A STORY-LINE FOR THE SECOND HALF OF THE AGE OF OIL

Note to file:
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The Gun Barrel or The Face

I have heard that, after an armed robbery, even if the robber did not wear a mask, the person robbed is more or less unable to describe the face of the robber. The weapon, the gun or the knife, can be described in great detail, but the clothes worn by the robber and the robber's face are remembered with substantially less detail. We naturally focus our attention on the source of the danger and filter out all other things around us.

I think a similar thing is happening to humankind, in some fashion, all around the world. People are becoming aware of the great dangers that we, as a species, are facing. We are focusing on that danger, but we are peculiarly unable to see exactly who the perpetrator is.

Not knowing precisely the source of the danger, we are inventing stories, like nightmares, about what is happening and how it will end. Stories of apocalyptic collapses, alien invasions, world-killing plagues, revolutions lead by machines, or global natural disasters now fill our cinemas and our bookstores. Such tales arise from our deep psyche as we try to put a face on our fears – as we try to put a face on the perpetrator of the great danger that is traumatizing us.

The Role of Stories as a Framework for Life's Plans

In his book "The Long Descent", John Michael Greer notes that we organize our plans for the future around stories that we tell ourselves. You can call these visions of the future, or story-lines if you wish, but they are essentially fictitious stories that we find credible in some fashion, and that we adopt as a framework for our more detailed personal plans. He notes that our stories of the future tend to come in two distinct varieties: we like to tell ourselves that all is well; and we like to tell ourselves that the sky is falling.

The first of these is the story of the future seen through rose-coloured glasses. In this story, the world will continue tomorrow much as it has in the past. Economies will continue to grow. Standards of living will continue to improve around the world until most countries enjoy a utopian lifestyle with plenty of food brought in from distant places, no more plagues or diseases, and a full range of freedom and rights. Global populations will grow to some as-yet-difficult-to-determine carrying capacity that we have not quite reached yet. Transformative technologies will continue to produce marvels that transform our experience and enable endless economic growth. Sure, there will be troubles as there always have been, but, in general things will continue to get better. This tale is not the tale of our nightmares. Rather, it is the reassuring tale we parents tell our children in the warm light of daylight as we try to convince them that their nightmarish imaginings are not true, and cannot be true.

The second of these is the story seen through our deepest fears - total collapse of all societies world-wide; total loss of all control to some alien or home-grown but non-human power that is completely beyond our knowledge and our ability to overcome; absolute and irretrievable loss of all that we, as humans, hold dear or all in which we take pride. It is this framework of despair and loss on which our apocalyptic and post-apocalyptic tales are hung. I do note, however, that every one of the these nightmarish tales that have made it to book or film has a "rose-coloured glasses" ending in which a person of heroic proportions finds a way to save some remnant of humanity and the things we treasure.

