MuseLetter

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This month's Museletter is about change. First up is an essay about one thing everyone interested in social change should know; this is followed by an interview looking at what it will take to change mainstream economic thinking.

Want to Change the World? Read This First

History is often made by strong personalities wielding bold new political, economic, or religious doctrines. Yet any serious effort to understand how and why societies change requires examination not just of leaders and ideas, but also of environmental circumstances. The ecological context (climate, weather, and the presence or absence of water, good soil, and other resources) may either present or foreclose opportunities for those wanting to shake up the social world. This suggests that if you want to change society—or are interested in aiding or evaluating the efforts of others to do so—some understanding of exactly how environmental circumstances affect such efforts could be extremely helpful.

Perhaps the most important key to grasping the relationship between the environment and processes of societal change was articulated by American anthropologist Marvin Harris (1927-2001). From the very beginning of efforts to systematically study human societies in the 18th and 19th centuries, it had been clear that there were strong correlations between how societies obtain their food (whether by hunting and gathering, horticulture, agriculture, animal herding, or fishing), and their social structures and beliefs about the world. Hunter-gatherers typically live in small peripatetic bands, have an egalitarian social structure, and regard the natural world as full of supernatural powers and personalities that can be contacted or influenced by shamans. Farmers, on the other hand, stay in one place and produce seasonal surpluses that often end up subsidizing the formation of towns as well as classes of full-time specialists in various activities (metal-working, statecraft, soldiery, banking, record-keeping, and so on); agricultural societies also tend to develop formalized religions presided over by a full-time, hierarchical priestly class. These systemic distinctions and similarities have held true on different continents and throughout centuries. Harris showed how shifts from one kind of food system to another were driven by environmental opportunity and necessity, and he refined his insights into an anthropological research strategy. [1]

Marvin Harris's *magnum opus* was the rather difficult book *Cultural Materialism: The Struggle for a Science of Culture* (1979). While he

was perfectly capable of writing for the general public—others of his titles, like *Cows, Pigs, Wars and Witches* (1974), and *Cannibals and Kings* (1977) were best-sellers—in *Cultural Materialism*, Harris was writing for fellow anthropologists. The book is full of technical jargon, and its author argues each point meticulously, presenting a surfeit of evidence. However, the kernel of Harris's theoretical contribution can be summarized rather briefly.

All human societies consist of three interrelated spheres: first, the *infrastructure,* which comprises a society's relations to its environment, including its modes of production and reproduction—think of this primarily as its ways of getting food, energy, and materials; second, the *structure,* which comprises a society's economic, political, and social relations; and third, the *superstructure,* which consists of a society's symbolic and ideational aspects, including its religions, arts, rituals, sports and games, and science. Inevitably, these three spheres overlap, but they are also distinct, and it is literally impossible to find a human society that does not feature all three in some permutation.

For social change advocates, it's what comes next that should agitate the neurons. Harris's "cultural materialism" [2] argues for the principle of what he calls "probabilistic infrastructural determinism." That is to say, the structure and superstructure of societies are always contested to one degree or another. Battles over distribution of wealth and over ideas are perennial, and they can have important consequences: life in the former East Germany was very different from life in West Germany, even though both were industrial nations operating under (what started out to be) nearly identical ecological conditions. However, *truly radical societal change tends to be associated with shifts of infrastructure.* When the basic relationship between a society and its ecosystem alters, people must reconfigure their political systems, economies, and ideology accordingly, even if they were perfectly happy with the previous state of affairs.

Societies change their infrastructure out of necessity (for example, due to depletion of resources) or opportunity (usually the increased availability of resources, made available perhaps by migration to new territory or by the adoption of a new technology). The Agricultural Revolution 10,000 years ago represented a massive infrastructural shift, and the fossil-fueled Industrial Revolution 200 years ago had even greater and far more rapid impact. In both cases, population levels grew, political and economic relations evolved, and ideas about the world mutated profoundly.

Explaining the former example in a bit more detail may help illustrate the concept. Harris was an early adopter of the now-common view of the Agricultural Revolution as an adaptive response to environmental shifts at the end of the Pleistocene, a period of dramatic climate change. Glaciers were receding and species (especially big herbivorous prey animals such as mammoths and mastodons) faced extinction, with human predation hurrying that extinction process along. "In all centers of early agricultural activity," writes Harris,

> the end of the Pleistocene saw a notable broadening of the subsistence base to include more small mammals,

> reptiles, birds, mollusks, and insects. Such 'broad spectrum' systems were a symptom of hard times. As the labor costs of the hunter-gatherer subsistence systems rose, and as the benefits fell, alternative sedentary modes of production became more attractive.

