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The Imminent Collapse Of Industrial Society

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The collapse of modern industrial society has 14 parts, each with a somewhat causal relationship to the next. (1) Fossil fuels, (2) metals, and (3) electricity are a tightly-knit group, and no industrial civilization can have one without the others. The decline in fossil-fuel production is the most critical aspect of the collapse, and most of the following text will be devoted to that topic. As those three disappear, (4) food and (5) fresh water become scarce; grain and wild fish supplies per capita have been declining for years, water tables are falling everywhere, rivers are not reaching the sea. Matters of infrastructure then follow: (6) transportation and (7) communication ? no paved roads, no telephones, no computers. After that, the social structure begins to fail: (8) government, (9) education, and (10) the large-scale division of labor that makes complex technology possible.

After these 10 parts, however, there are four others that form a separate layer, in some respects more psychological or sociological. We might call these "the four Cs." The first three are (11) crime, (12) cults, and (13) craziness ? the breakdown of traditional law; the ascendance of dogmas based on superstition, ignorance, cruelty, and intolerance; the overall tendency toward anti-intellectualism; and the inability to distinguish mental health from mental illness. There is also a final and more general part that is (14) chaos, resulting in the pervasive sense that "nothing works any more."

These are cascading dominoes; all parts of the collapse have more to do with causality than with chronology, although there is no great distinction to be made between the two. If we look at matters from a more purely chronological viewpoint, however, we can say that there is a clear division into two time periods, two phases. The first phase will be merely economic hardship, and the second will be entropy. In the first phase the major issues will be inflation, unemployment, and the stock market. The second phase will be characterized by the disappearance of money, law, and government. In more pragmatic terms, we can say that the second phase will begin when money is no longer accepted as a means of exchange.

The Triad

Modern industrial society is composed of a triad of fossil fuels, metals, and electricity. The three are intricately connected. Electricity, for example, can be generated on a global scale only with fossil fuels. The same dependence on fossil fuels is true of metals; in fact the better types of ore are now becoming depleted, while those that remain can be processed only with modern machinery and require more fossil fuels for smelting. In turn, without metals and electricity there will be no means of extracting and processing fossil fuels. Of the three members of the triad, electricity is the most fragile, and its failure will serve as an early warning of trouble with the other two. [Duncan (a), (b)]

Often the interactions of this triad are hiding in plain sight. Global production of steel, for example, requires 420 million tonnes of coke (from coal) annually, as well as other fossil fuels adding up to an equivalent of another 100 million tonnes. [Smil] To maintain industrial society, the production of steel cannot be curtailed: there are no "green" materials for the construction of skyscrapers, large bridges, automobiles, machinery, or tools.

But the interconnections among fossil fuels, metals, and electricity are innumerable. As each of the three members of the triad threatens to break down, we are looking at a society that is far more primitive than the one to which we have been accustomed.

Fossil Fuels

The entire world's economy is ultimately based on oil and other hydrocarbons. These provide fuel, fertilizer, pesticides, lubricants, plastic, paint, synthetic fabrics, asphalt, pharmaceuticals, and many other things. On a more abstract level, we are dependent on hydrocarbons for manufacturing, for transportation, for agriculture, for mining, and for electricity.

Oil is the lifeblood of our civilization. Even a bicycle, that ultimate symbol of an "alternate lifestyle," requires oil for lubrication, for paint, and for plastic components. The vehicle that delivers the bicycle runs on oil, over asphalt that is a form of oil. "Rubber" tires are often made of oil.

Oil is everything: that is to say, everything in the modern world is dependent on oil. As the oil disappears, our entire industrial society will go with it. There will be no means of supporting the billions of people who now live on this planet. Above all, there will be insufficient food, and the result will be terrible famine.

A good deal of debate has gone on about "peak oil," the date at which the world's annual oil production will reach (or did reach) its maximum and will begin (or did begin) to decline. The exact numbers are unobtainable, mainly because individual countries give rather inexact figures on their remaining supplies. The situation can perhaps be summarized by saying that at least 20 or 30 major studies have been done, and the consensus is that the peak is somewhere between the years 2000 and 2020. Within that period, a middle date seems rather more likely. [Campbell (a), (b); Gever; Simmons; Youngquist (a), (b)]

One reasonable description of past and future global oil production is Campbell and Laherrére's 1998 *Scientific American* article, “The End of Cheap Oil,” which serves as a sort of *locus classicus* . Their main chart seems to indicate an annual rate of increase of about 4 percent from the year 1930 to 2000, and an annual rate of post-peak decline of slightly over 3 percent, which would mean that around 2030 oil production will be down to about half of the peak amount. [Campbell and Laherrère] The chart is based partly on the bell-shaped curves that M. King Hubbert used in the 1950s when making accurate predictions of American and global oil decline. [Hubbert]

More-recent predictions of the annual rate of post-peak decline tend to range from about 4 to 9 percent. [Foucher, Höök, Poston] Starting at a peak of 30 billion barrels in 2010, a decline of 9 percent would mean dropping to half of that amount in 7 years ? hardly enough time to blink. The most likely figure might be 6 percent, and even that is ominous, resulting in a fall to half of peak production in 11 years. These predictions of larger decline rates take into consideration the fact that advanced technology is used to maximize productivity, which in turn has the ironic result that when the decline actually occurs it is swift. It is not the gentle slope depicted in Campbell and Laherrére's article, but something that looks more like a cliff.