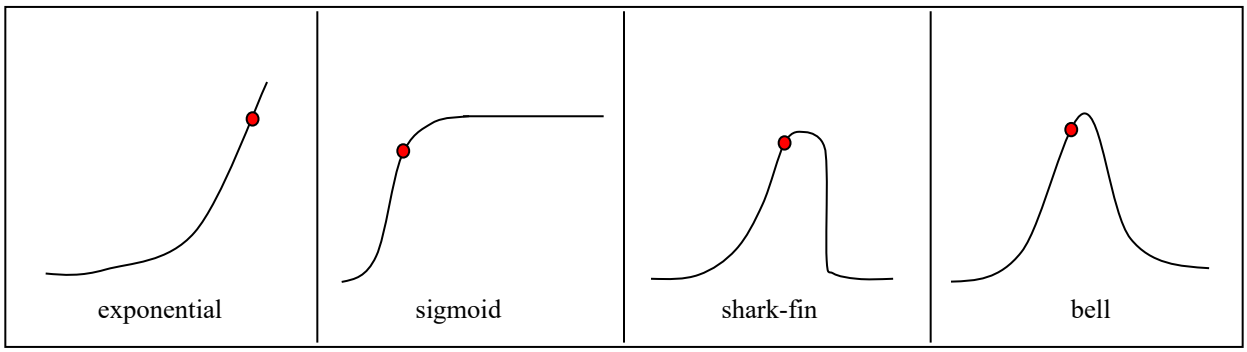
Evolved to be Optimists

I believe that our endless optimism in the face of almost certain disaster is part of our evolutionary heritage. Those people who went before who had a tendency to give up in despair when faced with insurmountable odds perished. They were eaten by predators. They drowned in floods. They starved in famines. They died of serious illnesses. They did not live to reproduce their genes. Now, I would not mean to imply that all such perils can be overcome so simply as by the application of determined optimism. On the other hand, I do believe that a propensity to strive for

survival in the face of such overwhelming odds and almost certain death gives some people an ever-so-slightly-greater probability of survival. Evolution works on just such tiny differences in probability of survival. This phenomenon is called natural selection, but has, rather regrettably, been called “survival of the fittest” in popular presentations. It should better be called "mildly increased probability of survival of those having an advantage conferred by a variation in phenotype when interacting with a new or changing circumstance.” Well, it’s not hard to see why “survival of the fittest” is used instead! In any case, optimism has become part of the phenotype of those people in history who have survived against great odds. It is now part of the phenotype of most people on the earth. We are the offspring of millions of years of the natural selection of optimists. It is part of our evolutionary imperative to always find hope in the midst of our greatest fears. This is why so many of us wear those rose-coloured glasses. This is why the brave among us, those who delve into their fearful imaginations to present the apocalyptic nightmarish tales that fill our bookstores and screens, must always don the rose-coloured glasses in the last few pages of the books, or in the last few scenes on the screen.

Exponential, Sigmoid, Sharkfin or Bell

So, what is the shape of the future that we see? What is the shape of the framework upon which we hang our story of the future. The key stories that we tell ourselves have four significantly different shapes or frameworks. They all start the same, with a slow rise followed by a fast rise up to the present day (red dots). The past looks amazingly similar in all of these frameworks. But the future looks drastically, almost cataclysmically, different.



Exponential

For most of us, looking at the future as irrepressible optimists, we see either an endless growth curve or a logistic growth curve (a sigmoid curve). Those who see endless growth, strangely, argue that endless growth is not only possible, and not just desirable, but a necessity for continued well-being. These people argue with a very straight face and sincere demeanor that endless growth of our economy can and should happen. They seem to understand that this implies an endlessly rising population, with an ever-increasing flow of matter and energy through the economy. But that thought does not give them more than a moment’s pause. Among the most vocal of these people are the leading proponents of modern economic theory. It puts one in mind of the leaders of Easter Island as they put their energies into building giant stone heads as they cut down their life-giving forests and allowed the soil of their crop-lands to be washed onto their near-shore reefs, bringing their civilization to an end. You wonder what those long-gone people were thinking, and you shake your head to think that people, evidently smart people, can be so obviously wrong-headed. Then you listen to the radio, read the newspapers, and realize that our global political leaders appear to have bought into this absurd framework for their vision of the future. The framework on which modern global orthodox economic policy is hung is exponentially shaped.

Sigmoid

For those of us who do not have our heads and our egos buried in the crazy logic of modern orthodox economic theory, there is a more pragmatic and credible option available in the logistics growth curve, also called the sigmoid curve, or the S-curve. The S-curve is the one by which the population rises to carrying capacity, starting slowly at first, rising along a path that approximates exponential growth for a while, but slowing and approaching some carrying capacity asymptotically. Such growth curves are characteristic of populations of organisms that are introduced into an environment in which there are few natural predators or endemic diseases. There are many examples of manifestations of this curve, both in the natural realm and in human culture. For example, the populations of rabbits, cane toads and camels have followed such a logistics growth curve in Australia. New

technology also grows along an S-curve. For example, the growth in the number of land-line telephones in North America followed such a curve as well.