Lifestyles based on cultivation took root and spread, and with them (eventually) came villages and chiefdoms. In certain places, the latter in turn mutated to produce the most radical social invention of all, the state:

> The paleotechnic infrastructures most amendable to intensification, redistribution, and the expansion of managerial functions were those based on the grain and ruminant complexes of the Near and Middle East, southern Europe, northern China, and northern India. Unfortunately these were precisely the first systems to cross the threshold into statehood, and they therefore have never been directly observed by historians or ethnologists. Nonetheless, from the archaeological evidence of storehouses, monumental architecture, temples, high mounds and tells, defensive moats, walls, towers, and the growth of irrigation systems, it is clear that managerial activities similar to those observed among surviving pre-state chiefdoms underwent rapid expansion in these critical regions immediately prior to the appearance of the state. Furthermore, there is abundant evidence from Roman encounters with "barbarians" in northern Europe, from Hebraic and Indian scriptures, and from Norse, Germanic, and Celtic sagas that intensifier-redistributor-warriors and their priestly retainers constituted the nuclei of the first ruling classes in the Old World.

While I have omitted most of Harris's detailed explanation, nevertheless we have here, in essence, an ecological explanation for the origin of civilization. What's more, Harris is not merely proposing an entertaining "just-so" story, but a scientific hypothesis that is testable within the limits of available evidence.

Cultural materialism is capable of illuminating not just grand societal shifts, such as the origin of agriculture or the state, but the deeper functions of cultural institutions and practices of many sorts. Harris's excellent textbook *Cultural Anthropology* (2000, 2007), co-authored with Orna Johnson, includes chapters with titles such as "Reproduction," "Economic Organization," "Domestic Life," and "Class and Caste"; each features illustrative sidebars showing how a relevant cultural practice (peacemaking among the Mehinacu of central Brazil, polyandry among the Nyimba of Nepal) is adaptive to environmental necessity. Throughout this and all his books, indeed throughout his entire career, Harris aimed to show that probabilistic infrastructural determinism is the only sound basis for a true "science of culture" that is capable of producing testable hypotheses to explain why societies evolve the way they do.

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Why is this important now? For the simple reason that our own society is on the cusp of an enormous infrastructural transformation.

Which is remarkable, because we're still reeling from the previous one, which began just a couple of centuries ago. The fossil-fueled Industrial Revolution entailed a shift from reliance on mostly renewable energy sources—firewood, field crops, some water power, wind for sails, and animal muscle for traction—to cheaper, more controllable, more energy dense, and (in the case of oil) more portable non-renewable sources.

Oil has given us the ability to dramatically increase the rate at which we extract and transform Earth's bounty (via mining machinery, tractors, and powered fishing boats), as well as the ability to transport people and materials at high speed and at little cost. It and the other fossil fuels have also served as feedstocks for greatly expanded chemicals and pharmaceuticals industries, and have enabled a dramatic intensification of agricultural production while reducing the need for field labor. The results of fossil-fueling our infrastructure have included rapid population growth, the ballooning of the middle class, unprecedented levels of urbanization, and the construction of a consumer economy. While elements of the Scientific Revolution were in place a couple of centuries prior to our adoption of fossil fuels, cheap fossil energy supplied a means of vastly expanding scientific research and applying it to the development of a broad range of technologies that are themselves directly or indirectly fossil-fueled. With heightened mobility, immigration increased greatly, and the democratic multi-ethnic nation state became the era's emblematic political institution. As economies expanded almost continually due to the abundant availability of high-quality energy, neoliberal economic theory emerged as the world's primary ideology of societal management. It soon evolved to incorporate several unchallenged though logically unsupportable notions, including the belief that economies can grow forever and the assumption that the entire natural world is merely a subset of the human economy.

Now, however, our still-new infrastructural regime based on fossil fuels is already showing signs of winding down. There are two main reasons. One is climate change: carbon dioxide, produced in the burning of fossil fuels, is creating a greenhouse effect that is warming the planet. The consequences will be somewhere between severe and cataclysmic. If we continue burning fossil fuels, we're more likely to see a cataclysmic result, which could make continuation of industrial agriculture, and perhaps civilization itself, problematic. We do have the option to dramatically curtail fossil fuel consumption in order to avert catastrophic climate change. Either way, however, our current infrastructure will be a casualty.