From a broader perspective it can be said that, as oil declines, more energy and money must be devoted to getting the less-accessible and lower-quality oil out of the ground. [Gever] In turn, as more energy and money are devoted to oil production, the production of metals and electricity becomes more difficult. One problem feeds on another. The issue can also be described in terms of money alone: when oil production costs about 5 percent of the economy, the latter begins a downward spiral. [Lardelli]

It should also be mentioned that the above-mentioned quest for the date of peak oil is in some respects a red herring. In terms of daily life, it is important to consider not only peak oil in the absolute sense, but peak oil per capita. The date of the latter was 1979, when there were 5.5 barrels of oil per person annually, as opposed to 4.5 in 2007. [BP]

In 1850, before commercial production began, there were about 2 trillion barrels of oil in the ground. By about the year 2010, half of that oil had been consumed, so about 1 trillion barrels remain ? which may sound like a lot, but isn't. At the moment about 30 billion barrels of oil are consumed annually, and that is probably close to the maximum that will ever be possible. When newspapers announce the discovery of a deposit of a billion barrels, readers are no doubt amazed, but they are not told that such a find is only two weeks' supply.

As the years go by, new oil wells have to be drilled deeper than the old, because newly discovered deposits are deeper. Those new deposits are therefore less accessible. But oil is used as a fuel for the machinery and for the exploration. When it takes an entire barrel of oil to get one barrel of oil out of the ground, as is increasingly the case with new wells, it is a waste of time to continue drilling.

The problem of the world's diminishing supply of oil is a problem of energy, not a problem of money. The old bromide that “higher prices will eventually make [e.g.] shale oil economically feasible” is meaningless. This planet has only a finite amount of fossil fuel. That fuel is starting to vanish, and “higher prices” will be quite unable to stop the event from taking place.

Much of modern warfare is about oil, in spite of all the pious and hypocritical rhetoric about “the forces of good” and “the forces of evil.” [Klare] The real “forces” are those trying to control the oil wells and the fragile pipelines that carry that oil. A map of recent American military ventures is a map of petroleum deposits. When the oil wars began is largely a matter of definition, though perhaps 1973 would be a usable date, when the Yom Kippur War — or, to speak more truthfully, the vulnerability resulting from the decline in American domestic oil — led to the OPEC oil embargo.

Coal and natural gas are also disappearing. Coal will be available for a while after oil is gone, although previous reports of its abundance in the US were highly exaggerated. [Rebecca Smith] Coal, however, is highly polluting and cannot be used as a fuel for most forms of transportation; the last industrial society will be a bizarre, crowded, dirty, impoverished world. Natural gas is not easily transported, and it is not suitable for most equipment.

The problem of the loss of fossil fuels will, of course, be received in the same manner as other large-scale disasters: widespread denial, followed by a rather catatonic apathy. The centuries will pass, and a day will come when, like the early Anglo-Saxons, people will look around at the scattered stones and regard them as “the work of giants.”

Global Energy and Electricity

Global production of energy for the year 2005 was about 500 exajoules (EJ), most of which was supplied by fo ssil fuels. This annual production of energy can also be expressed in terms of billion barrels of oil equivalent (bboe) [BP; Duncan (a), (b); EIA (c)] In 1990 this was 59.3 bboe and in 2005 it was 79.3, an increase of 34 percent.

However, the use of electricity worldwide rose from 11,865.4 terawatt-hours in 1990 to 18,301.8 in 2005 [BP], an increase of 54 percent. Since the use of electricity is rising much more quickly than the production of energy, it is uncertain whether in the future there will be sufficient energy to meet the demand for electricity. If not, there could be widespread brownouts and rolling blackouts. [Duncan (a), (b)] When electricity starts to go, so will everything else.

Alternative Energy

Alternative sources of energy will never be very useful, for several reasons, but mainly because of a problem of “net energy”: the amount of energy output is not sufficiently greater than the amount of energy input. [Gever] With the problematic exception of uranium, alternative sources ultimately don't have enough “bang” to replace 30 billion annual barrels of oil ? or even to replace more than the tiniest fraction of that amount.

