



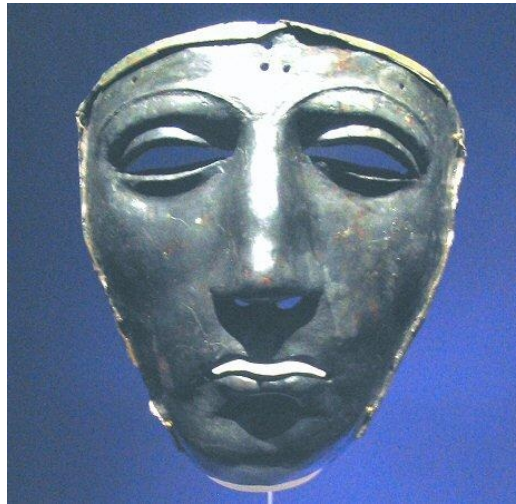
Excerpts from "Peak Civilization: The Fall of the Roman Empire"

Posted by [Ugo Bardi](#) on July 22, 2009 - 10:22am

Topic: [Environment/Sustainability](#)

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This is an abridged version of a 10,000+ word post which can be read [on Oil Drum Europe](#). We hope many will take the time to read the long version. Hopefully, these excerpts will give the flavor of the full story.--Gail.



A silver mask that had belonged to a Roman cavalryman of imperial times. It was found on the site of the battle of Teutoburg, fought in September 9 a.d. This year, 2009, marks the 2000th anniversary of the battle that led to the annihilation of three Roman legions and changed forever the history of Europe. It was a tremendous shock for the Romans, who saw their mighty army destroyed by uncivilized barbarians. It was not yet the peak of the Roman Empire, but it was a first hint that something was deeply wrong with it.

Ladies and gentlemen, first of all thank you for being here. This afternoon I'll try to say something about a subject that I am sure you are all interested in: the decline and the fall of the Roman Empire. It is something that has been discussed over and over; it is because we think that our civilization may follow the same destiny as the Roman one: decline and fall. So, the Roman Empire offers us some kind of a model. We can say it is the paradigm of collapsing societies. And, yet, we don't seem to be able to find an agreement on what caused the collapse of the Roman Empire.

The collapse seen from the inside.

But what does Namatianus think of all this? Well, he sees the collapse all around him, but he can't understand it. For him, the reasons of the fall of Rome are totally incomprehensible. He can only interpret what is going on as a temporary setback. Rome had hard times before but the Romans always rebounded and eventually triumphed over their enemies. It has always been like this, Rome will become powerful and rich again.

There would be much more to say on this matter, but I think it is enough to say that. . . the Romans did not really understand what was happening to their Empire, except in terms of military setbacks that they always saw as temporary. They always seemed to think that these setbacks could be redressed by increasing the size of the army and building more fortifications. Also, it gives us an idea of what it is like living a collapse "from the inside". Most people just don't see it happening--it is like being a fish: you don't see the water.

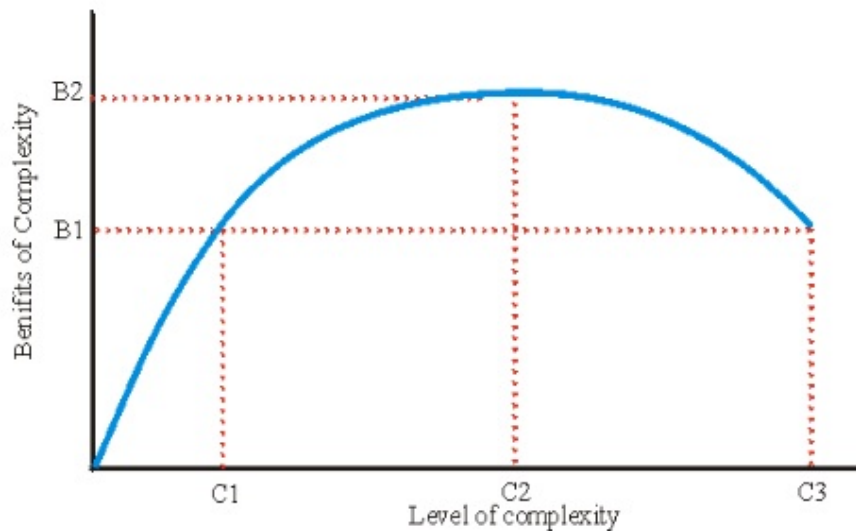
The situation seems to be the same with us: talking about the collapse of our civilization is reserved to a small bunch of catastrophists; you know them; ASPO members, or members of The Oil Drum - that kind of people. Incidentally, we can't rule out that at some moment at the time of the Roman Empire there was something like a "Roman ASPO", maybe "ASPE," the "association for the study of peak empire". If it ever existed, it left no trace. That may also happen with our ASPO; actually it is very likely, but let's go on.