The second big reason our fossil fuel-based infrastructure is endangered has to do with depletion. We're not running out of coal, oil, or natural gas in the absolute sense, but we have extracted these non-renewable resources using the best-first, or low-hanging fruit, principle. With oil, the most strategically important of the fossil fuels (because of its centrality to transportation systems), we have already reached the point of diminishing returns. Compared to a decade ago,

the global petroleum industry has more than doubled its rate of investment in exploration and production, while actual rates of global crude oil production have flat-lined. Costs of production are rising, and drillers are targeting geological formations that were formerly considered too problematic to bother with. With oil, the fate of the world's economy appears to hang on the outcome of a race between technology and depletion: while industry spokespeople and media pundits tend to cheer new technology such as hydraulic fracturing, persistently high oil prices and soaring production costs suggest that depletion is in fact pulling ahead. Similar diminishing-returns limits with coal and natural gas production will likely be encountered within the next decade, both in the US and the world as a whole.

At a bare minimum, climate change and fossil fuel depletion will force society to change to different energy sources, giving up reliance on energy-dense and controllable coal, oil, and gas in favor of more diffuse and intermittent renewable sources like wind and solar. This in itself is likely to have enormous societal implications. While electric passenger cars running on power supplied by wind turbines and solar panels are feasible, electric airliners, container ships, and 18-wheel trucks are not. Distributed electricity generation from renewables, together with a decline in global shipping and air transport, may favor less globalized and more localized patterns of economic and political organization.

However, we must also consider the strong likelihood that our looming, inevitable shift away from fossil fuels will entail a substantial reduction in the amount of useful energy available to society. Wind and sunlight are abundant and free, but the technology used to capture energy from these ambient sources is made from nonrenewable minerals and metals. The mining, manufacturing, and transport activities necessary for the production and installation of wind turbines and solar panels currently require oil. It may theoretically be possible to replace oil with electricity from renewables in at least some of these processes, but for the foreseeable future wind and solar technologies can best be thought of as fossil fuel extenders.

Nuclear power, with its unbreakable reliance on mining and transport, is likewise a fossil fuel extender—but a far more dangerous one, given unsolved problems with accidents, nuclear proliferation, and waste storage. When the construction and decommissioning of power plants, and the mining and processing of uranium are all taken into account, nuclear power also offers a relatively low energy return on the energy invested (EROEI) in producing it.

Relatively low energy returns-on-investment from both nuclear and renewable energy sources may themselves result in societal change. The EROEI of fossil fuels was extremely high in comparison with that of energy sources previously available. This was a major factor in reducing the need for agricultural field labor, which in turn drove urbanization and the growth of the middle class. Some renewable sources of energy offer a better EROEI than firewood or agricultural crops, but none can compare with coal, oil, and gas in their heyday. This suggests that the social consequences of the end of cheap fossil energy may include a partial re-ruralization of society and a shrinking of the middle class (the latter process is already beginning in the

United States).

With less useful energy available, the global economy will fail to grow, and will likely enter a sustained period of contraction. Increased energy efficiency may cushion the impact but cannot avert it. With economies no longer growing, our current globally dominant neoliberal political-economic ideology may increasingly be called into question and eventually overthrown.

While energy is key to society's infrastructure, other factors require consideration as well. Fossil fuels are depleting, but so are a host of additional important resources, including metals, minerals, topsoil, and water. So far, we have made up for depletion in these cases by investing more energy in mining lower grade ores, by replacing soil nutrients with commercial fertilizers (many made from fossil fuels), and by transporting water, food, and other goods from places of local abundance to regions in which those materials are scarce. This strategy has increased the human carrying capacity of our planet, but it is a strategy that may not work much longer as energy itself becomes scarcer.

Further alterations in the links between the environment and society will arise from climate change. Even assuming that nations undertake dramatic reductions in carbon emissions soon, cumulative past emissions virtually guarantee continued and increasing impacts that will include rising sea levels and worsening droughts and floods. By mid-century, hundreds of millions of climate refugees may be in search of secure habitat.