At the same time, alternative forms of energy are so dependent on the very petroleum that they are intended to replace that the use of them is largely self-defeating and irrational. Petroleum is required to extract, process, and transport almost any other form of energy; a coal mine is not operated by coal-powered equipment. It takes “oil energy” to make “alternative energy.”

The use of unconventional oil (shale deposits, tar sands, heavy oil) poses several problems besides that of net energy. Large quantities of conventional oil are needed to process the oil from these unconventional sources, so net energy recovery is low. The pollution problems are considerable, and it is not certain how much environmental damage the human race is willing to endure. With unconventional oil we are, quite literally, scraping the bottom of the barrel.

More-exotic forms of alternative energy are plagued with even greater problems. Fuel cells cannot be made practical, because such devices require hydrogen derived from fossil fuels (coal or natural gas), if we exclude designs that will never escape the realm of science fiction; if fuel cells ever became popular, the fossil fuels they require would then be consumed even faster than they are now. Biomass energy (from corn, for example) requires impossibly large amounts of land and still results in insufficient quantities of net energy, perhaps even negative quantities. Hydroelectric dams are reaching their practical limits. Wind and geothermal power are only effective in certain areas and for certain purposes.

Nuclear power presents significant environmental dangers, but the biggest constraints involve the addition of new reactor capacity and the supply of uranium. Peak production of uranium ore in the United States was in 1980. Mainly because the US was the world's largest producer, the peak of global production was at approximately the same date. [Energy Watch Group, Storm van Leeuwen] Statements that uranium ore is abundant are based on the falsehood that all forms of uranium ore are usable. In reality, only high-quality ore serves any purpose, whereas low-quality ore presents the unsolvable problem of negative net energy: the mining and milling of such ore requires more energy than is derived from the actual use of the ore in a reactor. The world's usable uranium ore will probably be finished by about 2030, and there is no evidence for the existence of large new deposits of rich ore. Claims of abundant uranium are generally made by industry spokespersons whose positions are far from neutral, who have in fact a vested interest in presenting nuclear energy as a viable option. [Storm van Leeuwen] One must also beware, of course, of the myth that “higher prices” will make low-grade resources of any sort feasible: when net energy is negative, even an infinitely higher price will not change the balance. For all practical purposes, the nuclear industry will come to an end in a matter of decades, not centuries.

The current favorite for alternative energy is solar power, but proponents must close their eyes to all questions of scale. The world's deserts have an area of 36 million km 2 , and the solar energy they receive annually is 300,000 EJ, which at a typical 11-percent electrical-conversion rate would result in 33,000 EJ. [Knies] As noted above, annual global energy consumption in 2005 was approximately 500 EJ. To meet the world's present energy needs by using solar power, then, we would need an array (or an equivalent number of smaller ones) with a size of 500/33,000 x 36 million km 2 , which is about 550,000 km 2 ? a machine the size of France. The production and maintenance of this array would require vast quantities of hydrocarbons, metals, and other materials ? a self-defeating process. Solar power will therefore do little to solve the world's energy problems.

The Problem of Infrastructure

Most schemes for a post-oil technology are based on the misconception that there will be a technological infrastructure for such future gadgetry, similar to that of the present day. Modern equipment is dependent on specific methods of manufacture, transportation, maintenance, and repair. In less abstract terms, this means machinery, motorized vehicles, and service depots or shops, all of which are generally run by fossil fuels. In addition, one unconsciously assumes the presence of electricity, which energizes the various communications devices, such as telephones and computers; electricity on such a large scale is only possible with fossil fuels.

To believe that a non-petroleum infrastructure is possible, one would have to imagine, for example, solar-powered machines creating equipment for the production and storage of electricity by means of solar energy. This equipment would then be loaded on to solar-powered trucks, driven to various locations, and installed with other solar-powered devices, and so on, ad absurdum and ad infinitum. Such a scenario might provide material for a work of science fiction, but not for genuine science.

The technological infrastructure will no longer be in place: oil, electricity, and asphalt roads, for example.

Partly for that reason, the social structure will also no longer be in place. Without the technological infrastructure and the social structure, it will be impossible to produce the familiar goods of industrial society.

Without fossil fuels, the most that is possible is a pre-industrial infrastructure, although one must still ignore the fact that the pre-industrial world did not fall from the sky as a prefabricated structure but took uncountable generations of human ingenuity to develop. The pre-industrial world also did not include feeding 7 billion people. For both reasons, we cannot suddenly step back into Jane Austen's day, when the population was a mere billion. The next problem is that a pre-industrial blacksmith was adept at making horseshoes, but not at making or repairing solar-energy systems; those who expect to conquer the future with space-age technology will have to pray that nothing goes wrong with toys that were invented at a time of abundant petroleum and the machinery that went with it.