The leading proponent of the S-curve seems to be the part of the back-office of the United Nations that studies global human populations. They see the population of the Earth levelling off at somewhere between 8 billion people and 17 billion people. The number has varied, and is currently, I believe, sitting at 10 billion. We recently passed the point at which more than 50% of the world's population is now living in cities. They see this trend continuing until all of the arable land is farmed and all of the oceans are efficiently harvested for food. And this vision of the future has been adopted implicitly by environmental economists, ecological economists, and most pragmatic scientists who are not in the business of studying the future. This is also the vision of the future that we members of the general population of North American society have bought into and pass on to our children. The UN says it. It must be so! We marvel at the fancy gadgets our children can now play with, and speculate on what additional wonders our grandchildren will see. We educate them to take their place in a growing modern society that we imagine will continue forever. This is a comfortable vision that we all think we can live with.

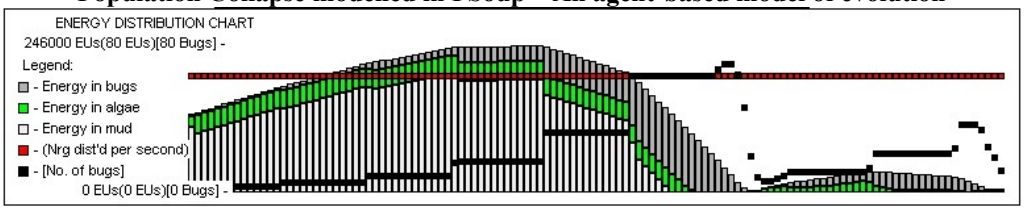
But the number of scientists who can still avoid thinking about the shape of the future is declining, and other parts of the UN back office are issuing regular reports on the health of the planet's biosphere, and those reports are not good. There are some problems appearing in the sigmoid story-line of the future.

Shark-fin

The shark-fin is a wonderful name for this framework for a story-line. It sounds as brutal and heartless as the representative stories portrayed in book and film. This is the framework upon which all of those nightmarish apocalyptic and post-apocalyptic tales are based that we see in books and on movie screens.

My first introduction to this shape of curve was when I modelled a population crash in an agent-based model of a population of bugs living in a pond. The chart shown below is clipped out of that scenario. It is a little dense, having three charts overlain in one. The red line represents energy flowing into the system from the Sun. It is constant in this scenario and does not change. The black dots represent the population of bugs, starting at 2 and rising as high as 65 or so. The histogram in the background shows the distribution of energy in the system: light grey in the mud; green in the algae; and dark grey in the bugs. I set up a scenario in which there was an large supply of initial energy in the mud in the pond, a thriving population of algae (food for the bugs), and a small population of 2 bugs (black line). There was also a steady but linear flow of 64 units of energy into the system per tick (red line), a steady population of algae feeding on energy and storing excess energy in the mud, but an exponential growth of bugs (black line). The algae started at carrying capacity and stayed there, but the bugs started well below carrying capacity. While the bug population was small, the amount of total energy in the system increased. Eventually, the bug population was sufficient (16 bugs) to consume all incoming energy, but the buildup of stored energy was still available. The bug population continued to grow to 64, well above carrying capacity (as determined by the flow of incoming energy), until the store of energy was also depleted. Soon after, the population of algae collapsed and the bugs starved en masse. A pair of shark fins appeared. (See chart below.)

Population Collapse modelled in PSoup – An agent-based model of evolution



Energy arrives at a steady rate of 64 units per tick (red line). Each bug consumes 4 units per tick. The carrying capacity is 16 bugs. Energy in the mud (light grey) accumulates as the population grows from 2 to 4, to 8, and to 16. Energy in the mud declines as the population goes to 32, then 64. The algae (green), the bugs' food source, does not disappear until the bug population is well above carrying capacity. The energy in the mud is analogous to energy stored in fossil fuels. Note the "shark-fin" collapse of the population, followed by a mini-shark-fin.