What destroyed the Roman Empire?

This is a transcription of an interview that Tainter gave in the film "Blind Spot" (2008)

In ancient societies that I studied, for example the Roman Empire, the great problem that they faced was when they would have to incur very high costs just to maintain the status quo. Invest very high amounts in solving problems that don't yield a net positive return, but instead simply allowed them to maintain what they already got. This decreases the net benefit of being a complex society.

Here is how Tainter describes his view in graphical form; in his book.



So, you see that Tainter has one thing very clear: complexity gives a benefit, but it is also a cost. This cost is related to energy, as he makes clear in his book. And in emphasizing complexity, Tainter gives us a good definition of what we intend for collapse. Very often people have been discussing the collapse of ancient societies without specifying what they meant for "collapse". For a while, there has been a school of thought that maintained that the Roman Empire had never really "collapsed". It had simply transformed itself into something else. But if you take collapse defined as "a rapid reduction of complexity" then you have a good definition and that's surely what happened to the Roman Empire.

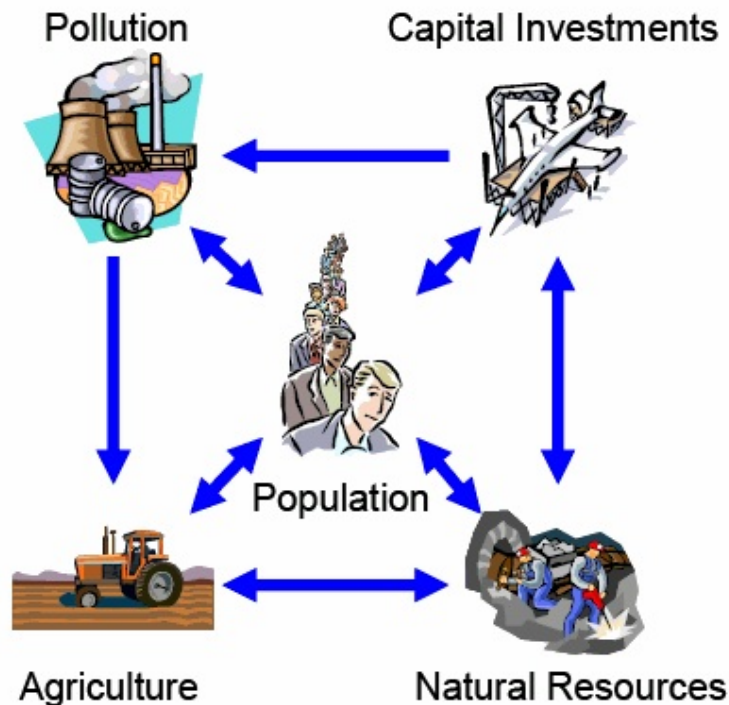
Consider the story that Roman Empire collapse because the Romans used to drink wine in lead goblets; and so they died of lead poisoning. That has some truth: there is evidence of lead poisoning in ancient Roman skeletons; there are descriptions of lead poisoning in ancient Roman texts. Surely it was a problem, probably even a serious one. But you can't see this story of lead poisoning in isolation; otherwise you neglect everything else: the Roman Empire was not just people drinking wine in lead goblets. Think of a historian of the future who describes the fall of the American Empire as the result of Americans eating hamburgers. That would have some truth and for sure the kind of food that most Americans eat today is - well - we know that it is doing a lot of damage to the Americans in general. But you wouldn't say that hamburgers can be the cause of the fall of the American Empire. There is much more to that.