Other Minerals

Global depletion of minerals other than petroleum and uranium is somewhat difficult to determine, partly because recycling complicates the issues, partly because trade goes on in all directions, and partly because one material can sometimes be replaced by another. Figures from the US Geological Survey, however, indicate that within the US most types of minerals are past their peak dates of production. Besides oil, these include bauxite (peaking in 1943), copper (1998), iron ore (1951), magnesium (1966), phosphate rock (1980), potash (1967), rare earth metals (1984), tin (1945), titanium (1964), and zinc (1969). [USGS] The depletion of all minerals in the US continues swiftly in spite of recycling. Rare-earth minerals pose a special problem because so much of the more-advanced technology is dependent on them, and because nearly all of them now come from China. [Adams]

Iron ore may seem infinitely abundant, but it is not. In the past it was ores such as natural hematite (Fe_2O_3) that were being mined. For thousands of years, also, tools were produced by smelting bog iron, mainly goethite, FeO(OH), in clay cylinders only a meter or so in height. Modern mining must rely more heavily on taconite, a flint-like ore containing less than 30 percent magnetite and hematite. [Gever] Iron ore of the sort that can be processed with primitive equipment is becoming scarce, in other words, and only the less-tractable forms such as taconite will be available when the oil-powered machinery has disappeared — a chicken-and-egg problem. With the types of iron ore used in the past, it would have been possible to reproduce at least the medieval level of blacksmithing in future ages. With taconite it will not.

Grain

Annual world production of grain per capita peaked in 1984 at 342 kg. [Earth Policy (a)] For years production has not met demand, so carryover stocks must fill the gap, now leaving less than two months' supply as a buffer. Rising temperatures and falling water tables are causing havoc in grain harvests everywhere, but the biggest dent is caused by the bio-fuel industry, which is growing at over 20 percent per year. In 2007, 88 million tons of US corn, a quarter of the entire US harvest, were turned into automotive fuel.

Fish

The world catch of wild fish per capita peaked in 1988 at 17 kg; by 2005 it was down to 14 kg. [Earth Policy (b)] The fishing industry sends out 4 million vessels to catch wild fish, but stocks of the larger species are falling rapidly, so the industry works its way steadily down the food chain. Janet Larsen notes in particular that "over the past 50 years, the number of large predatory fish in the oceans has dropped by a startling 90 percent. Catches of many popular food fish such as cod, tuna, flounder, and hake have been cut in half despite a tripling in fishing effort."

The losses in the production of wild fish are made up by aquaculture (fish farming), but aquaculture causes its own problems: inshore fish farms entail the destruction of wetlands, spread diseases, and deplete oxygen. Although her study is otherwise excellent, Larsen omits the fact that millions of tonnes of other fish must be turned into food every year for use in aquaculture. The FAO, with its usual pro-industry stance, labels these as "low-value/trash fish." [UN Food and Agricultural Organization]

Fresh Water

Fresh water is declining in many countries around the world, particularly Mexico, the western US, North Africa, the Middle East, Pakistan, India, China, and Australia. If a population crash does not occur in the next few years, by the year 2025 about 2 billion people will be living with extreme water scarcity, and about two-thirds of the world will be facing water shortages to some extent. [UN Environment Program] In Saudi Arabia and the adjacent countries from Syria to Oman, the annual water supply per capita fell from 1,700 m 3 to 907 m 3 between 1985 and 2005. In the countries of the Gulf Cooperation Council, most fresh water is supplied by desalination plants.

The diversion of water for agriculture and municipal use, combined with the effects of global warming, is causing rivers to run dry. The Colorado, the Ganges, the Nile, and the Indus are now all dry for at least part of the year before they reach the sea. In previous years, this was also true of China 's Yellow River ; whether better management will prevail remains to be seen. The Amu Darya, once the largest river flowing into the Aral Sea, now runs dry as its water is diverted for the cultivation of cotton. [Mygatt]

Most countries with water shortages are pumping at rates that cannot be maintained. The shallower aquifers could be replenished if pumping were reduced, but the deeper "fossil" aquifers cannot be rejuvenated when their levels are allowed to fall. Among the latter are the US Ogallala aquifer, the Saudi aquifer, and the deeper aquifer of the North China Plain. [Brown]

Agriculture uses more than 70 percent of the world's fresh water and is mainly responsible for the depletion of aquifers of both types. [UN Environment Program] World grain harvests tripled between 1950 and 2000, but only with increases in irrigation. The US depends on irrigation for a fifth of its grain production; in parts of the grain-producing states of Texas, Oklahoma, and Kansas the water table has fallen more than 30 meters, and thousands of wells have gone dry. [Brown] The situation is worse in China, where four-fifths of the grain harvest depends on irrigation. The fossil aquifer of the North China Plain maintains half of China's wheat production and a third of its corn. As a result of the depletion of water, Chinese annual grain production has been in decline since 1998.

