the theory of self-propagating systems: Those organizations (or other self-prop systems) that least allow respect for the environment to interfere with their pursuit of power here and now, tend to acquire more power than those that limit their pursuit of power from concern about what will happen to our environment fifty years from now, or even ten years. (Proposition 2.) Thus, through a process of natural selection, the world comes to be dominated by organizations that make maximum possible use of all available resources to augment their own power without regard to long-term consequences.

Environmental do-gooders may answer that if the public has been persuaded to take environmental concerns seriously it will be disadvantageous in terms of natural selection for an organization to abuse the environment, because citizens can offer resistance to environmentally reckless organizations. For example, people might refuse to buy products manufactured by companies that are environmentally destructive. However', human behavior and human attitudes can be manipulated. Environmental damage can be shielded, up to a point:, from public scrutiny; with the help of public-relations firms, a corporation can persuade people that it is environmentally responsible; advertising and marketing techniques can give people such an itch to possess a corporations products that few individuals will refuse to buy them from concern for the environment:; computer games, electronic social networking, and other mechanisms of escape keep people absorbed in hedonistic pursuits so that they don't have time for environmental worries. More importantly, people are made to see themselves as utterly dependent on the products and services provided by the corporations. Because people have to earn money to buy the products and services on which they are dependent:, they need jobs. Economic growth is necessary for the creation of jobs, therefore people accept environmental damage when it is portrayed as a price that must be paid for economic growth. Nationalism too is brought into play both by corporations and by governments. Citizens are made to feel that outside forces are threatening: "The Chinese will get ahead of us if we dont increase our rate of economic growth. Al Qaeda will blow us up if we don't improve our technology and our weaponry fast enough."

These are some of the tools that organizations use to counter environmentalists' efforts to arouse public concern; similar tools can help to blunt other forms of resistance to the organizations' pursuit of power. The organizations that are most successful in blunting public resistance to their pursuit of power tend to increase their power more rapidly than organizations that are less successful in blunting public resistance. Thus, through a process of natural selection, there evolve organizations that possess more and more sophisticated and effective means of blunting public resistance to their power'-seeking activities, whatever the degree of environmental damage involved. Because such organizations have great wealth at their disposal, environmentalists do not have the resources to compete with them in the propaganda war'.[4]

This is the reason, or an important part of the reason,[5] why attempts to teach people to be environmentally responsible have done so little to slow the destruction of our environment. And again—note well—the process we've described is not contingent on any accidental set of circumstances or on any defect in human character. Given the availability of advanced technology, the process inevitably accompanies the action of natural selection upon self-propagating systems.

[4] See Appendix Two, Part F.

[5] For other parts of the reason, see Kaczynski, Letters to David Skrbina: Aug.. 29, 2004, point (I); Nov.. 23, 2004, Part IV. E, point 1; March 17, 2005, Part I.A, points 6-8, 10-16, Part II.A, point 3, Part II.B, point 1,Part III.B, points 3-6.

Part IV

People who know something about the biological past of the Earth and see what the technological system is doing to our planet speak of a "sixth mass extinction," which they think is now in progress. Apparently they envision something like the extinction event at the end of the Cretaceous period, when the dinosaur's died out:: They assume that many kinds of complex organisms will survive, and the species that become extinct will be replaced by complex organisms of a different kind, just as the dinosaur's were replaced by mammals.[1] Here we argue that this (relatively) comforting assumption is unjustified, because the extinction event that has now begun is of a fundamentally different kind than all of the previous mass extinctions that have occurred on this planet:.

So far as is known, each previous mass extinction has resulted from the arrival of some one major disruptive factor, or at most perhaps two or three such factors.[2] Thus, it is widely believed that the dinosaur's were wiped out by the impact of an asteroid that kicked up colossal clouds of dust:. These obstructed the light of the Sun, cooling the planet and interfering with photosynthesis.[3] Presumably, mammals were better able to survive under these conditions than the dinosaur's were. There are paleontologists who argue that some species of dinosaur's survived for as long as a million year's after the impact of the asteroid, hence, that the asteroid alone was not enough to account for all of the extinctions that occurred at the end of the Cretaceous. The dinosaur's, they maintain, must have been finished off by some other factor—perhaps a prolonged period of unusual volcanic activity that continued to darken the atmosphere.[4] In any case, no one claims that more than a very few such factors—all of them simple, blind forces—were involved in the extinction of the dinosaurs or in other, previous mass extinctions.

In contrast to these earlier events, the extinction event that is now under way is not the work of a single blind force or even of two or three or ten such forces. Instead, it is the work of a multiplicity of intelligent, living forces. These are human organizations, self-prop systems that assiduously pursue their own short-term advantage without scruple and without concern for long-term consequences. In doing so they leave no

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[1] This assumption is implicit in, e.g.., Benton, pp. vi, viii; McKinney & Lockwood, p. 452; Feeney, pp. 20-21.

[2] See Benton, p.vii.

[3] Ibid.,p.iv. NEB (2007),V61.4, "dinosaur,"p. 104; Vol. 17, "Dinosaurs," pp. 317-18.

[4] See note 42.

stone unturned, no possibility untested, no avenue unexplored in their unremitting drive for power.

This can be compared to what happens in biology: In the course of evolution organisms develop means of exploiting every opportunity, utilizing every resource, and invading every corner where life is possible at all. Scientists have been surprised to discover living organisms surviving, and in some cases even thriving, in locations where there seemingly is nothing on which they could support themselves. There are communities of bacteria, worms, molluscs, and crustaceans that flourish near hydrothermal vents so deep in the ocean that no sunlight whatever can reach them and the downward drift of nutrients from the surface is entirely inadequate. Some of these creatures actually use hydrogen sulfide—to most organisms a deadly poison—as a source of energy.[5] Elsewhere there are bacteria that live a hundred feet beneath the seafloor in an environment almost completely devoid of nutrients.[6] Other bacteria nourish themselves on nothing more than "bare rock and water" at depths of up to 1.7 miles beneath the surface of the continents.[7] Everyone knows that there are organisms called parasites that find a home within other organisms, but many people may be surprised to learn that there are parasites that live in or on other parasites; in fact, there are parasites of parasites of parasites of parasites.[8]

> So, naturists observe, a flea
> Has smaller fleas that on him prey;
> And these have smiler still to bite 'em,
> And so proceed ad infinitum.[9]

Needless to say, there do exist limits to the conditions under which life can survive. E.g., it has been questioned whether there can ever be a "general mechanism by which any conventional protein could be made stable and functional at temperatures above 100° C."[10] Yet some organisms do live at temperatures as high as 113° C., though none is known to survive and reproduce at a higher temperature.[11]

Like biological organisms, the world's leading human self-prop systems exploit every opportunity, utilize every resource, and invade every corner where they can find anything that will be of use to them in their endless search for power. And as technology advances, more and more of what formerly seemed useless turns out to be useful after all, so that more and more resources are extracted, more and more corners are invaded, and more and more destructive consequences follow. For example:

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[5] Duxbury & Duxbury, pp. 111-12, 413-14. Zierenberg, Adams & Arp. Beatty et al.
[6] The WeekJune 8, 2012, p. 21.
[7] Kerr, p. 703.
[8] Popular Science, June 2013, p. 97.
[9] Jonathan Swift, "On Poetry: A Rhapsody," in Browning, p. 274.
[10] Zierenberg, Adams & Arp, p. 12962.
[11] Kerr, p. 703.

When humans made no use of metals other than iron meteorites, or nuggets of gold or copper that might be found by chance, the only mining activity consisted in the digging-out of rocks such as flint or obsidian that were used to make tools. But once people had learned to utilize metals on a large scale the destructive effects of mining became evident. Certainly by the 16th century, and probably much earlier, it was clearly recognized that mining poisoned streams and rivers and ruined the countryside where it occurred.[12] But in those days mining affected only a few districts where there were known deposits of relatively high-grade ore, and people who lived elsewhere probably never gave a thought to the damage caused by the extraction of metals. In recent times, however, more sophisticated means of detecting deposits of valuable minerals have been devised,[13] as well as methods for utilizing low-grade ores that formerly were left undisturbed because the extraction of metal from them was too difficult to be profitable.[14] As a result of these developments mining activities have continually invaded new areas, and severe environmental damage has followed.[15] It is said that the water flowing out of many old mining sites is so heavily contaminated that it will have to be treated "forever" to remove the toxic metals.[16] Of course, it won't be treated forever, and when the treatment stops, rivers will be irremediably poisoned.

Mining activities are invading still other areas because new uses have been found for elements that several decades ago had few if any practical applications. Most of the "rare earth" elements were of limited utility before the middle of the 20th century, but they are now considered indispensable for many purposes.[17] The rare earth neodymium,

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[12] Klemm, pp. 147-48.

[13] Evolutionary and Revolutionary Technologies far Mining, pp. 19-24. See our List of Works Cited—Works Without Named Author.

[14] E.g., miners have learned touse cyanide solutions and mercury—both highly poisonous—to leach gold out of sediments or crushed rock. Zimmermann, pp. 270-71, 276. NEB (2002), Vol. 21, "Industries, Extraction and Processing,"pp. 491-92. At least in the case of cyanide leaching, this can be done profitably even where only a minute quantity of gold is present in each ton of material treated. Diamond, p. 40. Low-grade copper ores were not utilized until about 1900, when Daniel C.Jackling devised methods that made it possible to mine and process such ores at a profit. World Book Encyclopedia (2015), Vol. 4, "Copper," p. 1044. Modern methods of processing copper ores are described in McGraw-Hill Encyclopedia of Science&Technology (2012), Vol. 4, "Copper metallurgy,"pp. 765-68. Methods have been developed for utilizing low-grade iron ores such as taconite. NEB (2003), Vol. 29, "United States of America," p. 372. See Zimmermann, pp. 271-73. Some iron ores contained too much phosphorus, so that steel produced from them was "almost unfit for practical purposes." Ibid., p. 284. Manchester, p. 32. The utilization of these ores was made possible by the invention at some time between 1875 and 1879 (sources are inconsistent as to the date) of the Thomas-Gilchrist process for making low-phosphorus steel from high-phosphorus ore. Zimmermann, p. 284. NEB (2003), Vol. 5, "Gilchrist, Percy (Carlyle)," p. 265; Vol. 11, "Thomas, Sidney Gilchrist," p. 716; Vol. 21, "Industries, Extraction and Processing,"pp. 420, 422, 447-48.

[15] E.g., Watson, p. lA (widespread mercury contamination from old gold-mining operations); Diamond, pp. 36-37, 40-41, 453-57.

[16] Diamond, pp. 455-56.

[17] Folger, pp. 138, 140, notes the current indispensability of rare earths; NEB (2007), Vol. 15, "Chemical Elements," pp. 1016-17, notes the former limited utility of rare earths. For a detailed description of

for example, is needed in large quantities for the lightweight permanent magnets used in wind turbines.[18] Unfortunately, most deposits of rare earths contain radioactive elements, hence the mining of these metals generates radioactive waste.[19]

The mining of rare earths also leads to other environmental problems, similar to those that are characteristic of mining generally.[20]

In quantitative terms, at least, uranium was of little importance prior to the development of atomic weapons and nuclear power-plants; it is now mined on a large scale. Relatively small amounts of arsenic were no doubt sufficient for medical applications and for the manufacture of rat poison and artists' pigments, but today the element is used in large quantities, e.g., to harden lead alloys and as a wood preservative. Fence posts treated with cupric arsenate are extremely common in the western United States[21]— there must be many millions of them. These posts last far longer than untreated ones, but they are not indestructible. They will eventually disintegrate, and when they do the arsenic they contain will spread through our environment. Large-scale mining and utilization of other toxic and/ or carcinogenic elements such as mercury, lead, and cadmium are likewise spreading them everywhere. Cleanup efforts are so puny in relation to the magnitude of the problem that they are little better than a joke.

The extraction and processing of other resources have followed similar trajectories. Petroleum, long known as a substance that seeped from the ground in places, originally had few uses. But during the 19th century it was discovered that kerosene, distilled from petroleum, could be burned for illumination in lamps, and for that purpose was superior to whale oil. As a result of this discovery the first "oil well" was drilled in Pennsylvania in 1859, and drilling elsewhere soon followed. The petroleum industry at that time was based mainly on kerosene; there was little demand for other petroleum products, such as natural gas and gasoline. But natural gas later came to be used on a large scale for heating, cooking, and illumination, and after the advent of the gasoline-powered automobile around the beginning of the 20th century the petroleum industry won a position of central importance in the economy of the industrialized

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the vast growth in applications of the rare earths, see Krishnamurthy & Gupta, pp. 33-73. Ibid., p. 73, states: "Over the years, analyzing world rare-earth demand on an annual basis has shown that it has remained more or less the same."This may be true for some limited span of years, say, perhaps, the ten years or so preceding the publication of Krishnamurthy & Gupta's book, but, given the vast expansion in the applications of rare earths, the statement would be implausible if applied over the long term. Krishnamurthy & Gupta themselves refer on pp. 743-44 to the "continued increase in global usage" and the "fast-expanding world demand" for at least some rare earths. Even if the demand has been static for a few years, it seems unlikely that it will long remain so.