The same kind of reasoning holds for other "causes" that have been singled out for the fall of Rome. Think, for instance, of climatic change. Also here, there is evidence that the fall of the Roman Empire was accompanied by droughts. That may surely have been a problem for the Romans. But, again, we might fall in the same mistake of a future historian who might attribute the fall of the American Empire - say - to the hurricane Katrina. (I have nothing special against the American Empire, it is just that it is the current empire)

The point that Tainter makes, quite correctly, in his book is that it is hard to see the fall of such a complex thing as an empire as due to a single cause. A complex entity should fall in a complex manner, and I think it is correct.

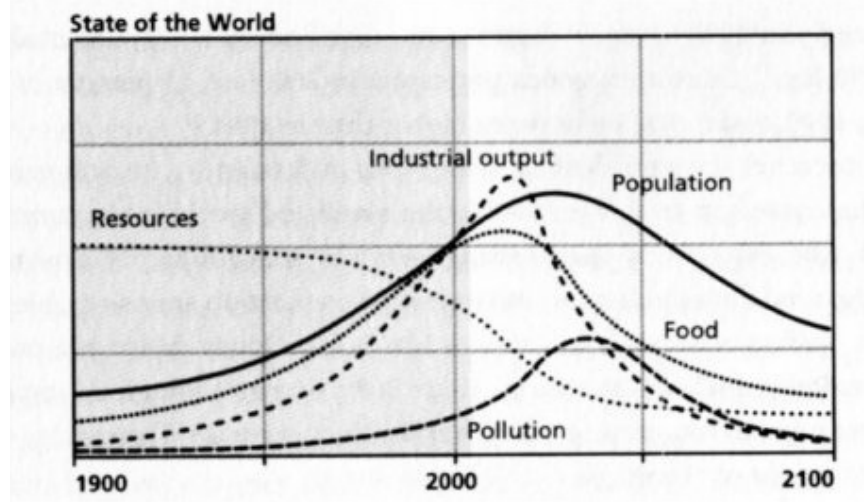
Dynamic Models of Collapse

As we know, "The Limits to Growth" was not about the fall of the Roman Empire. The authors tried to describe our contemporary world, but the model they used is very general and perhaps we can apply it also to the Roman Empire. So, first of all, we need to understand how the model works. Let me show you a simplified graphic representation of the model:



So, Myrtevit's image shows us the major elements of the world model - the model of "The Limits to Growth" - and their relationships. You see population, agriculture, natural resources, pollution and capital. Five main elements of the model; each one is rather intuitive to understand. What is important is the feedback relationship that exists among these elements. Perhaps the most important feedback loop is the one between capital and natural resources. Here is how the authors of "The Limits to Growth" have described this relationship:

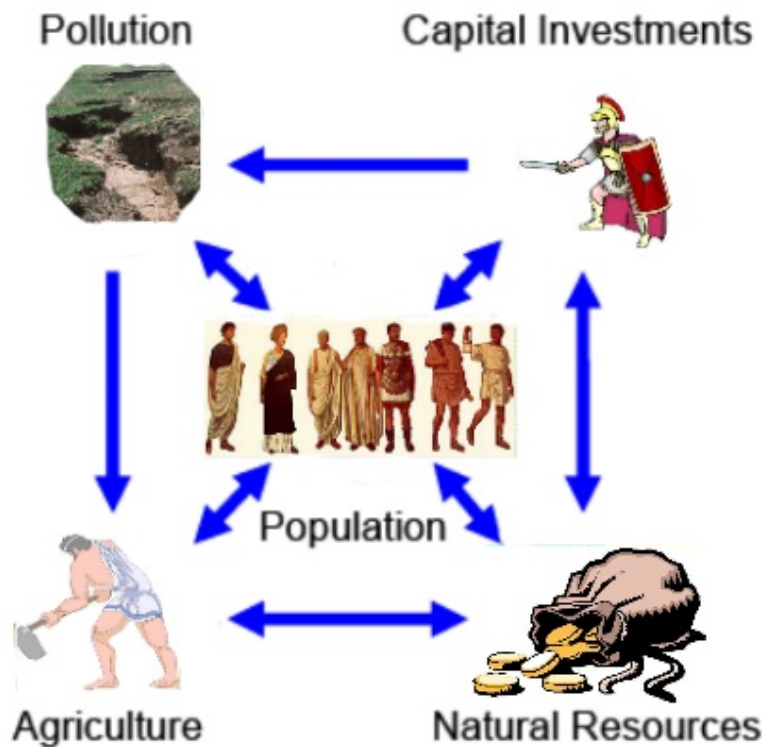
The industrial capital stock grows to a level that requires an enormous input of resources. In the very process of that growth it depletes a large fraction of the resources available. As resource prices rise and mines are depleted, more and more capital must be used for obtaining resources, leaving less to be invested for future growth. Finally investment cannot keep up with depreciation, and the industrial base collapses, taking with it the service and agricultural systems, which have become dependent on industrial inputs.



