Will Civilization Outlast Petroleum?

Book Review by Sheila Newman

Darwin's thesis, the *Origin of Species*, used geological calculations of the time to frame the Malthusian economics of ecology. Now, once again, a geological perspective comes into evolutionary discourse with Walter Youngquist's *Geodestinies*, the study of the role of minerals in the evolution and survival of human societies.

Here is a petroleum geologist who has carefully examined the problem of human multiplication, expansion and consumption, from the perspective of his own scientific specialty and mining experience. The result is an enjoyable learning experience for those lacking a geological background, although the take-home message is less cheery. Scientists and technicians from other disciplines will probably agree that Youngquist's work provides a keystone in the bridge to understanding and quantifying our current predicament. It is an example of what E.O. Wilson calls "Consilience." Youngquist is a brilliant science communicator.

Geodestinies: The inevitable control of Earth resources over nations and individuals
by Walter Youngquist
Portland, OR: National Book Co.
500 pages, $29.95

Geodestinies is a detailed exploration of the practical application of energy resources theory and fable. It is of particular interest to everyone on earth because the principle question it examines is: What does petroleum based energy do for civilization and how long is it going to last?

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Two major theories frame Youngquist's considered opinions on this question. The first is the Hubbert's Peak theory, which attempts to calculate when oil production will peak and decline. This is possibly the most famous and enduring of projections based on statistical trends of petroleum discovery and production, taking population growth and national consumption rates into account. The second is Rees and Wackernagel's "Ecological Footprint," which is a theory for measuring population impact on the earth and energy demand in different economies.

Using his many years of familiarity with his subject, plus consultation with experts in other aspects of these difficult fields, Youngquist quantifies the problem of materials and energy supply — principally obtained through mining — and situates our dependency on minerals as a defining quality of human civilization from the earliest times. In an expansion of the usually vague allusion to Easter Island, he shows how nations have risen and fallen according to the presence of minerals. He starts with salt, stone and copper and finishes by examining the potential productivity of current and emerging technologies for alternative energy sources.

He begins his book by explaining the uses of various minerals. He then describes the current dependencies of national economies on the export of specific minerals, especially upon oil. Of particular interest is his wide-ranging study of single mineral economies, like Saudi Arabia, United Arab Emirates, Venezuela, Oman, Kuwait, Bahrain, Qatar, Angola, Ecuador, Brunei, Algeria, Iraq, Indonesia, Iran, Libya, Mexico, Nigeria, which all depend very heavily on oil, and those with dependencies on other minerals, like Jamaica (bauxite), Liberia (iron ore), Nauru (phosphate), New Caledonia (nickel), Niger (uranium), Zaire (copper; also zinc and cobalt) ... and many other examples. He describes how different governments have managed these economies

profligately or with foresight as to the finiteness of their resources. In predicting the outlook for those nations which have failed to develop strategies for dealing with the problem of running out of such resources, he leads us into his study of the USA in particular. En route he observes the irony that, whereas the USA has already used up its richest mineral resources, Russia's slow economic development has left it rich in mineral resources for the future.

Much more could be made of the difference between Western Europe's and the United States's approach to population growth, energy consumption and energy resources since the time of the first oil shock in 1973. Youngquist's priority lies elsewhere, however, and he passes over these major policy differences between world powers quite quickly. This is because he will concentrate instead on the fortunes of the United States. The subsequent analysis of the politics and economics attached to state and interstate taxes on petroleum extraction and production in the United States is enthralling. For those who live outside the USA it increases awareness of how the oil economic system works within a federated economy.

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Youngquist's discussion of environmental considerations is relatively free of ideology. He concentrates on the problems of energy extraction but situates these logistically — in terms of impact on land, water, nature and society, in a manner his mining background must have facilitated.

He acknowledges the dim view the many ecological movements take of mining, but comments that mining generally has much less spatial environment impact than do housing, roads and shopping centers. Of course, mining is needed to create these things, but they are driven by the demands of individuals and economies and multiplied by the growth of populations. Constantly Youngquist brings us back to the impact of population growth on demand for energy and materials. Towards the end of his book, however, he warns that mining enough coal for liquefaction to replace oil fuels would have a hitherto inconceivably huge spatial impact "....it would involve strip mining vast quantities of western land [as opposed to land in the third world] each year" — much of which would be spent in fueling such a project anyway. (Coal liquefaction is one of the major options being considered by western countries with large coal reserves.)