[18] Margonelli, p. 17. Folger, loc. cit. (hundreds of pounds of neodymium for a single wind turbine). Krishnamurthy & Gupta, pp. 50-51, provide some technical details.

[19] Margonelli, p. 18. Folger, p. 145. Krishnamurthy &Gupta, e.g., p. 718.

[20] Ibid., Chapt. 9, pp. 717-744.

[21] The Bouma postyard near Lincoln, Montana, which treated posts and poles with cupric arsenate, was in operation throughout the author's 25-year residence in that area.

world. From that time on, new uses for petroleum products have continually been discovered. In addition, processes have been developed for transforming hydrocarbons so that formerly useless petroleum distillates can be turned into useful products, and oil deposits that, because of their undesirable characteristics (e.g;., high sulfur content), might not have been worth extracting, can now be made valuable.[22]

Oil companies have come up with ever more sophisticated methods for locating petroleum deposits, and this is one of the reasons why estimates of "known oil reserves" keep increasing. But the estimates also increase because previously inaccessible petroleum is made accessible by new technologies that make it profitable to extract petroleum (including natural gas) from ever more difficult sources. Drillers penetrate deeper and deeper into the Earth's crust, and are even able to drill horizontally; "fracking" (hydraulic fracturing) releases new reserves of oil, and especially gas, from shale rock; techniques are under development for utilizing the vast deposits of methane hydrate found on the ocean floor.[23] As a result of all these technical advances more and more of the Earth's surface is raped by the petroleum industry, and for humans who get in the way it's just tough luck. Fracking, for example, is not a benign technique;[24] among other things, wastewater disposal associated with fracking causes earthquakes.[25]

Anyone who thinks the technological world-system is ever going to stop burning fossil fuels (while any are left) is dreaming.[26] But whether or not the system ever renounces such fuels, other destructive sources of energy will be utilized. Nuclear powerplants generate radioactive waste; no provably safe way of disposing of such waste has yet been identified,[27] and the world's leading self-prop systems aren't even trying

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[22] For this whole paragraph see Zimmermann, pp. 323-24, 401-07; NEB (2002), Vol. 21, "Industries, Extraction and Processing,"pp. 515,520,523-28; Krauss, p. B8; C.Jones, p. 3B. Allan Nevins's biography ofJohn D. Rockefeller (see List of Works Cited), who created the Standard Oil Company, is also of interest in this connection.

[23] For this paragraph up to this point, see NEB (2002), Vol. 21, "Industries, Extraction and Processing," pp. 515-19; Mann, pp. 48-63; Walsh, "Power Surge," pp. 36-39; Reed, p. B6; Rosenthal, p. B6; K. Johnson & R. Gold, pp. Al, A6; Vara, pp. 20-21; USA Today, May 10, 2011, p. 2A, Nov. 23, 2012, p. lOA, Nov. 4, 2013, p. 3B, and Nov. 14, 2013, p. lA.

[24] See, e.g., Walsh, "Gas Dilemma," pp. 43, 45-46, 48; USA Today, July 19, 2016, p. 6B.

[25] 1he Week,, April 8, 2016, p. 7. USA Today, Aug. 11, 2016, p. 4A and Dec. 7, 2016, p. 6B.

[26] This conclusion is strongly suggested by the theory of natural selection as developed in the present chapter, and it is supported empirically by the system's failure to solve other problems that require worldwide international cooperation and renunciation of competitive advantages (e.g., the failure to eliminate war or nuclear weapons), as well as the failure to deal with the greenhouse effect itself. Note failure of global-warming summits in Copenhagen, USA Today, Nov. 16, 2009, p. 5A and Cancun, 1he Week, Dec. 10, 2010, p. 23, "Climate change: Resignation sets in." The famous "Paris Climate Agreement" was touted as a "turning point for the planet," USA Today, Oct. 6, 2016, p. lA, but President Trump, as we all know, has withdrawn the U.S. from that agreement, and even if the agreement had remained intact it would have accomplished very little toward bringing global warming under control, Lomborg, p. 7A.

[27] See note 27 to Chapter One; Wald, "Nuclear Industry Seeks Interim Site," pp. Al, A20, and "What Now for Nuclear Waste?," pp. 48-53.

very hard to find a permanent home for the accumulating radioactive garbage.[28] Of course, the self-prop systems need energy for the maintenance of their power here and now, whereas radioactive waste represents only a danger for the future and, as we've emphasized, natural selection favors self-prop systems that compete for power in the present with little regard for longterm consequences. So nuclear power-plants continue to be built, while the problem of dealing with their burned-out fuel is largely neglected. In fact, the problem of nuclear waste is on track to become totally unmanageable because, instead of a few of the big, old-style reactors, numerous small ones ("mini-nukes") will soon be built,[29] so that every little town can have its own nuclear power-plant.[30] With the big, old-style reactors at least the radioactive wastes have been concentrated at a relatively small number of sites, but with numerous mini-nukes scattered over the world radioactive wastes will be everywhere. One would have to be extraordinarily naive, or else gifted with a remarkable capacity for self-deception, to believe that each little two-bit burg is going to handle its nuclear waste responsibly. In practice, much of the radioactive material will escape into the environment.

"Green" energy sources aren't going to wean the system from its dependence on fossil fuels and nuclear power. But even if they did, green energy sources don't look so green when one examines them closely. "There's no free lunch when it comes to meeting our energy needs," says the director of the Natural Resources Defense Council's land program. "To get energy, we need to do things that will have impacts."[31]

The construction of wind farms entails the creation of radioactive waste because, as noted earlier, the lightweight permanent magnets in wind turbines require the rare-earth element neodymium. In addition, wind farms kill numerous birds, which fly into the "propellers" of the turbines.[32] Large numbers of new wind-farms are planned in the U.S., China, and presumably other countries as well,[33] and a likely result will be the extermination of many species of birds. "Shawn Smallwood, a Davis, Calif. ecologist and researcher [said:] 'Just the sheer numbers of turbines we're talking about—we're going to be killing so many raptors until there are no more raptors in my opinion.' "[34] Raptors play an important role in controlling rodent populations, so when the raptors are gone more pesticides will have to be used to kill rodents.

The United States has been developing a military robot called the EATR that relies on green energy inasmuch as it "fuels itself by eating whatever biomass"—a renewable

[28] See, e.g., "Radioactive fuel rods: The silent threat," 1he Week,, April 15, 2011, p. 13. Even where cleanup efforts are undertaken, they are likely to be characterized by incompetence and inefficiency. See, e.g., USA Today, Aug. 29, 2012, p. 2A; May 10, 2017, p. 3A ("Tunnel containing nuclear waste collapses"); June 26, 2017, pp. lA &2A.

[29] Carroll, pp. 30-33. Koch, p. 4B.

[30] Carroll, p. 33 ("The isolated Alaska village of Galena is in discussions with Toshiba" to buy a mini-nuke).

[31] Matheny, p. 3A.

[32] Welch, p. 3A. 1he Week, March 23,2012,p. 14.

[33] Welch, p. 3A. MacLeod, p. 7A.

[34] Welch, p. 3A.

resource—"it finds around it."[35] But you can imagine the devastation that would result from a war fought by armies of robots that gobble for fuel whatever biomass they find. And if the biomass-gobbling technology is ever adapted to civilian use, it will endanger every living thing that can be used to satisfy the system's always ravenous appetite for energy.

But solar energy is harmless, right? Well, not quite, for solar panels compete with biological organisms for the light of the Sun. Let's recall what we pointed out earlier, that the technological system invariably expands until it is using all available energy, and then it demands more. If fossil fuels and nuclear power[36] aren't going to satisfy the system's ever-growing demand for energy, then solar panels will be placed wherever sunlight can be collected. This means, inter alia, that solar panels will progressively invade the habitats of living things, depriving them of sunlight and therefore killing most of them. This is not speculation. Plans "to create huge solar energy plants in the deserts" of the western United States—"prime habitat for threatened plants and animals"[37]—are already being carried out.[38] In 2011 Janine Blaeloch, executive director of the Western Lands Project, predicted: "These [solar energy] plants will introduce a huge amount of damage to our public land and habitat."[39] There is reason to believe that Blaeloch's prediction is beginning to come true.[40] And remember, the system's appetite for energy is insatiable: In all probability the development of solar energy will

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[35] 1he Economist, April 2, 2011, p. 65.

[36] Nuclear energy will include electricity from fusion power-plants if such plants ever become a practical alternative. But as ofMarch 2017 all fusion reactors have consumed more energy than they have produced, and moreover such reactors are very expensive to build. See H. Fountain in our List of Works Cited. So it will be a long time before fusion power-plants become economically viable, if they ever do. Controlled fusion has been touted as an unlimited and perfectly clean source of energy, but in reality fusion power-plants will routinely release some radioactive tritium gas into the atmosphere and will produce radioactive waste that will have to be disposed o£ In addition, as with present-day fission power-plants, there will be a possibility of radiation-releasing accidents. See Taylor et al. Even if fusion plants were perfectly clean and economically competitive, we could expect the system's consumption of energy to increase exponentially until some limit were reached. If nothing else, the amount of heat generated would eventually lead—independently of any greenhouse effect—to an intolerable level of global warming.

[37] Matheny, p. 3A. See also Lovich & Ennen.

[38] See Hernandez et al.; Walsh, "Power Surge," pp. 34-35.

[39] Matheny, p. 3A. At this point the fust edition of the present work cited an item from 1he Week for the "fact" that the manufacture of solar panels required rare-earth elements, but it now appears that the "fact" is a myth.

[40] See Hernandez et al. Also, solar energy plants kill numerous birds. Walston et al. Of course, fossil-fuel power-plants too kill numerous birds, ibid., in addition to all the other environmental damage that they do. Our purpose here is not to show that "green" energy is no better than fossil-fuel energy. Our point is merely that the production of energy even from "green" sources does substantial damage to the environment. Since the technological system's appetite for energy is insatiable, the exploitation even of "green" energy sources will expand without limit and in the long run will devastate our environment just as surely as the use of fossil fuels will.

expand until there is no habitat left for living organisms other than the domesticated crops that the system grows to satisfy its own needs.

But there is much more to be taken into account. Notwithstanding the fully of Ray Kurzweil's fantasies of a future technological utopia, he is absolutely right about some things. He quite correctly points out that in thinking about the future most people make two errors: (i) They "consider the transformations that will result from a single trend [or from several specified trends that are already evident] in today's world as if nothing else will change."[41] And (ii) they "intuitively assume that the current rate of progress will continue for future periods," neglecting the unending acceleration of technological development.[42] In order to avoid falling into these errors ourselves, we have to remember that the assaults on the terrestrial environment that are known and observable now will not in future be the only ones. Just as the use of petroleum distillates in internal combustion engines was undreamed of before I860 at the earliest,[43] just as the use of uranium as fuel was undreamed of before the discovery of nuclear fission in 1938-39,[44] just as most uses of the rare earths were undreamed of until recent decades, so there will be future uses of resources, future ways of exploiting the environment, future corners for the technological system to invade that at present are still undreamed of. In attempting to estimate the coming damage to our environment, we cant just project into the future the effects of currently known causes of environmental harm; we have to assume that new causes of environmental harm, which no one today can even imagine, will emerge in the future. Moreover, we have to remember that the growth of technology, and with it the exacerbation of the harm that technology does to our environment, will accelerate ever more rapidly over the coming decades. All this being taken into consideration we have to conclude that, in all probability, little or nothing on our planet will much longer remain free of gross disruption by the technological system.

Most people take our atmosphere for granted, as if Providence had decreed once and for all that air should consist of 78% nitrogen, 21% oxygen, and 1 % other gasses. In reality our atmosphere in its present form was created, and is still maintained, through the action of living things.[45] Originally the atmosphere contained far more carbon dioxide than it does today,[46] and we may wonder why the greenhouse effect

[41] Kurzweil, p. 13. In some important ways Kurzweil himself falls into this error.