The dramatic thing was, all bugs were healthy, and, in fact, overfed, long after carrying capacity had been surpassed. The store of energy amassed by the algae in the mud was used to support a super-population until the store of energy

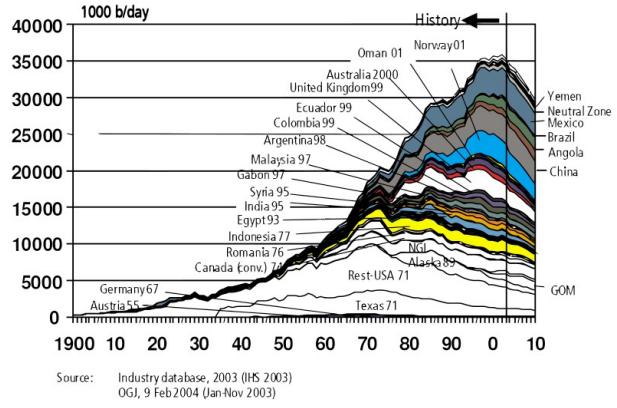
was depleted. In one generation of bugs, life turned from luxury to want, and then mass starvation ensued, and a small remnant of the population survived. After that, there was no further massive buildup of energy, and the population was forced to live closer to carrying capacity. The initial endowment had been spent.

Bell

The bell curve has a distinctive shape that looks like an old-fashioned school bell, or church bell. It is a symmetrical smooth bump with tapered edges. It rises slowly from nothing, has a rounded dome, and then subsides smoothly back to nothing. You may know it as the normal curve, or the Gaussian curve. There are several mathematical expressions that have the bell shape, but the normal curve is the best-known.

A man by the name of Hubbert predicted that the consumption of oil would follow a bell-shaped curve, now called the Hubbert curve. That is, he predicted that the consumption of oil would rise, slowly at first, then quickly for a while, and then slowing again until it peaked, then falling until it tapered off to nothing again. History has proven him to be right, more-or-less, so far. The scientists who study the consumption of fossil fuels have documented history's conformance to Hubbert's predictions, both at the national level, and now, at the global level. They seem to point to a global peak in oil production at some time around 2010 to 2020. For the sake of discussion, in this note I am assuming that peak happened in 2010, but the precise date is not important for me to make my point.

Wikipedia URL: https://en.wikipedia.org/wiki/Hubbert_peak_theory
At the reference URL we get this quote: "The Hubbert peak theory says that for any given geographical area, from an individual oil-producing region to the planet as a whole, the rate of petroleum production tends to follow a bell-shaped curve. It is one of the primary theories on peak oil."



2004 U.S. government predictions for oil production other than in OPEC and the former Soviet Union

This phenomenon is now referred to as "peak oil". The small cadre of very vocal scientists in the pay of the large oil companies have declared, for some time, that the peak oil theory is dead. They point to technological advances that have opened up formerly inaccessible deposits of hydro-carbons such as the deep off-shore oceanic deposits, the Canadian tar sands, and the Bakken shale deposits. Now, the discovery of massive methane hydrate deposits in the deep ocean trenches are raising hopes of endles hydrocarbons to burn. However, in the other camp are the scientists who classify themselves as Biophysical Economists, who argue that the Energy Returned On Energy Invested (EROEI) has declined steadily from about 100:1 in the 1920s to 10:1 in modern extraction efforts. The most accessible and the highest grades have been depleted. What remains is the difficult to access, and the lowest grade. The energy costs of extraction and refining are becoming a serious constraint. It is estimated that an EROEI of about 6:1 is the minimum return that can support a modern civilization. Those days are coming soon. Hubbert's peak is usually drawn as a bell-shaped curve. It remains to be seen what the future of Hubbert's peak will look like: bell, or shark-fin?

But, the issues with hydrocarbons are not just those of access, quality, quantity, and rate of consumption. The consumption of hydrocarbons creates greenhouse gasses, and those cause oceanic warming and oceanic acidification. Those processes are ocean killers, and planet killers. We MUST stop burning hydrocarbons for our energy.

Sharkfin or Bell?

At a recent meeting of the Biophysical Economics (BPE) conference, which met concurrently with the US Society of Ecological Economists (USSEE, or just EE), I had opportunity to listen to some of the leading lights of BPE, in a pub one evening, as they very briefly discussed their personal visions of the future. I noted that they did not even mention the standard S-shaped logistics growth curve as a framework for the future population of the Earth.