All this excess use of water is leading to political strife. While the seas have long been generally subject to international laws, it is only in recent decades that there have been major international problems with the world's fresh water. Because of falling water levels, new wells are drilled to greater depths than the old, with the result that the owners of the old wells are left without water. The result is a cycle of competition in which no one wins.

A similar competition exists with the world's rivers. Sixty percent of the world's 227 largest rivers have numerous dams and canals, and there are not many other rivers that are free from such obstructions. [UN Environment Program] Most countries sharing a large river with others are in the midst of violent struggle or about to become so. For example, India's Farakka Barrage, completed in 1975, diverts water from the Ganges into its Indian tributary, thereby depriving Bangladesh of water. [Dan Smith] Egypt and Sudan signed a treaty in 1959 allocating 75 percent of the Nile's water to the former and the remainder to Sudan , with no provisions for the other countries through which the river flows, and Egypt has threatened military action against any of those countries if their irrigation projects reduce the flow. [Elhadj]

It is not only military strength that settles issues of water distribution: countries with more water can produce more grain and thus influence the economies of less fortunate countries. It takes a thousand tonnes of water to produce a tonne of grain. In the short term it may therefore seem more sensible for water-poor countries to stop depleting their water by producing grain, and instead buying it from water-rich countries. [Brown, UN Environment Program] Between 1984 and 2000, at a cost of about $100 billion, Saudi Arabia foolishly tried to produce its own grain but then gave up and switched to importing it. Buying grain has its own negative side-effects, however, in terms of national security, foreign exchange, and lost local employment. [Elhadj] The biggest question of national security may be: What will happen when the grain-exporting countries themselves start running out of both grain and water?

Arable Land

With “low technology,” i.e. technology that does not use fossil fuels, crop yields diminish considerably. David Pimentel explains that the production of so-called field or grain corn (maize) without irrigation or mechanized agriculture is only about 2,000 kilograms per hectare. That is less than a third of the yield that a farmer would get with modern machinery and chemical fertilizer. [Pimentel; Pimentel and Hall; David Pimentel and Marcia H. Pimentel]

Yields for corn provide a handy baseline for other studies of population and food supply. At the same time, corn is an ideal crop for study because of its superiority to others: it is one of the most useful grains for supporting human life. For the native people of the Americas, it was an important crop for thousands of years. [Weatherwax] Corn is high-yielding and needs little in the way of equipment, and the more ancient varieties are largely trouble-free in terms of diseases, pests, and soil depletion. If it can't be done with corn, it can't be done with anything. Of course, in reality no one would live entirely on corn; the figures here serve merely as a basis of comparison with other crops in a mixed diet.

A hard-working (i.e. farming) adult burns about 1 million kilocalories (“calories”) per year. The food energy from a hectare of corn grown with “low technology” is about 9 million kilocalories. [Pimentel] Under primitive conditions, then, 1 hectare of corn would support only 9 people.

Even those figures are rather idealistic. We are assuming that people will follow a largely vegetarian diet; if not, they will need even more land. We need to allow for fallow land, cover crops, and green manure, for inevitable inequities in distribution, and for other uses of the land. We must account for any rise in population. Finally, most other crops require more land than corn in order to produce the same yield. On a global scale, a far more realistic ratio would be 4 people to each hectare of arable land.

The average American house lot is about a tenth of a hectare, including the land the house is sitting on. Those who expect to get by with “victory gardens” are unaware of the arithmetic involved. Perhaps some of the misunderstanding is due to the misconception that humans live on “vegetables” in the narrow sense of the word (e.g., in the sense of “green vegetables”). In reality, it is not “vegetables” but grains that are the foundation of human diet. Thousands of years ago, our ancestors took various species of grass and converted them into the plants on which human life now depends. Wheat, rice, corn, barley, rye, oats, sorghum, millet — these are the grasses people eat every day. It is members of the grass family that are used in raising the pigs and cows that are killed as other food. A diet of green vegetables would be slow starvation; it is grains that supply the thousands of kilocalories that keep us alive from day to day.

In the entire world there are 15,749,300 km 2 of arable land. [CIA] This is 11 percent of the world's total land area. The present world population (in 2010) is about 6.9 billion. Dividing the figure for population by that for arable land, we see that there are about 440 people per km 2 of arable land. On a smaller scale that means about 4 people per hectare. Only about a third of the world's 200-odd countries are actually within that realistic ratio of 4:1. In other words, we have already reached the limits of the number of people who can be supported by non-mechanized agriculture.

The UK, for example, has a population-to-arable ratio of slightly more than 10 people per hectare. What exactly is going to happen to the 6 people who will not fit onto the hectare? But many countries have far worse ratios.

Overpopulation

The world's population went from about 1.7 billion in 1900 to 2.5 in 1950, to nearly 7 billion in 2010. It has been said that without fossil fuels the population must drop to about 2 or 3 billion. [Youngquist (a)] The above figures on arable land indicate that in terms of agriculture alone we would not be able to accommodate the present number of people.