[42] Ibid., p.12.

[43] According to Zimmermann, p. 323, the frst functioning internal combustion engine (fueled by gas) was built in 1860. Internal combustion engines using gasoline and kerosene came later.

[44] NEB (2003), Vol. 29, "War, Technology of,"p. 575.

[45] NEB (2003), Vol. 14, "Atmosphere," pp. 317, 321-22, 330-31, and "Biosphere," p. 1155. Ward, especially pp. 46-53, 75. World Book Encyclopedia (2015), Vol. 6, "Earth,"p. 26 (the carbon cycle).

[46] NEB (2003), Vol. 14,"Biosphere,"p. 1155, says that the Earth's atmosphere once was "largely composed of carbon dioxide," but this is unlikely, since ibid., "Atmosphere," p. 321, refers to an "approximately hundredfold decline of atmospheric CO2 [= carbon dioxide] abundances from [3.5 billion] years ago to the present:." The present atmosphere contains roughly 400 parts per million, or 0.04%, of CO2^ Kunzig, p. 96 (chart). So the atmosphere of3.5 billion years ago must have contained something

didn't make the Earth too hot for lift ever to begin. The answer, presumably, is that the Sun at that time radiated much less energy than it does now.[47] In any case, it was the biosphere that took the excess carbon dioxide out of the air:

As primitive bacteria and cyanobacteria had, through photosynthesis or related life processes, captured atmospheric carbon, depositing it on the seafloor, carbon was removed from the atmosphere...

Cyanobacteria also were the first organisms to utilize water as a source of electrons and hydrogen in the photosynthetic process. Free oxygen was released as a result of this reaction and began to accumulate in the atmosphere, allowing oxygen-dependent life-forms to evolve.[48]

Biological processes also affect the amount of methane in the atmosphere,[49] and let's remember that methane has a far more powerful effect in promoting global warming than carbon dioxide does.[50] On the other hand, some experts claim that 3.7 billion years ago certain microbes generated large quantities of methane that, instead of warming the planet, cooled it by creating clouds that refected sunlight back into space. Supposedly, the Earth narrowly escaped becoming too cold for the survival of life.[51] However that may be, it's evident that a really radical disruption of the biosphere could cause an atmospheric disaster: a lack of oxygen, a concentration of toxic gasses such as methane or ammonia, a deficiency or an excess of carbon dioxide that would make our planet too cold or too hot to support life.

At present, the most imminent danger seems to be the possible overheating of the Earth through an excess in the atmosphere of carbon dioxide and perhaps methane.[52] Just how hot might the Earth get if humans continue to burn fossil fuels? About 56 million years ago there was a massive increase in the amount of carbon dioxide in our atmosphere, estimated to be roughly equal to the amount that would be added now if humans burned off "all the Earth's reserves of coal, oil, and natural gas."[53] The result was a radical change in the terrestrial environment, including a 9° F (5° C) rise in average temperatures[54] and the flooding of substantial parts of the continents.[55] There

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like l00x0.04%=4% of CO2^ On the other hand, Ward, p. 104, suggests that at that time as much as a third of the Earth's atmosphere may have been CO2^

[47] Estimates of the energy radiated by the Sun 3.5 billion years ago are inconsistent. Compare: NEB (2003), Vol. 14, "Biosphere,"p. 1155; ibid., Vol. 27,"Solar System,"p. 457; ibid., Vol.28, "Stars and Star Clusters,"p. 199; Ward,pp. 43, 74; Ribas, p.2.But it seems safe to say that the Sun today radiates somewhere between 25% and 45% more energy than it did 3.5 billion years ago.

[48] NEB (2003),Vol. 14,"Biosphere,"p. 1155. See also ibid.,"Atmosphere," p. 330; Ward,p. 75.

[49] NEB (2003), Vol. 14, 'Atmosphere,"p. 321. Mann, p. 56.

[50] E.g., Mann,p.62.

[51] Ward, pp. 74-75. For some remarks on Ward's book, see Appendix Four.

[52] Regarding methane see, e.g., USA Today, March 5, 2010, p. 3A ("Methane ... appears to be seeping through the Arctic Ocean floor and into the Earth's atmosphere... "); Mann,pp.56, 62.

[53] Kunzig, p. 94.

[54] Ibid., p. 96 (chart caption).

[55] Ibid., pp.90-91.

weren't any mass extinctions,[56] but this should give us no sense of security about the future of the biosphere, because we can't assume that the effect of adding a given amount of carbon dioxide to the atmosphere today will be the same as what it was 56 million years ago.[57]

The carbon dioxide added to the atmosphere 56 million years ago was probably added relatively slowly, over thousands of years.[58] If humans now burn off all petroleum reserves they undoubtedly will do so in a small fraction of that time, hence living organisms will have little opportunity to adapt to their changed environment. Moreover, the presumed equivalence of the amount of carbon dioxide being released today with what was released 56 million years ago is based on an estimate of the Earth's fossil-fuel reserves that almost certainly is far too low, for new and unexpected deposits of oil and natural gas are continually being discovered and estimates of the reserves are correspondingly raised. Account must also be taken of other ways in which humans add carbon dioxide to the atmosphere. For example, vast quantities of limestone are "burned" to make lime and portland cement[59]: CaCO3 -+ CaO + CO2. It's not clear how much of the carbon dioxide (CO2) is eventually recaptured by the lime (CaO) or how long that takes.

But even if the Earth warms no more than it did 56 million years ago, the consequences will be unacceptable to the powerful classes in our society. The world's dominant self-prop systems will therefore resort to "geo-engineering," that is, to a system of artificial manipulation of the atmosphere designed to keep temperatures within acceptable limits.[60] The implementation of geo-engineering will entail immediate, desperate risks,[61] and even if no immediate disaster ensues the eventual consequences very likely will be catastrophic.[62]

Chlorofluorocarbons ("CFCs") have been phased out by international agreement in order to allow the ozone layer, which protects living organisms from the Sun's ultraviolet radiation, to recover from the damage it has suffered in the past. The program has been a clear success,[63] and some people have suggested that the ozone agreement could provide a "template" for an international treaty to limit carbon-dioxide emissions.[64] But the agreement to phase out CFCs was possible only because CFCs are

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[56] Ibid., p.94.

[57] Ibid., p. 109 ("That episode doesn't tell us what will happen to life on Earth if we... burn the rest [of our planets fossil-fuel reserves].").

[58] Ibid., pp. 105-08.

[59] It is estimated that the manufacture of Portland cement accounts for about five percent ofall human-caused emissions of carbon dioxide. National Geographic,Jan. 2016, "Towering Above," unnumbered page.

[60] See Wood, pp. 70-76; Sarewitz & Pielke, p. 59; Time, March 24, 2008, p. 50.

[61] Wood, pp. 72, 73, 76.

[62] See Appendix Four.

[63] USA TodayJuly 1-4, 2016, p. lA.

[64] See ibid., Sept. 24, 2014, p. lOA.

of relatively minor economic importance and substitutes for them can be found.[65] Fossil fuels on the other hand are of central importance in the economies of all industrialized nations and those that are in the process of industrializing; consequently it is safe to say that whatever is done about the greenhouse effect will be too little and too late.

To the greenhouse effect we have to add numerous other factors that tend to disrupt the biosphere. As we've seen, living organisms will be progressively robbed of sunlight by continual expansion of the system's solar-energy installations. There will be no limit to the contamination of our environment with radioactive waste, with toxic elements such as lead, arsenic, mercury and cadmium,[66] and with a variety of poisonous chemical compounds.[67] There will be oil spills from time to time, since the safety measures taken by the petroleum industry are never quite sufficient,[68] and in some parts of the world the industry doesn't even make any serious effort to prevent spills.[69]

The foregoing effects of the technological system's activities have long been recognized as harmful, but there can be little doubt that many effects not recognized as harmful today will turn out to be harmful tomorrow, for this has often happened in the past.[70] "It has been estimated that the modern sediment loads of the rivers draining into the Atlantic Ocean may be four to five times greater than the prehistoric rates because of the effects of human activity."[71] How, in the long run, will this affect life in the ocean? Does anyone know? Genes from genetically engineered organisms can, and almost certainly will, be passed to wild plants or animals.[72] What will be the ultimate consequences for the biosphere of this "genetic pollution?" No one knows. Even if these and other effects turn out to be harmless when considered separately and individually,

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[65] Ibid.

[66] E.g., Science News, Vol. 163, Feb. 1, 2003, p. 72 (mercury); Batra (cadmium); USA Today, Aug. 7, 2014, p. 2A (mercury); ibid., Jan. 20, 2016, p. 8A (lead, but see also ibid.Jan. 27, 2016, p. 7A); 7he T&ek,Jan. 20, 2012, p. 18 (depleted uranium scattered by non-nuclear artillery shells, which causes birth defects).

[67] See notes 20, 21 to Chapter One and, e.g., Vegetarian Times, May 2004, p. 13 (quoting Los Angeles Times of Jan. 13,2004); U.S. News &World Report, Jan. 24, 2000, pp. 30-31. On cyanide, see notes 53 & 54, above.

[68] Regarding the effects of the 2010 oil spill in the Gulf of Mexico, see Time, Sept. 27, 2010, p. 18; 7he Week, Sept. 24, 2010, p. 7.

[69] 7he Tek, June 18, 2010, p.12. Searcy, pp. A4, A6.

[70] Examples: Artificial lighting is thought to be partly responsible for dramatic declines in firefly populations. National Geographic, June 2009, "ENVIRONMENT: Dimming Lights," unnumbered page. Many thousands of untested chemicals are getting into our environment, 7he Week, March 12, 2010, p. 14 and Dec. 2, 2011, p. 18; Time, April 12, 2010, pp. 59-60, and these sometimes turn out to have unexpected harmfol effects, e.g., "Shrimp on Prozac," The Week, Aug. 6, 2010, p. 19. Exotic species brought into a region in the belief that they are harmless often reproduce uncontrollably and do enormous damage. See note 36 to Appendix Two. The use of plastics has led to serious, totally unforeseen harm to life in the oceans. Duxbury & Duxbury, p. 302. Gardner, Prugh & Renner, pp. 86-87. USA Today, March 23, 2018, p. 3A ("Ocean garbage dump...").

[71] NEB (2003), Vol. 26, "Rivers." p. 860.

[72] E.g., Denver Post, Aug. 23, 2005, p. 2B.

all of the “harmless” effects of the system’s activities taken together will surely bring about major alterations in the biosphere.

Here we’ve done no more than scratch the surface. A full assessment of the ways in which the functioning of the technological world-system currently threatens to disrupt the biosphere would require a vast amount of research, and the results would fill several volumes. Will all of these factors add up to a disruption of the biosphere sufficient to prevent it from performing its function in maintaining the present composition of our atmosphere? It’s anybody’s guess. But that’s not all: Let’s not forget that the technological system is still in its infancy in comparison with what it will become over the next several decades. At a rapidly accelerating pace and in ways that no one has yet imagined, we can expect the world’s leading self-prop systems to find more and more opportunities to exploit, more and more resources to extract, more and more corners to invade, until little or nothing on this planet is left free of technological intervention—intervention that will be carried out in a mad quest for immediate increments of power and without regard to long-term consequences. In the opinion of this writer, there is a strong probability that if the biosphere is not destroyed outright it will at least be rendered incapable of maintaining any reasonable approximation to the present composition of our atmosphere, without which none of the more complex forms of life on this planet will be able to survive.

One plausible outcome might be that the Earth will end up like the planet Venus:

It has been suggested that the climate of the Earth could be ultimately unstable. Addition of gasses capable of trapping heat could accelerate the release ofH_2O and raise the temperature to a point where the oceans would evaporate ... Some believe that such changes may have occurred on Venus... Venus is a striking example of the importance of the greenhouse effect. Its atmosphere contains a large concentration of CO_2 [= carbon dioxide]. ... [T]he Venusian surface temperature is much hotter than the Earth’s—about 780° K [507° C or 944° F]—in spite of the fact that Venus absorbs less energy from the Sun because of its ubiquitous cloud cover... .”[73]

To sum up the thesis of this part of the present chapter: If the development of the technological world-system is allowed to proceed to its logical conclusion, it will in all probability leave the Earth uninhabitable for all of the more complex forms of life as we know them today. This admittedly remains unproven; it represents the author’s personal opinion. But the facts and arguments offered here are enough at least to show that the opinion can be entertained as a plausible hypothesis, and that it would be rash to assume without farther proof that the denouement we are facing will be no worse than earlier extinction events in the Earth’s history.