For them, the views on human population expressed by the UN agencies would be totally non-credible as the UN overlooks the role of energy flows, and the declining access to low-cost (in energy terms) energy sources. These presenters at the BPE conference believe that the human population of the Earth has been artificially heightened to extreme proportions by the consumption of immense amounts of energy in the form of fossil fuels, and when those sources of energy are consumed, the population will be unsustainable, and will fall dramatically. To be clear, they understand that there are still plenty of hydrocarbons on the planet, and there are plenty of other ways to acquire energy. But they argue that producing energy has energy costs, the best and easiest sources have been depleted, and what remains will be more and more costly, in energy terms, to access. Their science, which is tuned to measure energy flows, shows that, unless there is a never-before-seen increase in our ability to access and refine the remaining low-grade hydrocarbons, and a simultaneous never-before-seen ability to remove carbon from the atmosphere again, the human population must decline. Alternative renewable sources of energy can never replace the mind-bogglingly-immense amounts of energy we are currently reaping from high-grade easily accessible non-renewable fossil fuels. And, the science of ecologists, world-wide, shows that the mind-bogglingly-immense amounts of greenhouse gasses we are producing through the consumption of these fossil fuels are causing the oceans to die around us. By the time the oceans are dead, we will be long gone.

So, as I said, the BPE leading lights had discarded the S-curve as their personal framework for the story-line of the future without mention. For them, it seems to be a toss-up between a bell curve (slow collapse of the population) and a shark-fin curve (rapid collapse of the population). Or, so I heard one evening in a pub.

But, when scanning the program for the combined EE/BPE conference, there was not one speculative presentation that addressed what comes next. All of the presentations were either focused on describing the barrel of the gun (BPE track and fossil fuel consumption) or were implicitly hung on the framework of S-curve (EE and how to express ongoing ecological damage in economic terms). I could find no presentations that even made an attempt to understand the long-term implications of the BPE message. Perhaps, having seen the scorn heaped upon scientists who speak out about concerns about the future, from Malthus through to Meadows, they hold back, and just study past history.

Returning to Greer's book "The Long Descent", he postulates that the collapse will necessarily follow a bell curve. He calls this catabolic collapse. His ideas appeal to me for two reasons. First, I see some reason in his arguments. But, also, emotionally, I do not want to believe that we are doomed to a shark-fin cataclysmic collapse, for the mere reason that it is unpleasant to contemplate.

But Greer rejects the shark-fin curve on the basis of argumentation, rather than emotion. He argued that the nature of previous population collapses in unstable societies has always been bell-shaped. I am not sure that I can reject the probability of the shark-fin collapse quite as readily as Greer can. Other collapses of sophisticated societies to which Greer refers have happened within the milieu of other less-sophisticated functioning societies about them. When people became unhappy with the collapsing society, they could walk away into the jungle. They could opt out. And so the society could collapse like a tire losing its air. These collapses are characterized by a return from an uncommon height of social sophistication back to a more common lower level of social sophistication. I am not sure that the same circumstances will be found when a globe-spanning economic system collapses, and our immense food production and transportation systems suddenly fail. Nobody can opt out, and there will be nowhere to go. I suspect that even those unsophisticated present-day rural dwellers who currently have a subsistence-level lifestyle will be seriously affected by a collapse of our global economic systems because of the far-reaching effects of food and fertilizer distribution systems, and the far-reaching effects of pollution. I have seen estimates that somewhere between 40% to 90% of all of the energy in our global food supply comes directly or indirectly from fossil fuels. Fossil fuels were used to build the mines, mills and factories that produce the farm machinery, farm tools, fertilizers and pesticides, trucks and transportation systems that produce food. So the failure of a very sophisticated food production system can have very widespread and disastrous effects. Also, there's the problem of the dying oceans. We seem to be caught between the proverbial "rock" and "hard place". Like a rat caught in a trap, I am afraid that our only option will be to chew our own leg off.