Another calculation about future population can be made by looking more closely at the rise and fall of oil production. The rapid increase in population over the last hundred years is not merely coincident with the rapid increase in oil production. It is the latter that has actually allowed (the word “caused” might be too strong) the former: that is to say, oil has been the main source of energy within industrial society. It is only with abundant oil that a large population is possible. It was industrialization, improved agriculture, improved medicine, the expansion of humanity into the Americas, and so on, that first created the modern rise in population, but it was oil in particular that made it possible for human population to grow as fast as it has been doing. [Catton] If oil production drops to half its peak amount, world population must also drop by half.

Of course, this calculation of population on the basis of oil is largely the converse of the calculation on the basis of arable land, since in industrial society the amount of farm production is mainly a reflection of the amount of available oil.

If we look further into the future, we see an even smaller number for human population, still using previous ratios of oil to population as the basis for our figures. But the world a hundred years from now might not be a mirror image of the world of a hundred years in the past. The general depletion of resources might cause such damage to the structure of society that government, education, and intricate division of labor will no longer exist. In a milieu of social chaos, what are the chances that the oil industry will be using extremely advanced technology to extract the last drops of oil? Even then we have not factored in war, epidemics, and other aspects of social breakdown. The figure of 2 to 3 billion may be wildly optimistic.

Overpopulation is the overwhelming ultimate cause of systemic collapse. All of the flash-in-the-pan ideas that are presented as solutions to the modern dilemma — solar power, ethanol, hybrid cars, desalination, permaculture — have value only as desperate attempts to solve an underlying problem that has never been addressed in a more direct manner. American foreign aid has always included only trivial amounts for family planning [Spiedel]; the most powerful country in the world has done very little to solve the biggest problem in the world.

The reasons for this evasion of responsibility are many, including the influence of certain religious groups with the misnomer of "pro-life"; the left-wing reluctance to point a finger at poor people, immigrants, or particular ethnic groups; the right-wing reluctance to lose an ever-expanding source of cheap labor (and a growing consumer market); and the politicians' reluctance to lose votes in any direction. [Kolankiewicz]

Overpopulation can also be seen in terms of the distribution of resources: there is some validity to the argument that imposing family planning on poor countries is unfair if rich countries consume far more resources per capita. That argument, however, can be countered by the statement that overpopulation in one country leads to immigration, which in turn leads to overpopulation in another country; the onus of responsibility therefore lies on poor countries, not rich ones. It is also countered by the simple statement that people should not have children if they have no means of feeding them. And in any case, spreading the misery out universally can hardly be considered a solution, no matter how anyone tries to juggle the figures.

Overpopulation can always be passed off as somebody else's problem. It is the fundamental case of what Garrett Hardin calls "the tragedy of the commons" [Hardin (a), (b)]: although every oversize family knows the world will suffer slightly from that fecundity, no family wants to lose out by being the first to back down. Without a central governing body that is both strong and honest, however, the evasion is perpetual, and it is that very lack of strength and honesty that makes traditional democracy an anachronism. For all that might be said against their politics and economics, it is the Chinese who have made the greatest effort at dealing with excess numbers, although even their efforts can hardly be considered a success.

Discussion of overpopulation is the Great Taboo. Politicians will rarely touch the issue, although we no longer hold our breaths waiting for such people to speak the truth about anything. Even the many documents of the United Nations merely sidestep the issue by discussing how to cater to large populations, in spite of the fact that such catering is part of the problem, not part of the solution.

To speak against overpopulation is an exercise in futility. How likely is it that the required massive change in human thinking will ever take place? For such a thing to happen, it would be necessary for a large percentage of the human race to become literate, to read books, and to understand difficult scientific abstractions, scholarly entanglements which are neither comic nor tragic but simply unpropitious. Yet that is precisely the opposite of how most people behave. To broach the topic of overpopulation is only to invite charges of racism and elitism. Instead of dreaming of ways to reduce a population of several billion to a reasonable number overnight, therefore, it might be more sensible to think in terms of the medical system of triage: let us save those who can be saved.

Like so many other species, humanity expands and consumes until its members starve and die. The two basic, reciprocal problems of human life have still never been solved: overpopulation and the over-consumption of resources. As a result, the competition for survival is intense, and for most people life is just a long stretch of drudgery followed by an ignoble death. It is ironic that birth control, the most important invention in all of human history, has been put into practice in such a desultory manner. There is still no intelligent life on earth.