What can be taken as a near certainty is that—if the development of the technological system is allowed to proceed to its logical conclusion—the outcome for the biosphere will be thoroughly devastating; if it isn’t worse than the extinction event at the end of the Cretaceous when the dinosaurs disappeared, it can’t be much better;

[73] NEB (2003), Vol. 14, “Atmosphere,” p. 331.

if any humans are left alive, they will be very few; and the technological system itself will be dead.

But note the reservation in the foregoing statement: 'if the development of the technological system is allowed to proceed to its logical conclusion." The author has occasionally been asked: "If the system is going to destroy itself anyway, then why bother to overthrow it?" The answer, of course, is that if the technological system were eliminated **now** a great deal could still be saved. The longer the system is allowed to continue its development, the worse will be the outcome for the biosphere and for the human race, and the greater will be the risk that the Earth will be left a dead planet.[74]

[74] For some remarks concerning small islands in relation to the theory developed in the present chapter, see Appendix Two, Part G.

Part V

The techies' wet-dreams. There is a current of thought that appears to be carrying many technophiles out of the realm of science and into that of science fiction.[1] For convenience, let's refer to those who ride this current as "the techies."[2] The current runs through several channels; not all techies think alike. What they have in common is that they take highly speculative ideas about the future of technology as near certainties, and on that basis predict the arrival within the next few decades of a kind of technological utopia. Some of the techies' fantasies are astonishingly grandiose. For example, Ray Kurzweil believes that "[w]ithin a matter of centuries, human intelligence will have re-engineered and saturated all the matter in the universe."[3] The writing of Kevin Kelly, another techie, is often so vague as to border on the meaningless, but he seems to say much the same thing that Kurzweil does about human conquest of the universe: "The universe is mostly empty because it is waiting to be filled with the products of life and the technium ... . "[4] "The technium" is Kelly's name for the technological world-system that humans have created here on Earth.[5]

Most versions of the technological utopia include immortality (at least for techies) among their other marvels. The immortality to which the techies believe themselves destined is conceived in any one of three forms:

(i) the indefinite preservation of the living human body as it exists today;[6]

(ii) the merging of humans with machines and the indefinite survival of the resulting man-machine hybrids;[7]

(iii) the "uploading" of minds from human brains into robots or computers, after which the uploaded minds are to live forever within the machines.[8]

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[1] It is significant that Ray Kurzweil, the best-known of the techie prophets, started out as a science-fiction enthusiast. Kurzweil, p. 1. Kim Eric Drexler, the prophet of nanotechnology, started out "specializing in theories of space travel and space colonization." Keiper, p. 20.

[2] The techies of course include the transhumanists, but some techies— as we use the term—do not appear to be transhumanists.

[3] Grossman, p. 49, col. 2. Kurzweil, pp. 351-368.

[4] Kelly, p. 357.

[5] Ibid., pp. 11-12.

[6] Grossman, p. 47. Kurzweil, p. 320.

[7] Grossman, p. 44, col. 3. Kurzweil, pp. 194-95, 309, 377. Vance, p. 1, col. 3; p.6,col. 1.

[8] Grossman, p. 44, col. 3; p. 48, col. 1; p. 49, col. l. Kurzweil, pp. 198-203, 325-26, 377. The techies—or more specifically the transhumanists—seem to assume that their own consciousness will survive the uploading process. On that subject Kurzweil is somewhat equivocal, but in the end seems to assume

Of course, if the technological world-system is going to collapse in the not-too-distant future, as we've argued it must, then no one is going to achieve immortality in any form. But even assuming that we're wrong and that the technological world-system will survive indefinitely, the techies' dream of an unlimited life-span is still illusory. We need not doubt that it will be technically feasible in the future to keep a human body, or a man-machine hybrid, alive indefinitely. It is seriously to be doubted that it will ever be feasible to "upload" a human brain into electronic form with sufficient accuracy so that the uploaded entity can reasonably be regarded as a functioning duplicate of the original brain. Nevertheless, we will assume in what follows that each of the solutions (i), (ii), and (iii) will become technically feasible at some time within the next several decades.

It is an index of the techies' self-deception that they habitually assume that anything they consider desirable will actually be done when it becomes technically feasible. Of course, there are lots of wonderful things that already are and for a long time have been technically feasible, but don't get done. Intelligent people have said again and again: "How easily men could make things much better than they are—if they only all tried together!"[9] But people never do "all try together," because the principle of natural selection guarantees that self-prop systems will act mainly for their own survival and propagation in competition with other self-prop systems, and will not sacrifice competitive advantages for the achievement of philanthropic goals.[10]

Because immortality, as the techies conceive it, will be technically feasible, the techies take it for granted that some system to which they belong can and will keep them alive indefinitely, or provide them with what they need to keep themselves alive. Today it would no doubt be technically feasible to provide everyone in the world with everything that he or she needs in the way of food, clothing, shelter, protection from violence, and what by present standards is considered adequate medical care—if only all of the world's more important self-propagating systems would devote themselves unreservedly to that task. But that never happens, because the self-prop systems are occupied primarily with the endless struggle for power and therefore act philanthropically only when it is to their advantage to do so. That's why billions of people in

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that his consciousness will survive if his brain is replaced with nonbiological components not all at once, but bit by bit over a period of time. Kurzweil, pp. 383-86.

[9] Winston Churchill, Sept. 15, 1909, quoted by Jenkins, p. 212. Other examples: "... liberty, toleration, equality of opportunity, socialism... there is no reason why any of them should not be fully realised, in a society or in the world, if it were the united purpose of a society or of the world to realise it." Bury, p. 1 (originally published in 1920; see ibid., p. xvi). On July 22, 1944, John Maynard Keynes noted that forty-four nations had been learning to "work together." He added: "If we can so continue... [t]he brotherhood of man will have become more than a phrase." (Fat chance!) Skidelsky, p. 355.

[10] This of course does not mean that no self-prop system ever does anything beneficent that is contrary to its own interest, but the occasional exceptions are relatively insignificant. Bear in mind that many apparently beneficent actions are actually to the advantage of the self-prop system that carries them out.

the world today suffer from malnutrition, or are exposed to violence, or lack what is considered adequate medical care.

In view of all this, it is patently absurd to suppose that the technological world-system is ever going to provide seven billion human beings with everything they need to stay alive indefinitely. If the projected immortality were possible at all, it could only be for some tiny subset of the seven billion—an elite minority. Some techies acknowledge this.[11] One has to suspect that a great many more recognize it but refrain from acknowledging it openly, for it is obviously imprudent to tell the public that immortality will be for an elite minority only and that ordinary people will be left out.

The techies of course assume that they themselves will be included in the elite minority that supposedly will be kept alive indefinitely. What they find convenient to overlook is that self-prop systems, in the long run, will take care of human beings—even members of the elite—only to the extent that it is to the systems' advantage to take care of them. When they are no longer useful to the dominant self-prop systems, humans— elite or not—will be eliminated. In order to survive, humans not only will have to be useful; they will have to be more useful in relation to the cost of maintaining them—in other words, they will have to provide a better cost-versus-beneft balance—than any non-human substitutes. This is a tall order, for humans are far more costly to maintain than machines are.[12]

It will be answered that many self-prop systems—governments, corporations, labor unions, etc.—do take care of numerous individuals who are utterly useless to them: old people, people with severe mental or physical disabilities, even criminals serving life sentences. But this is only because the systems in question still need the services of the majority of people in order to function. Humans have been endowed by evolution with feelings of compassion, because hunting-and-gathering bands thrive best when their members show consideration for one another and help one another.[13] As long as self-prop systems still need people, it would be to the systems' disadvantage to offend the compassionate feelings of the useful majority through ruthless treatment of the useless minority. More important than compassion, however', is the self-interest of human individuals: People would bitterly resent any system to which they belonged if they believed that when they grew old, or if they became disabled, they would be thrown on the trash-heap.

But when **all** people have become useless, self-prop systems will find no advantage in taking care of anyone. The techies themselves insist that machines will soon surpass

[11] Grossman, p. 48, col. 3 ("Who decides who gets to be immortal?"). Vance, p. 6, col. 1.

[12] Humans need to be fed, clothed, housed, educated, entertained, disciplined, and provided with medical care. Whereas machines can work continuously with only occasional down-time for repairs, humans need to spend a great deal of time sleeping and resting.

[13] Also, modern societies find it advantageous to encourage people's compassionate feelings through propaganda. See Kaczynski, "The System's Neatest Trick," Part 4.

humans in intelligence.[14] When that happens, people will be superfuous and natural selection will favor systems that eliminate them—if not abruptly, then in a series of stages so that the risk of rebellion will be minimized.

Even though the technological world-system still needs large number's of people for the present:, there are now more superfluous humans than there have been in the past because technology has replaced people in many jobs and is making inroads even into occupations formerly thought to require human intelligence.[15] Consequently, under the pressure of economic competition, the worlds dominant self-prop systems are already allowing a certain degree of callousness to creep into their treatment of superfluous individuals. In the United States and Europe, pensions and other benefits for retired, disabled, unemployed, and other unproductive persons are being substantially

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[14] Grossman, pp. 44-46. Kurzweil, pp. 135ff and passim. Machines that surpass humans in intelligence might not be digital computers as we know them today. They might have to depend on quantum-theoretic phenomena, or they might have to make use of complex molecules as biological systems do. Grossman, p. 48, col. 2; Kurzweil, pp. 111-122; USA Today, March 8, 2017, p. 5B (IBM & other companies are working to develop computers that make use of quantum-theoretic phenomena). This writer has little doubt that, with commitment of sufficient resources over a sufficient period of time, it would be technically feasible to develop artificial devices having-general intelligence that surpasses that of humans ("strong artificial intelligence," or "strong AI," Kurzweil, p. 260). See Kaczynski, Letter to David Skrbina: April 5, 2005, first two paragraphs. Whether it would be technically feasible to develop strong AI as soon as Kurzweil, p. 262, predicts is another matter. Moreover, it is seriously to be doubted whether the world's leading self-prop systems will ever have any need for strong AI. If they don't, then there's no reason to assume that they will commit to it sufficient resources for its development. See Somers, pp. 93-94. Contra: The Atlantic, July/Aug. 2013, pp. 40-41; The Week, Nov. 4, 2011, p. 18. However, the assumption that strong AI will soon appear plays an important role in Kurzweil's vision of the future, so we could accept that assumption and proceed to debunk Kurzweil's vision by reductio ad absurdum. But the argument of **P**art **V** of this chapter does not require the assumption that strong AI will ever exist.

[15] e.g.: The Week, Sept. 30, 2011, p. 14 ("Capitalism is killing the middle class"); feb. 17, 2012, p. 42 ("No reason to favor manufacturing"); April 6, 2012, p. 11; May 4, 2012, p. 39 ("The half-life of software engineers"); Jan. 29, 2016, p. 32. USA Today, July 9, 2010, pp. 1b-2**B** (machines as stock-market traders); April 24, 2012, p. 3A (computer scoring of essays); Sept. 14, 2012, p. 4F; May 20, 2014, pp. 1A-2A; July 28, 2014, p. 6A; Oct. 29, 2014, pp. lA, 9A; Feb. 11, 2015, p. 3B; Dec. 22, 2015, p. IB; feb. 21, 2017, p. 3B. The Economist, Sept. 10, 2011, p. 11 and "Special report: The future of jobs"; Nov. 19, 2011, p. 84. The Atlantic, June 2013, pp. 18-20. Wall Street Journal, June 13, 2013, p. B6. Davidson, pp. 60-70. Carr, pp. 78-80. Foroohar, "What Happened to Upward Mobility?,"pp. 29-30, 34. Markoff, "Skilled Work Without the Worker," pp. Al, A19. Lohr, p. b 3. Rotman (entire article). Robots can even perform functions formerly thought to require a "human touch," e.g., they can serve as companions with which people connect emotionally just as they connect with other people. Popular Science, June 2013, p. 28. 7heAtlanticJanJFeb. 2016, p. 31; March 2017, p. 29.

reduced;[16] at least in the U.S., poverty is increasing;[17] and these facts may well indicate the general trend of the future, though there will doubtless be ups and downs.

It's important to understand that in order to make people superfluous, machines will not have to surpass them in general intelligence but only in certain specialized kinds of intelligence. For example, the machines will not have to create or understand art, music, or literature, they will not need the ability to carry on an intelligent, non-technical conversation (the "Turing test"[18]), they will not have to exercise tact or understand human nature, because these skills will have no application if humans are to be eliminated anyway. To make humans superfluous, the machines will only need to outperform them in making the technical decisions that have to be made for the purpose of promoting the short-term survival and propagation of the dominant self-prop systems. So, even without going as far as the techies themselves do in assuming intelligence on the part of future machines, we still have to conclude that humans will become obsolete. Immortality in the form (i)—the indefinite preservation of the human body as it exists today—is highly improbable.

