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"Summary of selections by Nicholas Georgescu-Roegen: Energy and Economic Myths"

(In this summary, a discussion of bioeconomics has been omitted, as it is very similar to the issues raised in "The Entropy Law and the Economic Problem," also summarized in this section.)

A number of strands of economic thought can be identified, but when seen from the perspective of the laws of physics, many of them are myths. These "myths" can be classified into three broad categories, each of which is discussed below.

Entropy Bootlegging

There is a notion that sources of usable energy are infinite because of man's inherent ability to defeat the entropy law. However, given that there can only be a finite amount of low entropy in a finite space, which continuously and irrevocably dwindles, we must recognize the finiteness of accessible resources. Even scientific authorities have voiced the hope that energy can eventually be made a free good. For example, some suggest that sea water could be decomposed into oxygen and hydrogen, the combustion of which will yield great amounts of energy. However, this is an impossibility because the entropy of water is higher than that of oxygen and hydrogen after decomposition. Others hope that nuclear energy will produce more energy than is consumed - another false hope. These proposals do not recognize that any activity must consume a greater amount of low entropy than is contained in the product; this is the deficit principle of the entropy law.

Economic Myths

Standard economists argue that, since the definition of resources changes over time, there cannot be an absolute limit on natural resources. It is true that estimates of available natural resources have often proved to be lower than the actual amounts; there may, for example, be more metal in the earth's crust than we know of at present. However, the issues of accessibility and disposability of those unknown reserves must not be ignored. More importantly, irrespective of how resources are defined, the total amount available must be finite. No taxonomic switch can change that.

Standard (neoclassical) and Marxist economists also argue that we will always be able to find substitutes for resources and to increase the productivity of any kind of energy or material. The basis of this assertion is that it has been done in the past and will therefore be possible in the future. However, the same kind of linear thinking would lead to the conclusion that no healthy young person will ever die. Extending the same logic, it is argued that only a few resources are incapable of eventually yielding extractive products at constant or declining costs, and that technology improves exponentially. While it is true that technological advances induce other advances, there may be an upper limit on the level of technological progress related to resource extraction.

Finally, there is what may be called the fallacy of endless substitution, which has both a theoretical and an empirical dimension. Theoretically, according to this argument nature imposes particular scarcities, not an inescapable general scarcity. Substitution for resources that run out is non-problematic as there are very few resources that defy economic replacement. Substitution will take place because of changes in relative prices; for example, it will take place first within the spectrum of consumer goods, with decreasing purchase of resource-intensive goods, and increasing purchase of other things. Similarly, in production, as natural resources become scarce other factors of production will take their place. There are two problems with these arguments. First, substitution within a finite stock of accessible low entropy cannot go on indefinitely. Second, with respect to substituting other factors for natural resources, we must recognize that there are no material factors other than natural resources. To think otherwise is erroneous.

On the empirical front, Solow has shown that for a number of different minerals, consumption per unit of GNP fell in the US between 1950 and 1970. However, this in no way shows that technological improvements led to a greater economy of resources. GNP may increase more than any input of minerals even if technology remains the same, or even deteriorates. More importantly, we do know that between 1947 and 1967 the per capita consumption of basic materials increased. What is relevant is not only the impact of technological progress on the consumption of resources per unit of GNP, but also the increase in the overall rate of resource depletion.

Another piece of empirical work to support the substitution thesis is the work of Barnett and Morse. They showed that between 1870 and 1957 the ratios of labor and capital costs to net output decreased in agriculture and mining, and argued that these numbers show that technological progress will render accessible resources that were previously thought to be unusable. However, while their numbers are indisputable, their interpretation is flawed. Economic history shows that great strides in technological progress have been touched off by discoveries of how to use new kinds of accessible resources. These technological innovations must be followed by a great mineralogical expansion to increase known reserves, which leads to a fall in energy prices. It is this cheaper energy that is substituted for capital and labor in the production process. Rising output and falling capital and labor costs can lead, then, to the results shown by Barnett and Morse, but this does not change the fact that the amount of energy being used has increased.

The Steady State: A Tropical Mirage

Some writers who have wanted to show that continuous growth will lead to all kinds of disasters have concluded that the solution is to achieve a steady-state or stationary-state economy. Their error is in not recognizing that a positively growing, a no growth, and a declining growth economy all converge towards annihilation in a finite environment. The essential point is that the total accessible resources that exist in the crust of the earth are bound to run out at some point if we assume, for example, that each individual will use up a positive amount of resources each year of his or her life. The only way in which a stationary state can go on forever is if accessible resources in the crust of the earth are inexhaustible.

There are other problems with the vision of a steady state. Apparently a stationary state is equated with an open thermodynamic steady state, which maintains its entropic structure through material exchange with its environment. But for such a state to exist, special conditions need to be met that make its perpetual existence close to an impossibility. Another problem with the concept is that while, on the one hand, throughput in such a state would be constant, on the other hand, the society would be forced to change its technology and mode of life to adapt to decreases in resource accessibility. This would call for the right innovations at the right time, and if this does not happen, as it inevitably will not, the state will collapse.

It is also argued that in a steady state there is more time for pollution to be reduced by natural processes and for technology to adapt to reductions in accessible resources. But the route to efficient and clean technologies may be through a system of trial and errors. Also it is argued that in a stationary state people will have more time for intellectual activities. History contradicts this point. There have been instances of quasi-stationary societies where the arts and sciences were practically stagnant. Finally, there is no way of determining, even in principle, what the optimum levels of population and capital must be at which the steady state will come to rest. However, the enormous disproportionality between the flow of solar energy and the much more limited stock of terrestrial free energy suggests a bioeconomic program emphasizing such factors as solar energy, organic agriculture, population limitation, product durability, moderate consumption, and international equity.