In view of the general unpopularity of family-planning policies, it can only be said euphemistically that nature will decide the outcome. Even if his words owe as much to observation of the stages of collapse as to divine inspiration, it is St. John's Four Horsemen of war, famine, plague, and death who will signify the future of the industrial world. Nor can we expect people to be overly concerned about good manners: although there are too many variables for civil strife to be entirely predictable, if we look at accounts of large-scale disasters of the past, ranging from the financial to the meteorological, we can see that there is a point at which the looting and lynching begin. The survivors of industrial society will have to distance themselves from the carnage.

The need for a successful community to be far removed from urban areas is also a matter of access to the natural resources that will remain. With primitive technology, it takes a great deal of land to support human life. What may look like a long stretch of empty wilderness is certainly not empty to the people who are out there picking blueberries or catching fish. That emptiness is not a prerogative or luxury of the summer vacationer. It is an essential ratio of the human world to the non-human.

Famine

Humanity has struggled to survive through the millennia in terms of balancing population size with food supply. The same is true now, but population numbers have been soaring for over a century. Oil, the limiting factor, is close to or beyond its peak extraction. Without ample, free-flowing oil, it will not be possible to support a population of several billion for long. Famine caused by oil-supply failure alone will probably result in about 2.5 billion above-normal deaths before the year 2050; lost and averted births will amount to roughly an equal number.

In terms of its effects on daily human life, the most significant aspect of fossil-fuel depletion will be the lack of food. “Peak oil” basically means “peak food.” Modern agriculture is highly dependent on fossil fuels for fertilizers (the Haber-Bosch process combines natural gas with atmospheric nitrogen to produce nitrogen fertilizer), pesticides, and the operation of machines for irrigation, harvesting, processing, and transportation.

Without fossil fuels, modern methods of food production will disappear, and crop yields will be far less than at present. Crop yields are far lower in societies that do not have fossil fuels or modern machinery. We should therefore have no illusions that several billion humans can be fed by “organic gardening” or anything else of that nature.

The Green Revolution involved, among other things, the development of higher-yielding crops. These new varieties could be grown only with large inputs of fertilizer and pesticides, all of which required fossil fuels. In essence, the Green Revolution was little more than the invention of a way to turn petroleum and natural gas into food.

Over the next few decades, therefore, there will be famine on a scale many times larger than ever before in human history. It is possible, of course, that warfare and plague will take their toll to a large extent before famine claims its victims. The distinctions, in any case, can never be absolute: often “war + drought = famine” [Devereux], especially in sub-Saharan Africa, but there are several other combinations of factors.

Although, when discussing theories of famine, economists generally use the term “neo-malthusian” in a derogatory manner, the coming famine will be very much a case of an imbalance between population and resources. The ultimate cause will be fossil-fuel depletion, not government policy (as in the days of Stalin or Mao), warfare, ethnic discrimination, bad weather, poor methods of distribution, inadequate transportation, livestock diseases, or any of the other variables that have often turned mere hunger into genuine starvation.

The increase in the world's population has followed a simple curve: from about 1.7 billion in 1900 to about 6.1 billion in 2000. A quick glance at a chart of world population growth, on a broader time scale, shows a line that runs almost horizontally for thousands of years, and then makes an almost vertical ascent as it approaches the present. That is not just an amusing curiosity. It is a shocking fact that should have awakened humanity to the realization that something is dreadfully wrong.

Mankind is always prey to its own “exuberance,” to use Catton's term. That has certainly been true of population growth. In many cultures, “Do you have any children?” or, “How many children do you have?” is a form of greeting or civility almost equivalent to “How do you do?” or, “Nice to meet you.” World population growth, nevertheless, has always been ecologically hazardous. With every increase in human numbers we are only barely able to keep up with the demand: providing all those people with food and water has not been easy. We are always pushing ourselves to the limits of Earth's ability to hold us. [Catton]

Even that is an understatement. No matter how much we depleted our resources, there was always the sense that we could somehow “get by.” But in the late twentieth century we stopped getting by. It is important to differentiate between production in an “absolute” sense and production “per capita.” Although oil production, in “absolute” numbers, kept climbing — only to decline in the early twenty-first century — what was ignored was that although that “absolute” production was climbing, the production “per capita” reached its peak in 1979. [BP]

The unequal distribution of resources plays a part. The average inhabitant of the United States consumes far more than the average inhabitant of India or China. Nevertheless, if all the world's resources were evenly distributed, the result would only be universal poverty. It is the totals and the averages of resources that we must deal with in order to determine the totals and averages of results. For example, if all of the world's arable land were distributed evenly, in the absence of mechanized agriculture each person on the planet would still have an inadequate amount of farmland for survival: distribution would have accomplished very little.

We were always scraping the edges of the earth, but we are now entering a far more dangerous era. The main point to keep in mind is that, throughout the twentieth century, oil production and human population were so closely integrated that every barrel of oil had an effect on human numbers. While population has been going up, so has oil production.