There are optimistic ways of viewing the future, based on assumptions that fossil fuels are in fact abundant and will last another century or more, that new nuclear power technologies will be more viable than current ones, that renewable energy sources can be scaled up quickly, and that likely impacts of climate change have been overestimated. Even if one or more of these assumptions turns out to be correct, however, the evidence of declining returns on energy and financial investments in oil extraction cannot be disregarded. An infrastructure shift is underway. Considering oil's role in industrial agriculture, this shift will undoubtedly and profoundly impact our food system—and food (which is our most basic energy source, from a biological perspective) is at the core of every society's infrastructure. Whether or not optimistic assumptions are valid, we probably face an infrastructural transformation at least as significant as the Industrial Revolution.

But the error bars on energy supplies and climate sensitivity include more pessimistic possibilities. Once useful fossil energy supply rates begin to falter, this could trigger an unwinding of the global financial system as well as international conflict. It is also possible that the relationship between carbon emissions and atmospheric temperatures is non-linear, with Earth's climate system subject to self-reinforcing feedbacks that could result in a massive die-off of species, our own included.

Choose your assumptions—optimistic, pessimistic, or somewhere in between. In any case, this is a big deal.

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We are living at a historic moment when the structure of society (economic and political systems) and its superstructure (ideologies) are about to be challenged perhaps as never before. When infrastructure changes, what seemingly was solid melts into air, paradigms fall, and institutions crumble, until a new societal regime emerges. Think of a caterpillar pupating, its organ systems evidently being reduced to undifferentiated protoplasm before reorganizing themselves into the features of a butterfly. What a perfect opportunity for an idealist intent on changing the world!

Indeed, fault lines are already appearing throughout society. From a cultural materialist point of view, the most important of these relate to *how* the inevitable infrastructure change will occur. Proponents of distributed renewable energy sources are the underdogs, and the defenders of centralized, fossil energy systems the incumbents in deepening disputes over subsidies and other elements of government energy policy. Meanwhile, grassroots opposition to extreme fossil fuel extraction methods is springing up everywhere that companies are fracking for oil and gas, drilling in deepwater, mining tar sands, or blasting mountaintops to mine coal. Opposition to an oil pipeline is fueling one of the hottest political fires in Washington D.C. And concern about climate change has acquired an intergenerational dimension, as young people across America sue state governments and federal agencies for failing to develop climate action plans. Young people, after all, are the ones who will most forcibly face the consequences of climate change, and their attitude toward older generations may not be forgiving.

We are also seeing increasing conflict over the structure of society—its systems of economic distribution and political decision-making. As economic growth grinds to a halt, the world's wealthy investor class is seeking to guarantee its solvency and maintain its profits by shifting costs onto the general public via bailouts, austerity measures, and quantitative easing (which lowers interest rates, flushing money out of savings accounts and into the stock market). Jobs downsize and wages fall, but the number of billionaires billows. However, rising economic inequality has its own political costs, as documented in Amazon's recent best-selling book, a 700-page tome called *Capital in the Twenty-First Century*, which unfortunately fails to grasp the infrastructural shift that is upon us or its implications for economy and society. Polls show rising dissatisfaction with political leaders and parties throughout the West. But in most countries there is no organized opposition group poised to take advantage of this widespread discontent. Instead, political and economic institutions are themselves losing legitimacy.

Infrastructural tremors are also reverberating throughout international geopolitics. The world's dominant superpower, which attained its status during the 20th century at least partly because it was the home of the global oil industry, is now quickly losing diplomatic clout and military "credibility" as the result of a series of disastrous miscalculations and blunders, including its invasions and occupations of Afghanistan and Iraq. Coal-fueled China is just now becoming world's largest economy, though it and other second-tier nations (UK,

Germany, Russia) are themselves beset with intractable and growing economic contradictions, pollution dilemmas, or resource limits.

Society's superstructure is also subject to deepening rupture, with neoliberalism coming under increasing criticism, especially since 2008. However, there is a more subtle and pervasive (and therefore potentially even more potent) superstructure to modern society, one largely taken for granted and seldom named or discussed, and it is likewise under assault. Essayist John Michael Greer calls this "the civil religion of progress." As Greer has written, the idea of progress has quietly become the central article of faith of the modern industrial world, more universally held than the doctrine of any organized religion. The notion that "history has a direction, and it has to make cumulative progress in that direction" has been common to both capitalist and communist societies during the past century. But what will happen to that "religious" conviction as the economy shrinks, technology fails, population declines, and inventors fail to come up with ways of managing society's multiplying crises? More to the point, how will billions of fragile human psyches adjust to seeing their most cherished creed battered repeatedly upon the shoals of reality? And what new faith will replace it? Greer suggests that it will be one that re-connects humanity with nature, though its exact form is yet to reveal itself.