People are very good at optimizing exploitation. The problem is that they exaggerate and take out of the system more than what the system can replace. And that is the reason of the curve. First you go up because you are so good at exploiting the resource; then you go down because you have exploited it too much. In the middle, there has to be a peak--it is "peak-resource". In the case of crude oil, people speak of "peak oil". In the case of a whole civilization, we may speak of "peak civilization". And, as we said before, peak civilization also corresponds to "peak complexity", in the sense that Tainter described.

The dynamic fall of the Roman Empire

Now we know that we should expect to see these bell curves in the behavior of a complex civilization or an empire. So, we can try to give a look to the Roman Empire in this perspective and see if it agrees with an interpretation based on system dynamics. So, first of all, let me propose a simplified model based on the same scheme that Magne Myrtveit proposed for our world as described in "The Limits to Growth".



We know that the Roman Empire was based mainly on two kinds of resources: military and agricultural. I put the image of a legionnaire for "capital resources" because legions can be seen as the capital of the Roman Empire; military capital. This capital, legions, would be built on a natural resource that was mainly gold. The legions didn't mine gold, they took it from the people who had mined it (or had stolen it from somebody else).

This feedback between military capital and gold is a point that is very well described by Tainter in his book. You can read how military adventures played a fundamental role in the growth of the empire, and earlier on of the Roman Republic. There was a clear case of positive feedback. The Empire would defeat a nearby kingdom, rob it of gold and take part of the population as slaves. Gold could be used to pay for more legions and go on conquering more lands. Positive feedback: the more legions you have, the more gold you can rob; the more gold you have, the more legions you can create. And so on...

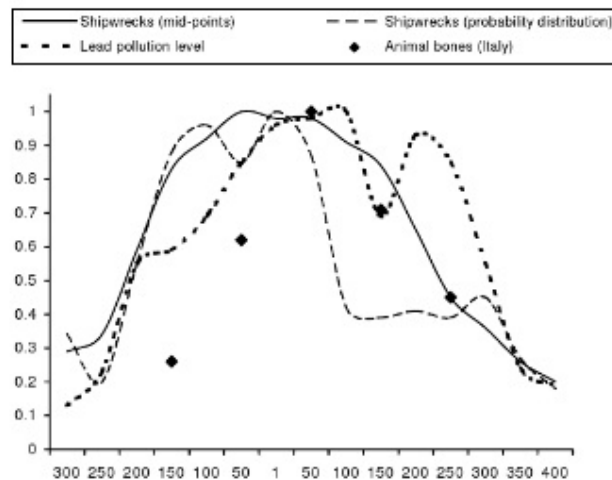
Then, there was agriculture. Surely it was an important economic activity of the Roman Empire, as you can read, again, in Tainter's book. Agriculture is also subjected to positive and negative feedbacks as you can see in the scheme. With good agriculture, the population increases. With more population, you can have more farmers. In the case of the Roman Empire, as population grows, you can have also more legions which will bring back home slaves which can be put to work in the fields. But agriculture has also a negative feedback, and that is erosion.