The techies—or more specifically the transhumanists—will argue that even if the human body and brain as we know them become obsolete, immortality in the form (ii) can still be achieved: Man-machine hybrids will permanently retain their usefulness,

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[16] e.g.: USA Today, July 20, 2011, p. 3A ("**P**ainful plan in R.I."); Sept. 29, 2011, pp. lA, 4A; Oct. 24, 2011, p. lA; Sept. 14, 2012, p. SA (Spain); Sept. 24, 2012, p. 6B (several e uropean countries); Sept. 28, 2012, p. 5B (Spain); Aug. 5, 2013, p. 3A; Oct. 16-18, 2015, p. lA; April 26, 2017,pp. 1A-2A. The Economist, June 11,2011, p. 58 (Sweden). The Week, April 6, 2012, p. 14 (Greece, Spain); July 29, 2011, p. 12 ("The end of the age of entitlements"). Drehle, p. 32. Sharkey, pp. 36-38. A friend of the author wrote on Oct. 3, 2012: "[My parents] don't have any set up for long term care ... and at this point many states... are doing what is called estate recovery and the like, which means that if Dad were to go in a nursing home... either his **V**eteran's stipend, social security, and pension would all go into paying for the care, meaning Mom would not have enough to live on... or, in a different scenario, Medicaid would put a lien on their house and when he dies, mom would be out of luck so Medicaid could be repaid for his 'care'—which at that low level is very poor care, by selling the house." In regard to probable future treatment of people who seek immortality: "The frozen head of baseball legend Ted Williams has not been treated well... [A]t one point Williams's head, which the slugger ordered frozen in hopes of one day being brought back to life, was propped up by an empty tuna-fish can and became stuck to it. To detach the can... staff whacked it repeatedly with a monkey wrench, sending 'tiny pieces of frozen head' flying around the room." The Week,, Oct. 16, 2009, p. 14.

[17] E.g.: USA Today, Sept. 29, 2011,pp. 1A-2A; Sept. 12, 2016, p. 3A. The Week, Sept. 30, 2011, p. 21 ("Poverty: Decades of progress, slipping away"); July 27, 2012, p. 16 ("Why the poor are getting poorer"). Kiviat, pp. 35-37. Also: "Half of all U.S. workers earned less than $26,364 in 2010—the lowest median wage since 1999, adjusted for inflation." The Week,, Nov. 4, 2011, p. 18. "The average American family's net worth dropped almost 40 percent... between 2007 and 2010." Ibid., June 22, 2012, p. 34. USA Today, Sept. 14, 2016, p. lA, reports: "Household incomes see first big gain since 2007." This no doubt reflects the current (up to Jan. 2018) high point in the economic cycle. As the economic cycle approaches the next low point, incomes likely will decline again.

[18] NEB (2003), Vol. 12, "Turing test," p. 56. NEB is more accurate on the Turing test than is Kurzweil, p. 294: In order to pass the test, machines may not have to "emulate the flexibility, subtlety, and suppleness ofhuman intelligence." See, e.g., The Week, Nov. 4, 2011, p. 18.

because by lining themselves with ever-more-powerful machines human beings (or what is left of them) will be able to remain competitive with pure machines.[19]

But man-machine hybrids will retain a biological component derived from human beings only as long as the human-derived biological component remains useful. When purely artificial components become available that provide a better cost-versus-benefit balance than human-derived biological components do, the latter will be discarded and the man-machine hybrids will lose their human aspect to become wholly artificial.[20] Even if the human-derived biological components are retained they will be purged, step by step, of the human qualities that detract from their usefulness. The self-prop systems to which the man-machine hybrids belong will have no need for such human weaknesses as love, compassion, ethical feelings, esthetic appreciation, or desire for freedom. Human emotions in general will get in the way of the self-prop systems' utilization of the man-machine hybrids, so if the latter are to remain competitive they will have to be altered to remove their human emotions and replace these with other motivating forces. In short, even in the unlikely event that some biological remnants of the human race are preserved in the form of man-machine hybrids, these will be transformed into something totally alien to human beings as we know them today.

The same applies to the hypothesized survival of human minds in "uploaded" form inside machines. The uploaded minds will not be tolerated indefinitely unless they remain useful (that is, more useful than any substitutes not derived from human beings), and in order to remain useful they will have to be transformed until they no longer have anything in common with the human minds that exist today.

Some techies may consider this acceptable. But their dream of immortality is illusory nonetheless. Competition for survival among entities derived from human beings (whether man-machine hybrids, purely artificial entities evolved from such hybrids, or human minds uploaded into machines), as well as competition between human-derived entities and those machines or other entities that are not derived from human beings, will lead to the elimination of all but some minute percentage of all the entities involved. This has nothing to do with any specific traits of human beings or of their machines; it is a general principle of evolution through natural selection. Look at biological evolution: Of all the species that have ever existed on Earth, only some tiny percentage have direct descendants that are still alive today.[21] On the basis of this

[19] Grossman, p. 44, col. 3. Vance, p. 6, col. 4. Kurzweil, pp. 24-25, 309, 377. Man-machine hybrids are also called "cyborgs."

[20] Kurzweil, p. 202, seems to agree.

[21] "Species come and go continually—around 99.9 per cent [of] all those that have ever existed are now extinct." Benton, p. ii. We assume this means that 99.9 percent have become extinct without leaving any direct descendants that are alive today. Independently of that assumption, it's clear from the general pattern of evolution that only some minute percentage of all species that have ever existed can have descendants that are alive today. See, e.g., NEB (2003), Vol. 14, "Biosphere," pp. 1154-59; Vol. 19, "Fishes," p. 198, and "Geochronology," especially pp. 750-52, 785, 792, 794-95, 797,802, 813-14, 819,820, 825-27, 831-32, 836, 838-39, 848-49, 858-59, 866-67, 872. Extinctions have by no means been limited to a few major "extinction events"; they have occurred continually throughout the evolutionary

principle alone, and even discounting everything else we've said in this chapter, the chances that any given techie will survive indefinitely are minute.

The techies may answer that even if almost all biological species are eliminated eventually, many species survive for thousands or millions of years, so maybe techies too can survive for thousands or millions of years. But when large, rapid changes occur in the environment of biological species, both the rate of appearance of new species and the rate of extinction of existing species are greatly increased.[22] Technological progress constantly accelerates, and techies like Ray Kurzweil insist that it will soon become virtually explosive;[23] consequently, changes come more and more rapidly, everything happens faster and faster, competition among self-prop systems becomes more and more intense, and as the process gathers speed the losers in the struggle for survival will be eliminated ever more quickly. So, on the basis of the techies' own beliefs about the exponential acceleration of technological development, it's safe to say that the life-expectancies of human-derived entities, such as man-machine hybrids and human minds uploaded into machines, will actually be quite short. The seven-hundred-year or thousand-year life-span to which some techies aspire[24] is nothing but a pipe-dream.

Singularity University, which we discussed in Part VI of Chapter One of this book, purportedly was created to help technophiles " guide research" and "shape the advances" so that technology would "improve society." We pointed out that Singularity University served in practice to promote the interests of technology-orientated businessmen, and we expressed doubt that the majority of technophiles fully believed in the drivel about "shaping the advances" to "improve society." It does seem, however, that the techies—the subset of the technophiles that we specified at the beginning of this Part V of the present chapter—are entirely sincere in their belief that organizations like Singularity University[25] will help them to "shape the advances" of technology and keep the technological society on the road to a utopian future. A utopian future will have to exclude the competitive processes that would deprive the techies of their thousand-year life-span. But we showed in Chapter One that the development of our society can never be subject to rational control: The techies won't be able to "shape the advances" of technology, guide the course of technological progress, or exclude the intense competition that will eliminate nearly all techies in short order.

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process, though at a rate that has varied widely over time. See Benton, p. ii; NEB (2003), Vol. 18, "Evolution, Theory of," pp. 878-79; NEB (2007), Vol. 17, "Dinosaurs,"p. 318.

[22] We don't have explicit authority for this statement, though it receives some support from Sodhi, Brook & Bradshaw, p. 518. We make the statement mainly because it's just common sense and seems generally consistent with the facts of evolution. We're betting that most evolutionary biologists would agree with it, though they might add various reservations and qualifications.

[23] Grossman, pp. 44-46, 49. Vance, p. 6, cols. 3-5. Kurzweil, e.g., pp. 9, 25 ("an hour would result in a century of progress").

[24] Vance, p. 7, col. 1 (700 years). "Mr. Immortality," The Week, Nov. 16, 2007, pp. 52-53 (1,000 years).

[25] Other such organizations are the Foresight Institute, Keiper, p. 29; Kurzweil, pp. 229, 395, 411, 418-19, and the Singularity Institute, Grossman, p. 48, col. 3; Kurzweil, p. 599n45.

In view of everything we've said up to this point, and in view moreover of the fact that the techies' vision of the future is based on pure speculation and is unsupported by evidence,[26] one has to ask how they can believe in that vision. Some techies, e.g., Kurzweil, do concede a slight degree of uncertainty as to whether their expectations for the future will be realized,[27] but this seems to be no more than a sop that they throw to the skeptics, something they have to concede in order to avoid making themselves too obviously ridiculous in the eyes of rational people. Despite their pro forma admission of uncertainty, it's clear that most techies confidently expect to live for many centuries, if not forever, in a world that will be in some vaguely defined sense a utopia.[28] Thus Kurzweil states flatly: "We will be able to live as long as we want ... ."[29] He adds no qualifiers—no "probably," no "if things turn out as expected.' His whole book reveals a man intoxicated with a vision of the future in which, as an immortal machine, he will participate in the conquest of the universe. In fact, Kurzweil and other techies are living in a fantasy world.

The techies' belief-system can best be explained as a religious phenomenon,[30] to which we may give the name "Technianity." It's true that Technianity at this point is

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[26] There is of course evidence to support many of the techies' beliefs about particular technological developments, e.g., their belief that the power of computers will increase at an ever-accelerating rate, or that it will some day be technically feasible to keep a human body alive indefinitely. But there is no evidence to support the techies' beliefs about the future of society, e.g., their belief that our society will actually keep some people alive for hundreds of years, or will be motivated to expand over the entire universe.

[27] Grossman, p. 48, col. 3; p. 49, col. 1 ("the future beyond the Singularity is not knowable"). Vance, p. 7, col. 4. See Kurzweil, pp. 420,424.

[28] "[S]ome people see the future of computing as a kind of heaven." Christian, p. 68. The utopian cast of techie beliefs is refected in the name of Keiper's journal, The New Atlantis, evidently borrowed from the title of an incomplete sketch of a technological "ideal state" that Francis Bacon wrote in 1623. Bury, pp. 59-60^^1. Probably most techies would deny that they are anticipating a utopia, but that doesn't make their vision less utopian. For example, Kelly, p. 358, writes: "The technium... is not utopia." But on the very next page he launches into a utopian rhapsody: "The technium... expands life's fundamental goodness. ... The technium... expands the mind's fundamental goodness. Technology... will populate the world with all conceivable ways of comprehending the infinite." Etc. Kelly's book as a whole can best be described as a declaration of faith.

[29] Kurzweil, p. 9.

[30] Several observers have noticed the religious quality of the techies' beliefs. Grossman, p. 48, col. 1. Vance, p. 1, col. 4. Markoff, "Ay Robot!," p. 4, col. 2 (columns occupied by advertisements are not counted). Keiper, p. 24. Kurzweil, p. 370, acknowledges the comment of one such observer, then shrugs it off by remarking, "I did not come to my perspective as a result of searching for an alternative to customary faith." But this is irrelevant. St. Paul, according to the biblical account, was not searching for a new faith when he experienced the most famous of all conversions; in fact, he had been energetically persecuting Christians right up to the moment when Jesus allegedly spoke to him. Acts 9: 1-31. Saul = Paul, Acts 13: 9. Certainly many, perhaps the majority, of those who undergo a religious conversion do so not because they have consciously searched for one, but because it has simply come to them.