All of these trends are in their very earliest phases. As infrastructure actually shifts—as fuels deplete, as weather extremes worsen—tiny cracks in the edifice of business-as-usual will become unbridgeable chasms.

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Here's my last big take-away message for would-be social changers: Only ideas, demonstration projects, and policy proposals that fit our emerging infrastructure will have genuine usefulness or staying power. How can you know if your idea fits the emerging infrastructure? There's no hard and fast rule, but your idea stands a good chance if it assumes we are moving toward a societal regime with less energy and less transport (and that is therefore more localized); if it can work in a world where climate is changing and weather conditions are extreme and unpredictable; if it provides a way to sequester carbon rather than releasing more into the atmosphere; and if it helps people meet their basic needs during hard times.

It's fairly easy to identify elements of our society's existing structure and superstructure that *won't* work with the infrastructure toward which we appear to be headed. Consumerism and corporatism are two big ones; these were 20th century adaptations to cheap, abundant energy. They justifiably have been the objects of a great deal of activist opposition in recent decades. There were reforms or alternatives to consumerism and corporatism that *could have worked* within our industrial infrastructure regime (or that did work in some places, not others): European-style industrial socialism is the primary example, though that might be thought of as a magnetic hub for a host of idealistic proposals championed by thousands, maybe even millions of would-be world-changers. But industrial socialism is

arguably just as thoroughly dependent on fossil-fueled infrastructure as corporatism and consumerism. To the extent that it is, activists who are married to an industrial-socialist vision of an ideal world may be wasting many of their efforts needlessly.

Historic examples offer useful ways of grounding social proposals. In the current context, it is important to remember that almost all of human history took place in a pre-industrial, "pre-progress" context, so it should be fairly easy to differentiate desirable from undesirable societal adaptations to analogous challenges in past eras. For example, anarchist philosopher and evolutionary biologist Peter Kropotkin, in his book *Mutual Aid,* praised medieval European cities as sites of autonomy and creativity—though the period during which they flourished is often thought of as a "dark age."

There are plenty of activist projects underway now that appear thoroughly aligned with the post-fossil fuel infrastructure toward which we are headed, including Permaculture cooperatives, ecovillages, local food campaigns, and Transition Initiatives. Relevant new economic trends include the collaborative economy, the sharing economy, collaborative consumption, distributed production, P2P finance, and the open source and open knowledge movements. While some of the latter merely constitute new business models that appear to spring from web-based technologies and social media, their attractiveness may partly derive from a broadly shared cultural sense that the centralized systems of production and consumption characteristic of the 20th century are simply no longer viable, and must give way to more horizontal, distributed networks. The list of existing ideas and projects that could help society adapt in a post-fossil fuel era is long. Plenty of people have sensed the direction of global change and come to their own sensible conclusions about what to do, without any awareness of Harris's cultural materialism. But such awareness could help at the margins by reducing wasted effort.

Do you want to change the world? More power to you. Start by identifying your core values—fairness, peace, stability, beauty, resilience, whatever. That's up to you. Figure out what ideas, projects, proposals, or policies further those values, but also fit with the infrastructure that's almost certainly headed our way. Then get to work. There's plenty to do, and lots at stake.

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[1] The simple observation that human culture is adaptive to environmental conditions is revelatory: Jared Diamond (author of *Guns, Germs and Steel*) has based a career on it, though he consistently fails to credit Harris—who was earlier and more thorough. Harris himself was careful to cite predecessors upon whose work he was building, including Karl Marx.

[2] The term *materialism* is loaded with connotations that distract from the issues at hand. In Marvin Harris's usage, the word refers merely to a way of thinking that assumes material effects are due to material causes. When I was teaching a college program on sustainability, I suggested to my students that they think of

probabilistic infrastructural determinism as "cultural ecology." I knew this was somewhat inaccurate, as cultural ecology is a school of anthropological thought closely related to, but distinct from, cultural materialism. However, many students simply couldn't get past the word *materialism*: for them, this was an irremediably distasteful term associated both with the negation of spirituality and with the American mania for buying and consuming corporate products.

Boom or bust time for critical thinking?