You can see erosion in the scheme listed as "pollution". It affects agriculture negatively. It reduces population and sets everything backwards: negative feedback, again. The

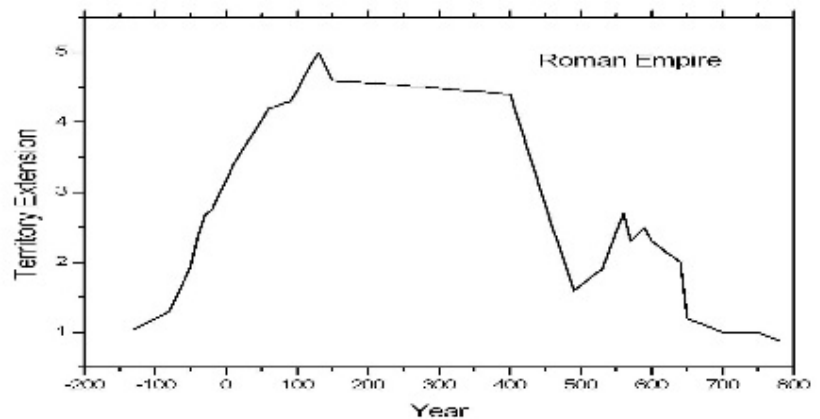
more you try to force agriculture to support a large populations (including the legions) the more strain you put on the fertile soil. Fertile soil is a non renewable resource; it takes centuries to reform the fertile soil, after that it has been lost. So, erosion destroys agriculture, population falls, you have a smaller number of legions and, in the end, you are invaded by barbarians. This is another negative feedback loop that is related to the fall of the Roman Empire.

First of all, if the decline and fall of the Roman Empire has been a case of overexploitation of resources, we should expect to see bell curves for industrial and agricultural production, for population, and for other parameters. As I said, the historical data are scant, but we have archaeological data. So, let me show a plot that summarizes several industrial and agricultural indicators, together with a graph that shows how the extension of the Empire varied in time. It is taken from In search of Roman economic growth, di W. Scheidel, 2007" The other graph is taken from Tainter's book.

In search of Roman economic growth, W. Scheidel, 2008



Taagenpere, 1968



Especially the upper graph is impressive. There has been a "peak-empire", at least in terms of production and agriculture, somewhere around mid 1st century. Afterward, there was a clear decline - it was not just a political change. It was also a real reduction in complexity as Tainter defines collapse. The Roman Empire really collapsed in mid 3rd century. It had a sort of "Hubbert peak" at that time.

The other parameter shown in the figure, the extension of the empire, also shows an approximately bell shaped curve. The Empire continued to exist as a political entity

even after it had been reduced to an empty shell in economic terms. If we think that the extension of the empire is proportional to the "capital" accumulated, then this relationship makes sense if we think of the dynamic model that we saw before. Capital, as we saw, should peak after production. This is a bit stretched as an interpretation, I admit. But at least we see also here a bell shaped curve.

Military expenses were not the only cause of the fall. With erosion gnawing at agricultural yields and mine productivity going down, we should not be surprised if the empire collapsed. It simply couldn't do otherwise. So, you see that the collapse of the Roman Empire was a complex phenomenon where different negative factors reinforced each other. It was a cascade of negative feedbacks, not a single one, that brought down the empire. And this shows how closely related to the Romans we are. Surely there are differences: our society is more of a mining society and less of a military based society. We don't use slaves but, rather, machines. We also have plenty of gadgets that the Romans didn't have. But, in the end, the interactions of the various elements of our economy are not that much different. What brought down the Romans, and eventually will bring us down, is the overexploitation of the resources. If the Romans could have found a way to use their resources, agriculture for instance, in ways that didn't destroy them, erosion in this case, their society could have lasted for a longer time. But they never found an equilibrium point - they went down always using a bit too much of what they had.

Avoiding Collapse

So, our Druid had seen the future and was describing it to Emperor Aurelius. He had seen the solution of the problems of Empire: Middle Ages. It was where the Empire was going and where it could not avoid going. What the Druid was proposing was to go there in a controlled way. Ease the transition, don't fight it! If you know where you are going, you can travel in style and comfort. If you don't, well, it will be a rough ride.