Future excess mortality can therefore be determined ? at least in a rough-and-ready manner ? by the fact that in modern industrial society it is oil supply that determines how many people can be fed. An increase in oil production leads to an increase in population, and a decrease in oil production leads to a decrease in population.

In round numbers, global oil production in the year 2008 was 30 billion barrels, and the population was 7 billion. The consensus is that in the year 2050 oil production will be about 2 billion barrels. The same amount of oil production occurred in the year 1930, when the population was 2 billion. The population in 2050 will therefore be the same as in 1930: 2 billion. The difference between 7 billion people and 2 billion is 5 billion, which will therefore be the total number of famine deaths and lost or averted births for that period.

We can also determine the number of famine deaths and lost or averted births on an annual basis. From 2008 to 2050 is 42 years. The average annual difference in population is therefore 5 billion divided by 42, which is about 120 million.

Many of those annual 120 million will not actually be deaths; famine will cause a lowering of the birth rate. [Devereux, Ó Gráda] This will sometimes happen voluntarily, as people realize they lack the resources to raise children, or it will happen involuntarily when famine and general ill health result in infertility. In most famines the number of deaths from starvation or from starvation-induced disease is very roughly the same as the number of lost or averted births. In Ireland's nineteenth-century famine, for example, the number of famine deaths was 1.3 million, whereas the number of lost births was 0.4 million. The number of famine deaths during China's Great Leap Forward (1958-1961) was perhaps 30 million, and the number of lost births was perhaps 33 million.

The “normal,” non-famine-related, birth and death rates are not incorporated into the above future population figures, since for most of pre-industrial human history the sum of the two — i.e. the growth rate — has been nearly zero. If not for the problem of resource-depletion, in other words, the future birth rate and death rate would be nearly identical, as they were in pre-industrial times. And there is no question that the future will mean a return to the “pre-industrial.”

Nevertheless, it will often be hard to separate “famine deaths” from a rather broad category of “other excess deaths.” War, disease, global warming, topsoil deterioration, and other factors will have unforeseeable effects of their own. Considering the unusual duration of the coming famine, and with Leningrad [Salisbury] as one of many precursors, cannibalism may be significant; to what extent should this be included in a calculation of “famine deaths”? It is probably safe to say that an unusually large decline in the population of a country will be the most significant indicator that this predicted famine has in fact arrived.

These figures obliterate all previous estimates of future population growth. Instead of a steady rise over the course of this century, as generally predicted, there will be a clash of the two giant forces of overpopulation and oil depletion, followed by a precipitous ride into the unknown future.

The Passage

What seems the best general concept of human society later in this century is not easy to formulate. The only keyword that seems applicable is “survivalist,” although for various reasons even that name is rather clumsy. With a slightly optimistic view of the future, one can say that a few people will succeed, and that such people will generally be those who have the skills to do so, even if there will be other people who stay alive by sheer chance. The greatest “resource” of all will be the knowledge inside one's own head. People with the information and skills required for supplying themselves and their community with food and shelter, however, can certainly be called survivalists, even if there should be a better label.

The trouble with the term “survivalist” is that it is often more suited to people who have been brought up on purely fictional accounts of Armageddon, as churned out by Hollywood film studios. The pleasure derived from watching such depictions of violence is not as innocent as it seems. Watching a movie is only one step removed from watching gladiators in an amphitheater hacking each other to pieces. In both cases our moral sensibilities are dulled: we fail to disapprove of the behavior we are observing. In both cases, also, the underlying message is that violence is the quick road to success. In the real world of the future, however, such forms of behavior might be of questionable value in the long run. The problem with cycles of revenge is that there is often no obvious distinction to be made between the "good" and the "bad." Bloodshed will be no more a lasting solution in the future than it was in Viking times. We must not forget that even in the Dark Ages there were many who sought a better way of life.

We must also keep in mind that as the centuries unfold the human world will always be much smaller than it is today. It may seem odd to speak of the social implications of hematite versus taconite, for example, but what we are really examining is a human population that will be shrinking considerably from its present numbers and living a less complicated life. The world will not be smaller in the sense of "the global village" with its rapid communication and transportation, but smaller in almost the opposite sense: that each person's life will be lived within a smaller geographic range than today, and that the total of human numbers will be small. That smallness will be repeated mile by mile, league by league: people will be counted in groups of hundreds rather than billions, and the kingdoms of the distant future will be the size of our present counties.

Other than the numbers and the technology, that future way of life may remain somewhat of a mystery for now. We might think of the Dark Ages of Europe, as previously mentioned. But then we must also consider scenarios of the past that are more pleasant ? for example, the first people to cross the Bering Strait, many thousands of years ago, discovered two entire continents entirely uninhabited by humans. What they found must have been an absolute paradise, or so it may seem us in our crowded day. Of course the difference between AD 1000 and 10,000 BC is obvious: at the earlier time, there was an excellent ratio between population and resources.

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