Following the massive bailouts, stimulus spending and quantitative easing of recent years, everyone breathed a sigh of relief and went back to sleep, says Richard Heinberg. But the coming global energy crisis will likely provide the jolt that wakes everyone up again.

Almantas Samalavicius: Governments, big business and hordes of individuals all over the world seem to be captivated by the idea of never-ending economic growth. In eastern Europe most left- and right-leaning parties, despite their differences and contradictions on other issues, promote the same ideology of economic growth; they all seem to believe that the only way to welfare and well-being is endlessly increasing production and consumption. Why is this type of thinking so strong and persistent despite sufficient evidence that it leads us to a dead-end? Can it be challenged with reasonable arguments when pro-growth positions look more like religious belief than any type of rational reasoning?

Richard Heinberg: You've identified the problem very well. The growth ideology is as much "religious" as economic (if we define "religion" as a self-reinforcing belief system immune to rational falsification). In fact, economics itself is far from being a science, and relies on many unexamined assumptions – including the assumption that growth of population and consumption can continue forever on a finite planet. This is all mere wishful thinking, and is characteristic of a certain mindset that accompanies booms of all kinds – whether stock market booms, real estate price booms, resource extraction booms, or whatever. People who are profiting from the boom adopt the attitude, "This can go on forever! Everyone will get rich!" Of course, it's never true. Rational arguments work for some people, but never for boom boosters.

Pro-growth economists and politicians feel especially justified by the fact that the boom they're boosting – fossil-fueled industrial expansion – has been going on for decades. However, the difference in time-scale doesn't mean that the basic boom-time dynamics aren't the same.

AS: How is the infatuation with economic growth related to ideas of progress and the power of science that came into being with the Enlightenment project and modernity? Many otherwise intelligent individuals firmly believe that present problems of climate change as well as potential economic crises (the speed and number of which is constantly growing) can be overcome using instruments from the "tool-box" of science. There are scientists who seriously claim that humanity was always challenged by various problems and always

managed to solve them, especially when aided by science and technological advancement. However, this does not seem to be working lately. What are the key factors that might and will stop our economy "growing"?

RH: Science and technology have certainly accomplished wonders during the past two centuries. And there are undoubtedly more discoveries and inventions awaiting us. However, there are two reasons to be sceptical that science and technology will keep our economy growing in perpetuity.

The first has to do with correctly identifying the sources of economic expansion since the Industrial Revolution. It is commonly believed that science, technology, and markets were the reasons for the boom. These all certainly played important roles, but the boom would not have happened without fossil fuels. Energy is the fundamental necessity for all economic activity, and for life itself. Fossil fuels gave us energy that was cheaper and more abundant by far than had ever been available previously. Now, as the "low-hanging fruit" of our endowment of coal, oil and gas are gone, and as climate change looms as an economy-killing threat, we must develop other energy sources to replace them. There are many options, but none are as cheap, abundant, portable and concentrated as fossil fuels. Technology does not operate by itself; it needs energy. And while some technologies help us access new energy sources, they cannot violate the laws of thermodynamics. There is no free lunch!

The second reason is that science and technology are subject to the law of diminishing returns. In the early days of scientific research, a small investment yielded major discoveries. Today it requires teams of scientists using extremely expensive equipment just to test a very minor improvement on a basic technology that has been in use for decades. Many researchers into the history of science and technology have come to the same conclusion: we have reached a stage where investments in discovery and invention are soaring, but the outcomes are of dwindling practical importance.

AS: In *The End of Growth* you point out the factors that will prevent the economy from growing and among these you mention climate change, shortages of energy, water and minerals as well as "waves of bank failures, company bankruptcies", among others. And there is a lot of evidence available to support this attitude, as well as large quantities of serious literature on these subjects. Yet have we experienced a serious shift in human awareness? What can help politicians and people to realize that while preaching further growth we are setting ourselves on the road to nowhere? Do you believe that informing and educating people can change anything?

RH: I don't seriously think that a book like mine will change the minds of most politicians and economists, or of a majority of the general public. However, if the facts I'm citing are true and relevant, if my logic is sound, and if I argue my case competently, a small percentage of the public will start to think differently. Those people will make better decisions in their own lives and help push the public discussion along. Will that be enough to avert climate change, bank failures and all the rest? Of course not. But at least for those few who were warned, and perhaps for others as well, the future will be

better than it would have been if I had not written *The End of Growth*. I think it's important that we each do what we can, despite the enormity of the looming challenges.