So, I think that the shark-fin curve is a very real probability. But, I don't see how humanity can plan to survive a shark-fin cataclysm. A shark-fin collapse will happen badly regardless of how we prepare. We can only hope that, if the shark-fin appears, some heroic person who survives will save some remnant of humanity when we get to the

bottom of the curve. We need Hollywood to write that script for us. But, as I say, like Greer, I choose to look to the bell-shaped curve and catabolic collapse - for him, because he thinks it is most likely; for me, because I like it better. But, if we cannot plan our way through a shark-fin collapse, I think to myself, perhaps we can lay plans that will prevent that from happening. So, let's put on those rose-coloured glasses and look for a way to avoid the shark-fin and find hope in a controlled catabolic collapse.

The Bell – A Controlled Catabolic Collapse

Now, the word collapse implies out-of-control disintegration, so how can we have a "controlled catabolic collapse". Greer postulates that there will be periods of relative stability (in societal complexity as well as population levels) punctuated by periods of social, economic and population collapse. He believes that this will happen as a natural process, and that this process is somewhat unavoidable. I can see the reason of that argument, assuming that the shark-fin does not appear at some point and end it all abruptly. But I choose not to consider that calamity, and keep my somewhat smudged but still rose-coloured glasses in place. So, if the process of catabolic collapse is unavoidable, how can we lay plans for it? That is, how can we lay plans to avoid the shark-fin? And how can we lay plans to manage the series of small collapses that are the only viable alternative.

Well, unavoidable is not the same as unpredictable. Suppose we know a building is in danger of collapse but we don't know when it will fail, how it will fail, or what the damage will be. We can take control of its fate by bringing it down on a planned schedule. We can plan where it will fall, when it will fall, how it will fall, and how we can clean up the mess after it has fallen. We can turn unpredictable characteristics of the fall into controlled parameters if we act in time. If we take too long to make decisions, the collapse may happen in an uncontrolled manner, possibly as a shark-fin. But if we plan and act in a timely fashion, the collapse is "controlled", in that limited sense.

That's fine for a building, but can we do it for components of society? Can we control the collapse of components of the complex society in which we live? Can we, as a species, control the collapse of our own population on a global scale? This raises immense ethical issues that take us far and away over the line of current views of politically correct and politically acceptable opinions and actions. So, the question becomes, how can we plan for a controlled catabolic collapse within an ethical regime that has global acceptance? This would be very difficult, indeed. But I think we have no choice but to try. We MUST put on those rose-coloured glasses that our evolutionary past has bequeathed to us, and start the job.

So, stepping quickly over that difficult question of ethics, what might be the elements of catabolic collapse, in what order, and at what pace?

I believe that we need to replace the S-curve and the shark-fin curve in the world's imagination with a different curve, a bell curve, on which our science and our imaginations can work. I believe that if we describe a story line of catabolic collapse in which we identify what will collapse, and when, and how, it has the real potential to make several things happen:

- the people who have the courage and imagination to write books and make films about the dangers we face as a species, those who explore our nightmarish imaginings, will turn their imaginations to exploration of the ethical, social, economic and ecological issues implicit in each step of that collapse;
- instead of avoidance of topics too difficult to face (i.e. the high probability of ultimate disaster vs. the obviously false promise of continued existence as it is), public attention will turn its rose-coloured glasses to the smaller disasters and start to examine the associated issues of each small collapse with critical but optimistic interest;
- historians, politicians, ecologists, economists, scientists and sociologists will start to argue over the correct order of collapse, the when, the why, and the how, and plans will start to emerge;
- all of that effort expended by scientists, ecologists, biologists, and economists whose work is implicitly hung on the framework of the S-curve, or whose work is focussed on describing the "barrel of the gun", will turn their attention to studying the ethical, social, economic and ecological issues around a declining human population as the availability of fossil fuels declines.

If those things, listed above, started to happen now, I would feel there is some reason to continue to wear my rose-coloured glasses. I would feel there is hope for the future of humankind.

Recapitulation Of History In Reverse (ROHIR)

So, how do we construct that straw-man bell-curve? How do we populate it with events and dates of predicted collapses? I would suggest that we start with the very simple-minded view that the "second half of the age of oil", so-called by C.A.S. Hall and his associates, will be a recapitulation of the first half of the age of oil, but in reverse order. For the sake of discussion, let's call it the Recapitulation Of History In Reverse (ROHIR) method of construction of a future story-line.