Like Kurzweil, many techies stand to profit fnancially from Technianity, but it is entirely possible to hold a religious belief quite sincerely even while one profts from it. See, e.g., 7he Economist, Oct. 29, 2011, pp. 71-72.

not strictly speaking a religion, because it has not yet developed anything resembling a uniform body of doctrine; the techies' beliefs are widely varied.[31] In this respect Technianity probably resembles the inceptive stages of many other religions.[32] Nevertheless, Technianity already has the earmarks of an apocalyptic and millenarian cult: In most versions it anticipates a cataclysmic event, the Singularity,[33] which is the point at which technological progress is supposed to become so rapid as to resemble an explosion. This is analogous to the Judgment Day[34] of Christian mythology or the Revolution of Marxist mythology. The cataclysmic event is supposed to be followed by the arrival of technoutopia (analogous to the Kingdom of God or the Worker's Paradise). Technianity has a favored minority—the Elect—consisting of the techies (equivalent to the True Believers of Christianity or the Proletariat of the Marxists[35]).The Elect of Technianity, like that of Christianity, is destined to Eternal Life; though this element is missing from Marxism.[36]

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[31] E.g;., Grossman, p. 46, col.2.

[32] Christianity in its inceptive stages lacked a uniform body of doctrine, and Christian beliefs were widely varied. Freeman, passim, e.g.., pp. xiii-xiv, 109-110,119,141,146.

[33] Grossman, pp. 44-46. Kurzweil, p. 9. Another version of the Singularity is the "assembler breakthrough" posited by nanotechnology buffs. Keiper, pp. 23-24.

[34] It's not entirely clear whether the Day ofJudgment and the Second Coming ofJesus are supposed to occur at the same time or are to be separated by a thousand years. Compare Relevation 20: 1-7, 12-13 with NEB (2003), Vol. 17, "Doctrines and Dogmas, Religious,"p.406 (referring to "the Second Coming... of Christ... to judge the living and the dead") and ibid., Vol. 7, "Last Judgment," p. 175. But for our purposes this is of little importance.

[35] A correspondent (perhaps under the mistaken impression that the proletariat included all of the "lower" classes) has raised the objection that the proletariat was not a minority. Marxist literature is not consistent as to who belongs to the proletariat. For instance, Lenin in 1899 held that the poor peasants constituted a "rural proletariat." See "The Development of Capitalism in Russia,"e.g., Conclusions to Chapter II, section 5; in Christman,p. 19. But in 1917 Lenin clearly implied that the peasantry, including the poor peasants, did not belong to the proletariat, which he now identified as "the armed vanguard of all the exploited, of all the toilers." See "The State and Revolution," Chapt. II, section 1; Chapt. III, sections 1 & 3; respectively pp. 287-88, 299, 307 in Christman. It is the proletariat in this sense—the vanguard of all the toilers—that we have in mind when we speak of the Elect of Marxist mythology, and it's clear from Marxist theory generally that the proletariat in this sense was to consist mainly if not exclusively of industrial workers. E.g., Lenin wrote in 1902: "the strength of the modern [socialist] movement lies in the awakening of the masses (principally the industrial proletariat)..." (emphasis added). "What is to be Done?," Chapt. II, first paragraph; in Christman, pp. 72-73. Stalin, History of the Communist Party, likewise made clear that the proletariat consisted of industrial workers and that these at the time of the 1917 revolution comprised only a minority of the population; e.g;., first chapter, Section 2, pp. 18, 22; third chapter, Sect on 3, pp. 104–05 and Section 6, p. 126; fifth chapter, Section 1, p. 201 and Section 2, p. 211. Almost certainly, industrial workers have never constituted a majority of the population of any large country.

[36] On the subject of apocalyptic and millenarian cults, see NEB (2003), Vol. 1, "apocalyptic literature" and "apocalypticism,"p. 482; Vol. 17,"Doctrines and Dogmas, Religious,"pp. 402, 406, 408. Also the Bible, Revelation 20.

Historically, millenarian cults have tended to emerge at "times of great social change or crisis."[37] 1his suggests that the techies' beliefs reflect not a genuine confidence in technology, but rather their own anxieties about the future of the technological society—anxieties from which they try to escape by creating a quasi-religious myth.

[37] NEB (2003), Vol. 8, "millennium," p. 133. See also Vol. 17, "Doctrines and Dogmas, Religious," p. 401 ("Eschatological themes thrive particularly in crisis situations..."). See Freeman, p. 15. For millenarian cults in China, see Ebrey, pp. 71,73,190,240; Mote, pp. 502,518,520,529,533.

Appendix

Part A

Proposition 2 of Chapter Two states that in the short term, natural selection favors self-propagating systems that pursue their own short-term advantage with little or no regard for long-term consequences.

- Steven LeBlanc[1] argues that among primitive societies natural selection favors ecological recklessness. Suppose one group lives prudently within its resources while a neighboring group allows its population to grow to the point where its resources are over-strained, so that its environment is damaged and it can no longer feed itself adequately. In order to find an outlet for its surplus population, the second group may try to take the first group's territory by force, and it is likely to succeed, because it has more people and can put more warriors into the field than the first group can. "This smacks of a Darwinian competition—survival of the fittest—between societies. Note that the 'fittest' of our two groups was not the more ecological, it was the one that grew faster."[2] LeBlanc admits that his argument is oversimplified,[3] and certainly it is not applicable in all circumstances, but it does seem to contain a good deal of truth.

- During the 1920s the Soviets needed to acquire technological equipment from industrialized countries in order to catch up with the West economically, so they resorted to trade with Western capitalists.[4] One might have thought that capitalists would refuse to trade with communists, since the latter were bent on destroying capitalism, but in order to make a profit the capitalists were willing, as Lenin allegedly put it, to "sell the rope to their own hangmen."[5] In 1971, Alinsky claimed to "feel confident" that he could "persuade a millionaire on a

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[1] LeBlanc, pp. 73-75.

[2] Ibid., p. 75.

[3] Ibid., p. 73.

[4] NEB (2003), Vol. 21, "International Relations," p. 829.

[5] Ibid. But it's not clear whether Lenin ever actually made that statement. See Horowitz, p. 152. On the subject of capitalists' trade with the Soviets, NEB, loc. cit., does not seem entirely consistent with Ulam, pp. 196, 265, who says that the Soviets received only "a mere trickle" of help from the West. But Ulam, p. 337, acknowledges that the capitalists were willing at least to some extent to do business with the Soviets, so, lacking a definitive resolution of the apparent inconsistency, we will let this passage stand as in the first edition of the present work.

Friday to subsidize a revolution for Saturday out of which he would make a huge profit on Sunday even though he was certain to be executed on Monday."[6] Alinsky was exaggerating for humorous effect, but his remark does reflect a truth about capitalism. It's easy to attribute the capitalists' shortsightedness to "greed," but there is a reason why capitalists are greedy: Those who forgo profit in the present from concern for long-term consequences tend to be eliminated by natural selection.

- The U.S. financial crisis that began in 2007 resulted from the widespread offering of risky ("subprime") loans to borrowers who needed the money to buy homes but might never be able to pay it back[7] Lenders such as savings-and-loan associations sold the right to collect their subprime loans to other financial organizations, which sold the right in turn to still other organizations, and so forth, in a process much too complex to be described here. The subprime loan market was so lucrative and important that even the government-sponsored enterprise known as Fannie Mae feared "the danger that the market would pass [it] by"[8] if it refused to deal in subprime loans. Fannie Mae was so big and powerfull that its survival would not have been threatened if it had not participated in the subprime loan market, but we can imagine that many smaller, private financial enterprises would have been unable to survive in the face of competition if they had failed to make use of the opportunities offered by subprime loans. However, for enterprises that did make use of those opportunities there was a terrible price to be paid when the housing bubble burst. Even the two gigantic government-sponsored enterprises, Fannie Mae and Freddie Mac, collapsed and had to be rescued by the government.[9] Needless to say, many private financial enterprises too went bankrupt.[10] What appears to have happened is that the pressure of competition forced these enterprises to take risks that later had fatal consequences. No doubt greed too was involved, but, as we pointed out a moment ago, capitalists who are not greedy tend to be eliminated by natural selection.

In the modern world, international trade is highly important for the economic success of the nations involved;[11] it is even believed that no modern nation could survive economically if it did not participate in international trade.[12] But in the longer term such trade entails serious risks:

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[6] Alinsky, p. 150.
[7] The story is told by Peterson and, less completely, by Utt.
[8] Peterson, p. 150n6. See also pp. 160-63.
[9] Ibid., pp. 151, 167.
[10] Ibid.,pp. 150-51. Utt, p. 12.
[11] NEB (2003), Vol. 21, "International Trade," pp. 900-03.
[12] Ibid., p. 905 ("There is general agreement that no modern nation... could really practice self-sufficiency...").

> [A] country that has become heavily involved in international trade has given hostages to fortune: a part of its industry has become dependent upon export markets for income and for employment. Any cutoff of these foreign markets ... would be acutely serious; and yet it would be a situation largely beyond the power of the domestic government involved to alter. Similarly, another part of domestic industry may rely on an inflow of imported raw materials, such as oil for fuel and power. Any restriction of these imports could have the most serious consequences;[13]

and reliance on the importation of manufactured goods too can be risky.[14]

It's possible that Germany's dependence on international trade was a decisive factor in that country's defeat in World War I, for the British blockade was so effective in cutting off German trade that by the end of the war it had brought Germany to the verge of starvation.[15] On the other hand, Britain's dependence on international trade would have led to a German victory in either World War I or World War II if the British hadn't succeeded, with American help, in defeating Germany's submarine campaign, for the U-boats would otherwise have starved Britain into submission.[16] What we see, therefore, is that for the sake of economic survival in the short term nations must take the risk of allowing themselves to become dependent on international trade, even though their dependence may have grave or even fatal consequences in the long run.

- It is currently believed that the United States is "the most profligate or wasteful" of all developed countries in its use and abuse of its natural resources.[17] This has probably been true throughout U.S. history. In colonial times, American forming methods were recognized as highly improvident in comparison with European ones,[18] and Zimmermann points out the reckless and wasteful way in which, during the 1860s and 1870s, the fabled Comstock Lode in Nevada was exhausted within twenty years, whereas, says Zimmermann, a similar body of ore in Europe would have provided thousands of miners with a livelihood for centuries.[19] This was probably typical of .American mining practices at the time. Yet America's profligacy in the use of its natural resources didn't prevent it from becoming the world's dominant economic power. And the country that is now beginning to

[13] Ibid. See also "Relying on China is a big mistake," *1be Week,* Oct. 22, 2010, p.18.

[14] See "How supply chains hinge on Asia," *1be Week,* Nov. 11, 2011, p. 42.

[15] NEB (2003), Vol. 20, "Germany," p. 115; Vol. 21, "International Relations," p. 814; Vol. 29, "War, Theory and Conduct of," p. 652, and "World Wars,"pp. 963,969,976,986.

[16] Ibid., Vol. 29, "World Wars," pp. 963, 969-970, 976, 977, 979-980, 997-98, 1008. Patterson, p. 121. Dunnigan & Nofi, p. 245.

[17] *GMO Quarterly Letter, April 201 l,p.* 18. Since GMO is a large investment firm, it is hardly likely to have leftist or radical-environmentalist leanings.

[18] Boorstin, pp. 105,120, 163,193,260,261, 263-65. W.S. Randall, pp. 189,229.

[19] Zimmermann, pp. 266-67.This doesn't necessarily mean that European mining methods were more environmentally sound than American ones.

challenge America's dominance is China, which is notorious for its environmental irresponsibility.[20] As these examples illustrate, reckless exploitation of natural resources can favor the achievement of power in the short term, however deadly its long-term consequences may be.

Part B

In connection with Propositions 4 and 5 of Part II of Chapter Two, we mentioned that pre-industrial empires spanning vast distances "actively created, if they did not already have, relatively rapid means of transportation and communication."

The Egyptians had the Nile. Tre Romans relied heavily on water transport over the Mediterranean and the rivers that flowed into it,[21] and for overland travel they built their famous roads. The Persians built a canal connecting the Mediterranean to the Red Sea, and a "Royal Road" that stretched 1,600 miles and made possible the quick delivery of letters by postal relays.[22] Imperial China, throughout its history, built and maintained canals, roads, and bridges and operated postal relays.[23] The Mongol empire of Chinggis (Genghis) Khan "utilized homing pigeons as messengers" and had "an extensive system of messenger posts" through which relays of riders carried messages at top speed.[24]

The Incas built roads and bridges over which relays of runners could carry messages rapidly, while freight was transported on the backs of human porters or llamas.[25] The Maya never created an empire of any substantial extent, and their lack of developed facilities for long-distance transportation or communication probably had something to do with this.[26] The Aztecs' system of long-distance communication was poorly developed: Messages were carried by relays of runners,[27] but there was no adequate system of roads for them, and some routes were probably impassable during the rainy season.[28] So it's not surprising that the Aztec "empire" (if it can be called that) was only weakly cohesive: Conquered peoples could be forced to pay taxes, or to contribute troops for Aztec campaigns and labor-gangs for Aztec work-projects, but in other

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[20] Presumably China is not considered a "developed country." Cf. note 17. China's environmental irresponsibility is so well known that it doesn't seem necessary to cite any authority, but as examples we mention "The cracks in China's engine," *1be Week,* Oct. 8, 2010, p. 15; Bradsher, p. AS; *USA Today,* Feb. 25, 2014, p. 2A; March 5, 2015, p. *SA;* Dec. 2, 2015, p. *SA;* Dec. 8, 2015, p. 3A.