Youngquist's rundown on alternative fuel sources and technologies is succinct but comprehensive. He clearly defines and examines the qualities of energy producing materials, their accessibility, and the 'energy slave' values of different fuels. He also costs, examines and quantifies the productive capacity of various emerging technologies. He then evokes the broad range of major practical problems involved in implementing new technologies within our infrastructure and society.

In a methane-fueled economy, for instance, grave competition would arise over allocating land between food production and fuel production. Although a hydrogen-fueled economy holds much promise, enormous logistical and technical problems arise due to the huge size necessary for storage and conveyancing structures in a hydrogen economy, the difficulty in separating and then maintaining hydrogen as a separate element, and the near impossibility of using it as a liquid (due to its very low liquidity point). It costs more energy to extract and utilize the minerals that go to make energy storage batteries than they actually store. Reliable sources of energy to store, including solar, remain highly problematic. Power cannot be stored over the long-term in batteries and batteries themselves are expensive and need frequent replacing. Electrically powered non-rail transport would require an entirely new fueling and service infrastructure. Then there is the conundrum of how to obtain and process minerals to build storage and conveyancing infrastructure for an alternative fuel economy, in the absence of cheap plentiful fuel in the first place.

The twenty-first century's crucial stumbling block is, of course, replacing the advantages of abundant, easily transportable, easily stored, highly adaptable fossil petroleum fuels. Producing electricity for heating, light, and electrically powered tools,

machinery and rail transport is not the overwhelming problem. The production of large amounts of electricity is feasible by other means already. The real difficulty lies in the dependency of the vast nodes and connecting highways of human settlement upon our non-rail transport system for agriculture, mining, forestry, fishing, travel, defense, trade and food. "In the area of transportation oil provides 97 percent of the world's energy."[1]. Our reliance on wheels and airplanes and their reliance on oil seems inescapable. The replacement of fossil petroleum in the quantity contemporary global civilization requires for non-rail transport, appears to be well beyond our current technology. Even if we drastically reduce our individual and collective use of energy, the chances of maintaining all of our current population, let alone the chances of sustaining any future growth, seem dim to say the least.

Using statistical analysis of trends and his oil-geologist knowledge, Youngquist makes a good case for us to worry that we will run out of cheap abundant oil for transport, primary and extractive industries, well before we find an effective replacement. Peak of aggregate global oil production is generally expected around the end of the first decade of the 21st century. After this production would begin to decline.[2] Competition between regional powers for access to remaining reservoirs is then likely to rise along with human population numbers.

The problem of supplying electricity is more manageable, but still very difficult. In the short term the world trend seems to be towards a nuclear solution, despite the dangers, as a background to a variety of alternatives like wind, solar and tidal. The virtually limitless power of fusion is a distant future possibility, but many only give humans a 50-50 chance of ever succeeding in finding the technology. Those who think it will be found also think it will take about 50 years.[3]

In his discussion of fuel and population growth, Youngquist does not forget the dependency of agriculture on fuel and oil based fertilizers. Modern farms are really giant moving oil-powered factories with wheeled machines for digging, planting, spraying, harvesting, threshing, rolling, cutting, packaging and transporting over many hectares. Maintenance of the agricultural revolution depends on mining to provide fertilizers from oil and other minerals. These are conveyed all over the world by using the mostly oil-powered modern transport system. The decline of the petroleum based economy will thus also remove from human civilization the greater part of the agricultural productivity gained through the agricultural revolution. Meanwhile humans have covered much of the earth's fertile land with the infrastructure used to house and transport humans.

Youngquist's *Geodestinies* leaves the reader with the idea that there is really only one option in the short term, to reduce human population growth and energy consumption as fast as possible, in order to reduce the loss of life and widespread misery which an economic crash associated with the decline of cheap plentiful oil would seem inevitably to obtain. Energy conservation, new technologies, and spatial re-organization in the 'developed world' will buffer and diminish suffering, but will not vastly alter, the scale of impact of this event.[4]

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NOTES

1. *Geodestinies*, p.204

2. *Geodestinies*, Chapter 12.

3. *Geodestinies*, pp. 226-227

4. As I mentioned earlier, Youngquist does not compare Europe with the English-speaking settler countries. This is certainly no criticism of such a comprehensive work. It would, however, be interesting to know if he might agree that some European countries, like France, with effective electric rail transport systems, and declining population growth, and the capacity to supply their populations locally, will have a better chance. It would seem that countries like the United States, Canada and Australia, upon which much of the world's food supply depends, and which have rapidly growing populations of their own, as well as a high dependency on road transport, would probably fare less well. The outlook of "developing countries" is another area that needs investigation.