For example, assume 2010 to be the peak of the Hubbert curve, the bell-curve that describes the consumption of oil on a global basis. Public health measures embodied in city sewers were established starting about 1850, 160 years before the peak. Then, using the ROHIR method, we can predict that public health benefits accruing from extensive sewer systems will collapse about 160 years after the peak, or approximately in the year 2170.

The simple-minded logic behind ROHIR is as follows. It was not possible for certain modern facilities (e.g. medical research laboratories) to appear until society had reached a certain population density and a certain level of sophistication and complexity to support the continued existence of such facilities. That level of complexity implies a certain population density, and a certain flow of energy to support that level of population density and social complexity. As the flow of energy declines, the level of social complexity will decline at approximately the same rate, and population density MUST decline. The flow of energy 100 years post-peak flow will be approximately equal to the flow of energy 100 years prior-to-peak, because we are assuming a bell curve. Therefore the level of complexity and population density supportable on a given date post-peak will match that supportable at a comparable time pre-peak. The problem is, increases in population density and social complexity are pleasant things to experience, and are generally not resisted by the populace. However, reductions in population density and social complexity are unpleasant things to experience, and so will generally be strongly resisted by the populace. The rise in social complexity (and population density) was smooth, but the decrease in social complexity (and population density) will be much less so.

What are some indications that our western society is facing a crisis of the nature implied by all of these ideas. Much of the infrastructure in North America was built in the era from 1920 to 1960 (many old buildings and sewer lines and roads) and this infrastructure needs to be replaced, but we can barely afford to pay the interest on our public debts, let alone replace most of our failing infrastructure. Our justice system is so complex, ornate, and expensive to operate that few average citizens believe they can find justice there. Few citizens trust the health system, the legal system, or even the educational system. People need to go to school for an incredible 16 to 20 years before they are able to enter adult society as productive citizens, and then many debt-laden newly minted adult citizens cannot find suitable work for which they have been trained at such massive public and personal expense.

Population densities, public infrastructure and social complexity are, ultimately, maintained by flows of energy. We cannot maintain our population, our physical infrastructure, nor our exceedingly complex and dysfunctional social systems without a constant flow of cheap energy. Our western society is sagging under the weight of the energy costs of its own maintenance now. And those flows of energy are about to decline.

A Proto-type of a Bell-Shaped Story-Line

So, here is my example of a future story-line for the end of the modern age, and the decline of humanity's reign on this planet. The dates and events in the following table have not been researched at this point, but are pulled from the scrap lumber pile at the back of my mind. I use them as examples of how a future story-line with a bell-curve shape can be constructed.

Table I – A proto-type of a story line based on a bell-shaped curve of rise and decline.

Date	Historic event in trend to modern world		Date	Predicted event in future collapse
2010	Production and consumption of oil hits a peak		2010	Production and consumption of oil hits a peak
2010	World population hits 7 billion		2010	Population congestion in cities becomes a problem and energy flows to cities begin to dwindle.

Table I – A prototype of a story line based on a bell-shaped curve of rise and decline (continued).