[21] Pirenne, e.g., pp. 166-173, 194-95, 236. Elias, pp. 224,229.

[22] World Book Encyclopedia (2015), Vol. 15,"Persia,Ancient," p.297.

[23] Ebrey,pp.64,70,85,116,141-42, 143 (photo caption),207,209,214. Mote,pp. 17-18,359,620-21,646-653,714,749,903,917,946. NEB (2003),Vol. 16,"China," p. 106.

[24] NEB (2003), Vol. 29, "War, Technology of," p. 622. Mote, p. 436.

[25] Malpass, pp. 68-69. East, p. 160.

[26] See Diamond, pp. 164-66.

[27] Hassig,p. 51.

[28] Ibid., pp. 53, 67.

respects there was very little centralized control.[29] Even at that, the "empire" appears to have reached the maximum geographical extent that was possible with the existing means of transportation and communication,[30] and it was probably unstable, for revolts were frequent.[31]

Part C

It seems clear in general that internal dissension within large human groups tends to be inversely proportional to the magnitude of external threats or challenges to the group, so that a dramatic reduction of external threats or challenges tends to be followed by a marked increase in internal dissension. "A social scientist, Michael Desch, ... noticed that external threats led to internal cohesion, and when the threat was removed, the cohesion broke down, sometimes violently."[32] This was hardly an original observation on Desch's part. But here, as so often elsewhere, "clean" historical examples are scarce, due to the complexity of historical developments in the real world. See note 7 to Chapter Two. However, we offer four relatively clean examples:

- "The general view of thinking Romans was that the relaxation of external pressures" due to "the temporary end of the age of major wars (ca 130 BC)" was what led to the "internal disintegration" of the Roman Republic.[33] Though the Britannica seems uncertain, it's hard to believe that the relaxation of external pressures was not at least a contributing factor in the rise of internal conflict at Rome.

- "The landing of Spanish troops near Tampico [about 1829] rallied the [Mexican] nation to a unified effort, and the intrepid General Santa Anna ... defeated the invaders ...For a moment, the victory bolstered Mexican national pride. But now the danger from abroad that had served to unite the country. .. vanished and internal dissensions took on a new and ugly face."[34]

- With the disappearance of the external danger from Britain at the end of the American War of Independence in 1783, "disunity began to threaten to turn into disintegration . ... The states were setting up their own tariff barriers against each other and quarreling among themselves ... ." This no doubt is why John Adams

[29] Davies, pp. 46, 110-14,128,199-201,218,219. Hassig, pp. 11-22,26, 64,157,171-72,253-54,256-57.

[30] Davies, pp. 183-84,191,199-201,207. Hassig, p. 254.

[31] Davies,pp. 107, 110, 112, 128,201,204-05,207,221.Hassig,pp. 22, 25-26, 195, 198, 229, 231, 263. It should be remembered, however, that Aztec history prior to the arrival of the Spaniards is based on sources of very doubtful reliability. See Davies, p. xiv.

[32] Beehner, p. 9A.

[33] NEB (2003), Vol. 20, "Greek and Roman Civilizations," p. 300.

[34] Bazant, p.43.

(the future President) wrote not long after the end of the war that the United States needed an external enemy to protect it from the "danger of dividing."[35]

- During the latter part of World War II, when it had become clear that Germany was irrevocably on the road to defeat, "the Anglo- American accord, which had held very strongly during the testing two and a half years of defeat followed by only peripheral attack, instead of being warmed by the sun of victory began badly to cool. ... The dispute about Operation Anvil] escalated between 21 June and 1 July [1944] from disagreements at the Chiefs of Staff level to exchanges between Prime Minister and President that were far more acrimonious than anything which had previously passed between them... [T]he Anvil disagreement was the beginning of a new pattern. Before it the American and British Chiefs of Staff had rarely disagreed on a major issue. After it they were rarely on the same side of any issue ... ."[36]

For further examples see note 164 to Chapter Three, and Beehner's article.[37]

Part D

In Part II of Chapter Two we discuss self-prop systems that arise to challenge the dominant global self-prop systems. All the examples we give there consist of (formal or informal) organizations of human beings, but self-prop systems that challenge the global self-prop systems also appear at the biological level. Thus there are invasive species—plants or animals that multiply uncontrollably in new environments[38]—and new infectious diseases (e.g., AIDS and Lyme disease) that arise more rapidly than means for curing or preventing them can be found.[39] In addition, older varieties of

[35] NEB (2003), Vol. 29, "United States of America," pp. 216-17. See also McCullough, pp. 397-98. Adams wrote his comment about the need for an external enemy in the margin of a book he was reading;. Haraszti, p. 149. From ibid., pp. 140-42, it can be inferred that Adams probably wrote the comment in 1784 and certainly wrote it before Franklin's death in 1790.

[36] Jenkins, pp.748-750.

[37] Beehner, loc. cit.

[38] E.g., Sodhi, Brook & Bradshaw, p. 516; Weise, "Invasive Species," p. 4A.. Examples: Pythons in Florida. 1he Week, Feb. 17, 2012, p. 23. Feral pigs in southwestern U.S. 1he Atlantic, Nov. 2009, p. 22. Kudzu vine in eastern U.S., quagga mussels in Lake Michigan. Invasive species are "a nasty side effect of modern transportation technology," by means of which exotic species are intentionally or unintentionally brought into new environments. "Nature's marauders," 1he Week, Dec. 10, 2010, p. 15. Attempts to control invasive species by introducing nonnative predators tend to backfre because the predators themselves are likely to get out of control. Hamilton, p. 58.

[39] "Since the mid-1970s, mere than 30 new diseases have emerged ... . Most of these are believed to have moved from wildlife to human populations... Damaged ecosystems—characterized by toxins, degradation of habitat, removal of species and climate change—create conditions for pathogens to move in ways they wouldn't normally move." "Tracking Disease," Newsweek, Nov. 14, 2005, p. 46. Once a disease has crossed over to humans from some other species, modern transportation technology, population

disease-causing bacteria that once seemed well under control have evolved new forms that are resistant to antibiotics, so that the corresponding diseases are difficult or impossible to cure.[40]

But in the long run these self-prop systems will probably be less dangerous to the global self-prop systems than will those biological selfprop systems that have been intentionally or unintentionally created or altered through direct human action, e.g., through genetic engineering. One would have to be extraordinarily naive to imagine that organisms created, altered, or manipulated by humans will always remain safely under control, and in fact there already have been cases in which such organisms have **not** remained under control, including cases in which organisms have escaped from research facilities.[41] For example, the so-called "killer bees" are a hybrid of European and African bees that escaped from a research facility in Brazil. Since then they have spread over much of South America and into the United States, and they have killed hundreds of people.[42] Something much, mucp worse could happen at any time, for the safety record of our biological laboratories is appallingly bad.[43]

It's true that, to date, no biological self-prop system affected by conscious human intervention has come close to threatening the survival of any of the dominant global self-prop systems, but present-day biotechnology is still in its infancy in comparison with what we can expect for the coming decades. As human interventions in biology reach farther and further, the risk of disastrous consequences continually rises, and as long as the technological equipment needed for such interventions exists, there are no practicable means of controlling this risk. Small groups of amateurs are already dabbling in genetic engineering.[44] These amateurs wouldn't have to create synthetic life or do anything highly sophisticated in order to bring on a disaster; merely changing a few genes in an existing organism could have catastrophic consequences. The chances of disaster in any one instance may be remote, but there are potentially thousands or millions of amateurs who could begin monkeying with the genes of microorganisms, and thousands or millions of minute risks can add up to a very substantial risk. And

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density, and urbanization make it possible for the disease to spread widely. ^ammen, p. 102. "AIDS in the 19th Century?," The Week, Oct. 17, 2008, p. 24. New diseases often are mutated forms of earlier ones. E.g., ibid.; "Mutant rabies is spreading," ibid., May 22, 2009, p. 19. See also USA Today, Dec. 18-20, 2015, p. 4A;Jan. 28, 2016, p. lA; Jan. 29, 2016, p. 3A.

[40] E.g.: Allan, p. 34. The Economist, April 2, 2011, pp. 73-75. USA Today, Oct. 28, 2013, p. lOA; Dec. 17, 2013, pp. 1A-2A; March 5, 2014, p. 6B; Aug. 5, 2015, p. 3A; May 27, 2016, p. 3A.

[41] E.g., "Experimental Cotton Seed in Accidental Mix," Denver Post, Dec. 4, 2008, p. 13A. See also ibid., Aug. 23, 2005, p. 2B ("Genetically modified wheat pollen can drift to other plants more easily than scientists believed, passing genes to...weeds...").

[42] Blau, especially pp. 16-18. NEB (2003), Vol. 2, "bee," p. 42. USA Today, Oct. 9, 2014, p. SA; Oct. 10, 2014, p. 4A.

[43] E.g.: Denver Post, Aug. 8, 2007, p. 14A. USA Today, March 2, 2015, pp. 1A-2A; May 29-31,2015, pp. 1A,4A,SA;June 4, 2015, p. lAJune 29,2015, pp. 1A-2A; July 7, 2015, p. 3A; July 22, 2015, p. 3A;June 3-5, 2016, pp. 1A-2A; Jan. 5, 2017, pp. 1A-2A. Diamond, p. 54.

[44] Weise, "DIY Biopunks," p. 7A.

the risk has now been vastly increased by the discovery of a powerful new technique that makes gene-editing cheap, quick, and easy.[45]

Some people think it may become possible in the future to create microscopic ("nanotechnological"), non-biological self-prop systems that could reproduce themselves uncontrollably, with deadly consequences for the whole world.[46] Others claim that (macroscopic) self-reproducing robots will probably be built, and even the rabid technophile Ray Kurzweil admits that such machines will evolve beyond the control of human beings.[47] This writer does not have the technical expertise to judge whether such speculations are plausible or whether they should be dismissed as science fiction. Yet:, today's science fiction often turns out to be tomorrow's fact..

Because of their ability to reproduce themselves by the billions in a short time, microscopic self-prop systems, biological or not., may prove to be especially dangerous to the global self-prop systems. On the other hand, human self-prop systems may turn out to be more dangerous after all, not only because they are intelligent, but also because they exist as subsystems of the global self-prop systems and therefore can potentially impair the integrity of the latter. But this line of inquiry is leading us too far into speculation, so we'll drop it here.

Part E

In Part II of Chapter Two we've argued that when only relatively few individuals are available from among which to select the "fittest" (in the Darwinian sense), the process of natural selection will be inefficient in producing self-propagating systems that are ft for survival. We illustrate with an example.

The inefficiency of government agencies or enterprises, in comparison with private enterprises, is notorious, and the reason is clear: Natural selection is not operative among the agencies or enterprises of a given government.. If a government-owned or government-controlled agency or enterprise is inefficient.—even grossly inefficient.—the government tries to reform it in someway, or simply gives it enough money to keep it from collapsing. Rarely indeed will a government allow such an agency or enterprise to die a natural death. In contrast., private enterprises that become inefficient are (barring government interference) eliminated by natural selection.[48]

It seems safe to say that among private enterprises—just as among biological organisms—natural selection leads to the evolution of sophisticated mechanisms that promote the vigor of such enterprises—including mechanisms that are too complex or

[45] Feibus, p. 5B.

[46] Joy, pp. 246-48. Keiper, pp. 27-28. See also "A molecular motor," The UVeek, Sept. 23, 2011, p. 23 (reporting nano-sized "motor").

[47] Robots of the future "should be able to self-replicate." "What are the odds?," The Weekifiuly 2-9, 2010, p. 45 (summarizing an article from Scientific American,June 2010).