AS: The last century produced an ideology that might be called scientism. This ideology claimed to contain a "scientific" view of things but produced quite the opposite social effects. How much do you think we are still dominated by its mythologies and how do these block us from seeing the future in realistic terms?

RH: The fault does not lie with the scientific method. This is simply a way of testing and sorting assertions about reality. We need more critical thinking, not less. However, science is often directed toward the ends of those who are able to pay for research projects. So, for example, we have chemical companies funding research to "prove" that genetically modified foods are perfectly safe, and oil companies funding research apparently showing that fracking is completely harmless to the environment and to human health. Because it's science, we therefore tend to believe it. We must always question the motives behind research projects, as well as the assumptions on which they rest.

AS: Many people do not seem to believe in the peak-oil scenario, or at least not in the likelihood of its immanent occurrence. And despite evidence of lower quantities of available resources (including oil), as well as fewer locations and more complicated methods for extracting oil (so well discussed and documented in your book), the attitude towards this problem is in a certain sense reminiscent of the attitude that haunted the famous and extremely insightful study entitled *The Limits to Growth*. Some critics doubt the evidence, others cherish their faith in the "miracles" of science and technology... You seem to insist that this time "the party's over" (to refer to the title of your previous book). Why is it over as you suggest?

RH: The evidence is rock-solid at this point. If you define "oil" as only the stuff that can be bought and sold as oil (that is, if you exclude substances like biofuels, condensate, and natural gas liquids), then world oil production stopped growing in 2005. That is not because the oil industry stopped investing in exploration and new production technologies. Quite the opposite: between 1998 and 2005, the industry spent 1.5 trillion dollars on exploration and production, yielding 8.6 million barrels per day in additional world oil production. Between 2005 and 2013, the industry invested four trillion dollars in exploration and production, yet this more-than-doubled investment produced no new net production if we define "oil" narrowly and (in my view) correctly, as only what can be sold as petroleum refinery inputs. Meanwhile, oil prices have settled at a "new normal" of over 100 dollars per barrel. The only important new production (which merely offsets declines elsewhere) has come from tight oil sources in the US, and those are subject to very rapid per-well decline rates, as we have documented in our work at Post Carbon Institute (see for example *here*), so this will be a very short-term boom, and it will not be replicated to any significant extent elsewhere in the world.

I fully expect that oil industry spokespeople like Daniel Yergin will be telling us that "peak oil is rubbish" even after total world oil production has been clearly and obviously declining for a decade or

more. But, of course, by that time there won't be much of an economy left, and their audience will be largely occupied with tasks like finding enough food to eat.

AS: The energy crisis was a global issue a few decades ago, albeit for somewhat different reasons. Now we seem to be approaching another end of a cycle. What will be the consequences of the new global energy crisis and can we still hope to avoid it? If so, what strategies do you think might help us?

RH: I don't think there is any way of avoiding a global energy crisis at this point. However, we can survive it more successfully if we do two things: invest in alternative (renewable) energy sources now while we can, and learn to live well with less. Find ways to fill basic human needs (growing food, heating water, keeping warm in the winter) by using much, much less energy. Often this can be done fairly cheaply, but it does require effort and changes in habits. The sooner we start, the easier the transition will be.

AS: For several decades, the school of economic thought associated with the likes of Herman E. Daly insisted on a sort of steady-state economics and on zero-growth or degrowth (á la Serge Latouche) strategies. However, these schools of thought remain marginalized by mainstream or neo-classical economic thinking, which seems to dominate in the academy, business and government circles. What is required to change current economic mainstream thinking? How could universities and colleges respond to the urgent issues of our time?

RH: Frankly, I think only a big shock will change mainstream economic thinking. We actually started to hear some economists starting to question their assumptions in late 2008, early 2009. Then, when governments and central banks stepped in with massive bailouts, stimulus spending and quantitative easing, everyone breathed a sigh of relief and went back to sleep – even though the fundamental problems had not been addressed and the "solutions" are obviously short-term. It will take a bigger jolt to wake everyone up again.

Meanwhile, the ranks of followers of Daly, Latouche and other ecological economists continue to grow. It's especially important that ecological economics gains a larger foothold in academia, as young people are still being indoctrinated with a view of the world that is demonstrably false, and that is driving the world toward a series of looming catastrophes. If you're a student, consider studying and teaching ecological economics.