Date	Historic event in trend to modern world		Date	Predicted event in future collapse
2000	World population hits 6 billion		2020	World population falls to roughly 6 billion
1990	Construction of massive cities		2030	Failure of massive cities
1980	De-regulation of banking and insurance		2040	Severe regulation imposed on banks
1975	World population hits 4 billion		2045	World population falls to roughly 4 billion
1972	The concept of discounted cash flows is invented		2048	The use of discounted cash flows is proven to be absurd and not based on economic realities
1970	Gold standard for money is abandoned		2050	Gold standard for money is re-established
1970	Railroads abandoned and torn up		2050	Railroads re-constructed
1965	Digitization of money		2055	Abandonment of digitized money
1960	World population hits 3 billion		2060	World population falls to roughly 3 billion
1960	Transportation converts from train-based to automobile-based containerized transport.		2060	Automobile-based transportation systems fail with a return to boats and trains without containers
1955	Widespread construction of roads		2065	Widespread failure of roads
1950	Antibiotics arrive to conquer diseases		2070	The final failure of antibiotics
1950	Fungicides and pesticides improve crop production		2070	The final failure of pesticides and fungicides
1948	The first electrical computers are built		2072	The last electrical computers fail
1940	The first medical laboratories are built		2080	The last medical labs close down
1935	Construction of mega-dams		2085	Failure of mega-dams
1925	World population hits 2 billion		2095	World population falls to roughly 2 billion
1920	Rise of the industrial use of oil		2100	Industrial use of oil ceases
1920	Regulation of major corporations		2100	Deregulation of major corporations
1920	Rise of global banking systems		2100	Failure of global banking systems
1900	The rise of the great secular ideologies like democracy, capitalism, communism, socialism, fascism, rule of law.		2120	The final extinguishment of the great secular ideologies
1880	Rise of North American hegemony		2140	Demise of North American hegemony
1850	Construction of city sewers boosts public health		2170	Sewage infrastructure fails with public health drop
1820	The first mechanical computers are built		2200	The last mechanical computers are built
1800	World population hits 1 billion		2220	World population falls to roughly 1 billion
1750	Rise of industrial use of coal		2270	Industrial use of coal ceases
1650	Amoral corporations receive a first charter		2470	Corporations are banished as amoral
1600	Feudalism fades as nations arise		2520	Nations fade as local powers arise
1500	The age of reason starts		2520	The age of reason ends

What this exercise gives us is a series of predictions, down the right-hand columns, about what will happen when. Once ROHIR is used to establish a baseline of such predictions, each can be modified in effect, shifted in time, or otherwise addressed to improve the credibility of the result. In addition, assymetric factors can be layered on top. For example, alternate energy sources cannot possibly stop the decline because the volume of energy produced will be insufficient to take up the slack, but they can slow the rate of decline. Also, climate change will obviously not reverse itself quickly, if ever, and that will cause an assymetry in all events. Resource depletion of non-renewables will not reverse itself ever, and that will cause an assymetry. Finally, people will resist change, and that will cause delays, leading to assymetries.

Now I, personally, would be surprised if any one of my ‘predictions’ proves to be true, as written, because I have not attempted to address assymetries. But, on the other hand, I strongly believe that, if Greer’s “catabolic collapse” is going to happen, the future is going to look very much like the above chart “in spirit”. Why? Because the flow of energy determines how much physical infrastructure we can build and maintain. Because the flow of energy determines how much food we can produce and transport. Because the flow of energy determines how much social complexity we can afford to maintain in our fundamental social systems such as health, education, justice, public administration, finance, and politics. Here ‘complexity’ can be interpreted as time spent discussing and deciding

rather than in the actions of food production. As the flow of energy declines, we, as a global society, must find a way to function with less energy. We will redesign our physical infrastructure to use less energy. We will reconfigure our food production and transportation systems. We will de-complexify our social systems. We will cancel many personal and corporate rights currently enjoyed. We will not have a choice. Many will suffer severe losses, severe misery, and severe injustices along the way. This is what catabolic collapse will look like. Knowing what may be coming, we can plan for it and mitigate it!

The Challenge for Humanity

I believe that the challenge for humanity, the challenge for this generation and those to follow, will be to manage a bell-shaped catabolic collapse of our global society and our global population, instead of an unmanaged shark-fin-shaped collapse. If we don't do it willingly, it will be done for us by nature. And nature tends to be brutal. And the signs of coming collapse are starting to appear. Deep in our psyches, we know that.

I also believe that the sooner we start to examine the ethical, economic and social implications of a declining population in a society of declining energy flows and declining complexity, the more able we will be to manage the first difficult stages.

I suggest that a means by which we can start our imaginations working on the problem is to use a method such as the ROHIR method to build a bell-shaped future story-line that is (a) more credible than the fraudulent exponential or sigmoid frameworks that currently hold our minds and hearts captive; and (b) less frightening and less catastrophic than the shark-fin framework that haunts our subconscious, and is manifest in our artistic fantasies.