[48] Compare Bowditch, Buono & Stewart, pp. 264-65; Steele, pp. 87-88.

subtle to be understood, controlled, or even recognized by human beings. Students of business administration do of course understand many of the mechanisms at work in successful enterprises. Clearly, however, they are far from a complete understanding of all such mechanisms, for if the principles underlying the efficient functioning of private enterprises were fully understood, then government agencies or enterprises could be made equally efficient by applying to them the same principles. Government agencies and enterprises do try to apply the known principles of business administration, but they nevertheless remain far less efficient than private enterprises—because a great deal of what makes an enterprise efficient remains unknown to, or beyond the control of, human beings.[49]

However, even if natural selection is inoperative among the agencies or enterprises belonging to a given government, natural selection does operate on governments and on the nations they govern. For example, when the countries of the communist bloc failed to compete successfully with the West, their governments and their economic systems were radically transformed in imitation of Western governments and economic systems. The Soviet Union broke apart, and from its fragments new nations under new governments were born. So why doesn't natural selection make national governments, including governmental agencies and enterprises, equal to private enterprises in vigor and efficiency?

In any capitalist system there are many thousands of business enterprises. New enterprises are continually being formed, while some older enterprises go bankrupt, or are absorbed by more powerful enterprises, or are split into two or more separate enterprises. Thus, ample scope for evolution through natural selection is provided by the number of business enterprises and the fluidity with which such enterprises are formed or eliminated. But there are only about two hundred sovereign nations in the world. The creation of new nations and the demise of old ones are infrequent events. Likewise infrequent is the replacement of a nation's government by a new government of a different type. Thus, among nations and their governments, there is only relatively limited scope for evolution through natural selection, and this, we think, explains why governments, with their agencies and enterprises, have not evolved to the same level of efficiency as private enterprises have.

Part F

One of the most serious mistakes that people make in thinking about the development of societies is to assume that human beings make collective decisions of their own free will and can impose those decisions on their society, as if human volition were something existing **outside** of the organizational structures of society and capable of acting independently of those structures. In reality, human volition is to a very sig-

[49] From Bowditch, Buono & Stewart, passim, e.g., pp. 31-32, it is clear how far the experts are from a full understanding of what makes an enterprise efficient.

nificant extent a **product** of the organizational structures of society,[50] for one of the most important factors that determine the success of an organization is its capacity for **people-management;** that is, its ability to induce people to think and act in ways that serve the needs of the organization.

Some techniques of people-management may be described as "external," meaning that they are used to influence the thought and behavior of people who are not members of the organization that applies the techniques. External techniques include, among others, those of propaganda[51] and public relations. Propaganda and public relations techniques can also be applied internally, to manage the behavior of the members of the organization that applies the techniques; and other techniques are designed specifically for internal use. Business schools give courses in a subject called "Organizational Behavior," which is, in part, the study of techniques through which an organization can manage the behavior of its own members.[52] Also important are techniques for selecting individuals who are suited to become members of a given organization.[53]

But we maintain that the people-managing capability of organizations is not limited to techniques, that is, to methods understood and consciously applied by human beings. We argue that through natural selection organizations evolve mechanisms not recognized or understood by human beings that tend to induce people to act in ways that serve the needs of the organization. This ties in with what we argued in Part E of this Appendix, about the operation of natural selection among business enterprises.

Of course, all these conscious and unconscious mechanisms put together are very far from achieving complete control over human behavior. The mechanisms are effective only in a statistical sense: They tend on average to make people think and act in ways that serve the organizations that possess the mechanisms, but different individuals are influenced in different degrees, and there are always exceptional individuals whose thought and behavior are radically at odds with those that would serve the needs of the organizations in question.

Nevertheless, organizations' capabilities for people-management, whether they are consciously applied techniques or subtly evolved mechanisms unrecognized by humans, are highly important, and people who make naive statements like, "We [meaning society at large] can choose to stop damaging our environment"—as if the human race had some sort of collective free will—are out of touch with practical reality..[54]

A moment ago we said that, through natural selection, organizations evolve mechanisms not recognized or understood by human beings that tend to induce people to act in ways that serve the needs of the organization.

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[50] See Appendix Two in Kaczynski, Fitch & Madison edition.

[51] For information on modern propaganda techniques, see Lindstrom, and also Wu, in our List of Works Cited.

[52] See, e.g., Bowditch, Buono & Stewart, passim.

[53] Peck, pp. 74-84.

[54] For example, Jared Diamond's book is titled Co/lapse: How Societies Choose to Fail or Succeed, as if societies could consciously make choices of that kind.

Let's illustrate with an example.

Until recent times, when technological and economic strength became paramount in warfare, the fighting quality of a society's soldiers was an important factor in the process of natural selection among societies. All else being equal, those societies that produced the best warriors tended to expand their power at the expense of other societies. It's unlikely that military experts would attribute differences in fighting quality solely to causes that are known and controlled by human beings, such as training techniques or methods of military organization. Rather, there are cultural differences among societies—differences that can be identified, if at all, only on a highly speculative basis—that affect the fighting quality of soldiers. Presumably societies have evolved, through natural selection, cultural mechanisms that have tended to produce better soldiers.

Warriors of primitive societies, or of societies at a relatively early stage of civilization, have seldom been able to stand up in pitched battles against trained and experienced European troops, unless the latter were grossly outnumbered, taken by surprise, confused by unfamiliar terrain, or otherwise placed at a grave disadvantage.[55] This cannot be attributed solely to the superiority of European weapons,[56] which indeed have not always been superior under the relevant conditions of combat. Nor can it be attributed to physical courage; if anything, primitives are probably braver on an individual basis than Europeans are.[57] The superiority of European troops can best be attributed to (unidentified) cultural mechanisms evolved through natural selection in the course of millennia, during which European history has been characterized by constant warfare. Of course, there has always been warfare among primitives, too, but such warfare has typically been carried on primarily through guerrilla-like raids rather than pitched bat-

[55] E.g., Davies, pp. 249-250, 271 (military superiority of Spaniards over Aztecs). Ibid., p. 252 ("It was only... by bombarding [the Spaniards] from the rooftops in Tenochtitlan, or from above the deep ravines in Peru, that the Indians were able to achieve a measure of success."). On this subject Hassig does not seem entirely consistent. On pp. 266-67 he says that "the Aztecs were [militarily] a match for the Spaniards," but also that the Aztec system was "a viable one... in the absence of a major competing power around which disaffected members could unite. But this vacancy was filled by the Spaniards." Given the colossal size of Aztec armies—e.g., 400,000 men (p. 227); 100,000 men (p. 229, p. 233)—a few hundred Spaniards could not have constituted "a major competing power" unless they were militarily more than a match for far larger numbers of Aztecs.

[56] E.g., the North American Indians "could not stand up against a bayonet charge," Wissler, p. 93, even though bayonets would have been no more effective than the spears of primitives. Davies, pp. 250-51, discusses the reasons for the Spaniards'military superiority over the Aztecs, including their purportedly superior weapons, and then concludes on p. 252: "The psychological superiority of the Spaniards in the battle-feld was probably more decisive than any other factor... Face to face, the Indians were simply not a match for the Spaniards..." Hassig, pp. 237,238, agrees that the Spaniards' advantage in weaponry was not the decisive factor in their victory over the Aztecs.

[57] E.g., Davies, p. 250 (Spanish chroniclers insisted on the bravery of the Aztecs); p. 277 (referring to "many feats of individual bravery" by Aztecs against Spaniards). Hassig, p. 237, says that in "skill and valor" the "individual Aztec warriors were... the equal of any Spanish soldier... ." Turnbull, Change and Adaptation, pp. 89-90, 92, describes traditional Africans' contempt for the cowardice of Europeans.

tles. So it's not surprising that primitives tend to make excellent guerrilla fighters but are rarely able to put together a regular army capable of facing Europeans on equal terms. Societies at an early stage of civilization, like those of the Aztecs and Incas, ordinarily have had extensive experience of pitched battles, but perhaps have not been subjected to selection through that type of warfare for the same length of time or at the same level of intensity as European societies have; and this may be the reason why their armies have been unable to stand up against European ones.

The fighting qualities of soldiers could be argued ad infinitum, but our interest here is not in fighting qualities per se (nor do we mean to make any value judgment about such qualities). Our purpose at the moment is only to illustrate the point that human organizations evolve, through natural selection, mechanisms that favor their survival and expansion, including mechanisms that are not understood or recognized by human beings.

Part G

In commenting on an earlier, less complete exposition of the theory developed in Chapter Two of this book, Dr. Skrbina observed that a small, isolated island might be considered analogous, for the purposes of the theory, to the Earth as a whole, and he raised by implication the question of whether a counterexample to the theory might be found on a small island without human inhabitants.[58] A proper discussion of this question would require a good knowledge of the biology of small, isolated islands, which this writer does not have. Let's merely take note of the fact that the smaller the island, the less biodiversity it has.[59] This perhaps makes it doubtful whether the ecosystem of such an island could be "highly complex" (as students of industrial accidents use that term); or whether it could be "rich" enough so that (under Proposition 1 of Chapter Two) new self-propagating systems would continually arise to challenge the dominant ones.

So much for islands without human inhabitants. It may be worthwhile, however, to glance briefy at small, isolated islands occupied by humans at a primitive technological level, of which Jared Diamond provides us with two relevant examples: Easter Island and Tikopia. Easter Island certainly offers no counterexample to our theory, since its inhabitants did indeed devastate it as far as was possible with the limited technology at their disposal.[60] Tikopia, on the other hand, merits a closer look.

Tikopia is so tiny (1.8 square miles[61]) that a good runner could doubtless go from one end of the island to the other in somewhere between ten minutes and an hour',

[58] Letter from David Skrbina to the author, Aug. 10, 2011.

[59] Edward 0. Wilson has "offered a formula that mathematically predicts a geometric reduction in the biodiversity of a given habitat as the size of the habitat shrinks." French, p. 72.

[60] Diamond, pp. 79-119.

[61] Ibid., p. 286.

depending on the shape of the island, the nature of the terrain, and the straightness or crookedness of the footpaths. Thus, sufficiently rapid transportation and communication were possible between any two parts of Tikopia, and self-prop systems spanning the entire island—analogous to the global self-prop systems considered in Chapter Two—could have developed.

It's impossible to know whether such self-prop systems did in fact develop on Tikopia in the remote past. What we do know is that in the course of their first 800 years on the island the original settlers did devastate Tikopia ecologically[62] but:—probably because they had no advanced technology—they apparently didn't devastate it so thoroughly as to cause a major die-off of the human population. Instead, they were able to support themselves by adopting new methods of food production.[63] It's not clear that their economy could be called stable, since they changed it repeatedly over the next 2,000 years until significant European intervention occurred around 1900 AD. But they didn't suffer economic collapse.[64]

The Tikopians moreover seem to have achieved something analogous to the "world peace" considered in Part II of Chapter Two—though it was not entirely stable, as we'll point out in a moment. To the extent that it **was** stable, its stability can be attributed to the fact that Tikopian society was neither highly complex nor tightly coupled, and was not "rich" enough (in the sense of Proposition 1 of Chapter Two) so that new self-prop systems would frequently arise to challenge the island's dominant selfprop systems. The total population of the island was only about 1,300,[65] and within a culturally uniform population of that size we wouldn't necessarily expect any new, strong, aggressive self-propagating human groups to arise within any reasonable period of time.

Even so, the Tikopian "world peace" was not so stable as to prevent all destructive competition: On at least two occasions there were wars in which entire clans were exterminated.[66] Because the Tikopians fought only with primitive weapons (bows and arrows, etc.), their wars damaged only the Tikopians themselves and not their environment. We can imagine what would have happened if they had had advanced technology to fight their wars with; most of us have seen photographs of World War I battlefields ravaged by high-explosive shells, whole forests torn to shreds and so forth.[67] Of course, it's highly unlikely that an island the size of Tikopia could have the mineral resources to sustain an advanced technology. But if it did, then even nonviolent economic competition—even just mining activities alone—would have been enough to ruin the island.

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[62] Ibid., p. 292.

[63] Ibid.

[64] Ibid.

[65] Ibid., p. 289.

[66] Ibid., p. 291.

[67] "Huge tracts of woodlands were reduced to muddy felds of splintered tree trunks, devoid of wildlife." Polish American journal, March 2015, p. 16.

Thus the example of Tikopia does not undercut the theory developed in Chapter Two. Because the islanders lacked advanced technology, and because their society was neither highly complex nor tightly coupled and was not "rich" enough to ensure the frequent emergence (under Proposition 1 of Chapter Two) of vigorous new self-prop systems, Tikopia did not satisfy the conditions for the theory to be applicable.

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