We may imagine a hypothetical "driven transition" in which the government of the Roman Empire at the time of Marcus Aurelius would have done exactly that: abandon the walls, reduce the number of legions and transform them into city militias, reduce bureaucracy and Imperial expenses, delocalize authority, reduce the strain on agriculture: reforest the land. The transition would not have been traumatic and would have involved a lower loss of complexity: books, skills, works of art and much more could have been saved and passed to future generations.

All that is, of course, pure fantasy. Even for a Roman Emperor, disbanding the legions couldn't be easy. After all, the name "Emperor" comes from the Latin word "imperator" that simply means "commander". The Roman Emperor was a military commander and the way to be Emperor was to please the legions that the Emperor commanded. A Roman Emperor who threatened to disband the legions wouldn't have been very popular and, most likely, he was to be a short lived Emperor. So, Emperors couldn't have done much even if they had understood system dynamics. In practice, they spent most of their time trying to reinforce the army by having as many legions as they could. Emperors, and the whole Roman world, fought as hard as they could to keep the status quo ante, to keep things as they had always been. After the 3rd century crisis, Emperor

Diocletian resurrected the Empire transforming it into something that reminds us of the Soviet Union at the time of Breznev. An oppressive dictatorship that included a suffocating bureaucracy, heavy taxes for the citizens, and a heavy military apparatus. It was such a burden for the Empire that it destroyed it utterly in little more than a century.

Our Druids may be better than those of the times of the Roman Empire, at least they have digital computers. But our leaders are no better apt at understanding complex system than the military commanders who ruled the Roman Empire. Even our leaders were better, they would face the same problems: there are no structures that can gently lead society to where it is going. We have only structures that are there to keep society where it is - no matter how difficult and uncomfortable it is to be there. It is exactly what Tainter says: we react to problems by building structure that are more and more complex and that, in the end, produce a negative return. That's why societies collapse.

So, all our efforts are to keep the status quo ante. For this reason we are so desperately looking for something that can replace crude oil and leave everything else the same. It has to be something that is liquid, that burns and, if possible, even smells bad. Drill more, drill deeper, boil tar sands, make biofuels even if people will starve. We do everything we can to keep things as they are.

And, yet, we are going where the laws of physics are taking us. A world with less crude oil, or with no crude oil at all, cannot be the same world we are used to, but it doesn't need to be the Middle Ages again. If we manage to deploy new sources of energy, renewable or nuclear - fast enough to replace crude oil and the other fossil fuels, we can imagine that the transition would not involve a big loss of complexity, perhaps none at all. More likely, a reduced flux of energy and natural resources in the economic system will entail the kind of collapse described in the simulations of "The Limits to Growth." We can't avoid going where the laws of physics are taking us.

Conclusion: Showdown at Teutoburg

Two thousand years ago, three Roman legions were annihilated in the woods of Teutoburg by a coalition of tribes of the region that the Romans called "Germania". Today, after so many years, the woods of the region are quiet and peaceful places, as you can see in this picture:



Civilizations and empires, in the end, are just ripples in the ocean of time. They come and go, leaving little except carved stones proclaiming their eternal greatness. But, from the human viewpoint, Empires are vast and long standing and, for some of us, worth fighting for or against. But those who fought in Teutoburg couldn't change the course of history, nor can we. All that we can say - today as at the time of the battle of Teutoburg - is that we are going towards a future world that we can only dimly perceive. If we could see clearly where we are going, maybe we wouldn't like to go there; but we are going anyway. In the end, perhaps it was Emperor Marcus Aurelius who had seen the future most clearly and understood that it is not for us to change it.

Nature which governs the whole will soon change all things which thou seest, and out of their substance will make other things, and again other things from the substance of them, in order that the world may be ever new.

Marcus Aurelius Verus - "Meditations" ca. 167 A.D.

The full post can be found here: ["Peak Civilization": The Fall of the Roman Empire.](#)



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