**BRIEF ANALYSIS**

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## Malthus Reconsidered

by David Deming

In *An Essay on the Principle of Population*, first published in 1798, Thomas Malthus stated his aphorism that the geometric growth of population must eventually exceed the arithmetic growth of resources. Malthus is most often invoked in the context of acrimonious ideological debates on human population growth and its effect on the natural environment.

Environmental advocates, including Paul Ehrlich, Harvard University's Club of Rome and the United Nations, decry human population growth, claiming that it causes intolerable pollution and will result in a scarcity of key natural resources and mass starvation. Others have called for international programs to slow or reverse population growth and for govern-

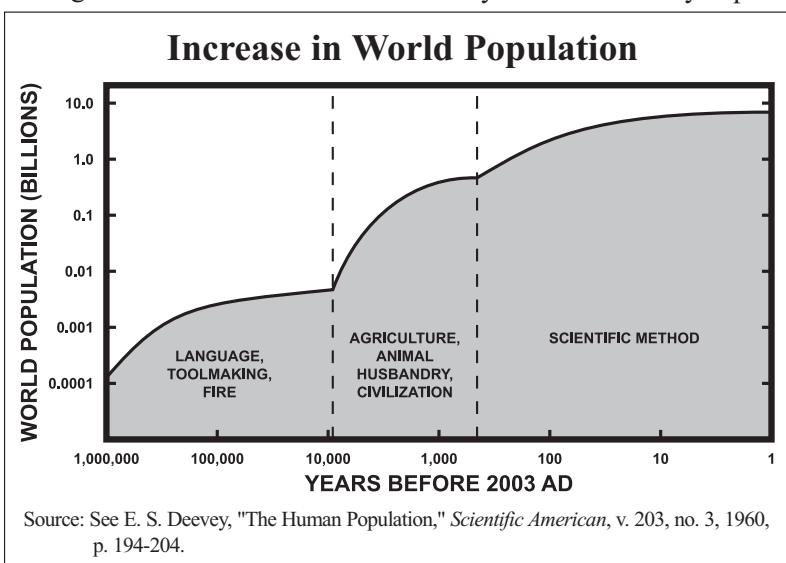
mental controls on natural resource use. However, Malthus' arguments, upon which some of these fears are based, are rarely scientifically analyzed.

**The Theory.** The gist of Malthus' theory was that population growth must eventually outstrip the growth of resources, primarily food. According to Malthus, "the power of population is indefinitely greater than the power in the earth to produce subsistence for man. Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio." As a result, Malthus concluded, "humanity must perpetually exist in a state of misery, as population tends to invariably expand to the point that food supplies are at the subsistence level." Following Malthus, contemporary scholars often mistakenly assume that exponential growth necessarily implies fast growth. For instance, in the 1972 book *Limits to Growth*, by Dennis Meadows and others, the authors stated that "Exponential increase is deceptive because it generates immense numbers very quickly." That statement is not necessarily true. Exponential growth need not be

faster than linear growth (a straight line), nor is it true that exponential growth must eventually exceed linear growth. Both exponential and linear growth can be fast or slow. Exponential growth of any arbitrary value only exceeds arithmetic growth in one uninteresting case: infinite time. Thus, Malthus' thesis is not necessarily true.

**The Facts.** Malthus' thesis can also be tested scientifically. As Malthus himself noted, "a just theory will always be confirmed by experiment." Since Malthus first

published more than 200 years ago, arguably enough time has passed to determine whether or not he was correct. From 1800 to 2000, world population increased from about 1 to 6 billion. According to Malthus' thesis, per capita food consumption for the world should now be lower than in 1800. While historical food production data are difficult to find, proxies indicate that per capita food



production has increased over the last 200 years.

- From 1600 through 1974, the percentage of the population in Great Britain employed in agriculture dropped from 67 percent to about 6 percent.
- From 1800 through 1990, the price of wheat in the United States — expressed as a percentage of wages — fell 96 percent.
- From 1800 to 2000, the population of England and Wales increased from about 9 million to more than 50 million while the inflation-adjusted price of wheat fell by more than 90 percent.
- From 1961 through 1998, the world population increased from 3.1 billion to 5.9 billion — but over the same time period world daily average-consumption of food calories increased from 2,250 to 2,800.

The preceding facts would seem to falsify Malthus' hypothesis.

Empirical falsifications of Malthus' proposition are often met by the criticism that not enough time has passed for

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population growth to outstrip food production. But how much time is necessary to test the hypothesis? Is 200 years not enough? A hallmark of scientific hypotheses is that they make specific predictions that can be falsified. If Malthus' hypothesis cannot be falsified within any finite value of time, then its scientific status is questionable.

**Demographic Transitions.** Malthus did not foresee that technological changes would enable resource growth to outstrip population growth. Nor did he anticipate the demographic transition that takes place as societies move from agricultural to technological civilizations. Malthus thought that population increase in prosperous societies was a universal rule and called it an "incontrovertible truth."

In his memorable 1968 essay *Tragedy of the Commons*, Garrett Hardin (1968, p. 1,244) noted that "there is no prosperous population in the world today that has, and has had for some time, a [population] growth rate of zero." If this was true in 1968, it is no longer true today. The birthrate necessary for zero population growth is 2.1 births per woman. The birthrate in many developed countries is now substantially lower than the minimum required to replace the population. For instance:

- Japan has a total fertility rate of 1.3 births per woman, and its population is projected to fall 21 percent by 2050.
- The total fertility rate for Europe in 2002 was 1.4 births per woman, and the population is projected to fall 11 percent by 2050.
- Developed regions of the world — Europe, North America, Australia, Japan and New Zealand — have 19 percent of the world's population and an average fertility rate of 1.6 births per woman.

In less developed areas the fertility rate has also fallen dramatically and continues to decline:

- In the 1950s, the average woman in Africa, Asia and Latin America gave birth to 6 children.
- By 2002, the average fertility rate in these less developed areas had fallen to 3.1 births per woman.

Among the reasons that have been given for the falling birth rates that accompany economic development:

- In agrarian societies, children are an economic asset, whereas in technological societies they are an economic liability.

- Birth control has become increasingly available and culturally acceptable.
- Infant mortality rates have fallen.
- Women in technological societies spend more time on education and work, and less time on childbearing and rearing.

In retrospect, it is now apparent that a turning point in the history of human population growth took place in the period from 1962 to 1963. In those years, the Earth's human population reached its highest growth rate — 2.2 percent per year. Since then, the growth rate has decreased, reaching 1.2 percent in 2001. If this trend continues, the world's population will likely stabilize and perhaps even begin declining before the end of this century.

Scientist Edward S. Deevey predicted this demographic transition in world population in 1960. Deevey identified three surges in world population during human history and prehistory [see the figure]. The first expansion began during the period when people developed language and tool-making, and started using fire. The second population explosion started about 10,000 years ago when people began to abandon the hunter-gatherer lifestyle for agriculture and animal husbandry. Deevey attributed the third acceleration of world population in 1960 to a decrease in the death rate caused by the scientific-industrial revolution. He noted that the growth of the human population in previous revolutions had followed an S-shaped curve, with a plateau inevitably following a period of rapid growth.

In the 1970s, however, it is clear that Deevey's analysis was largely forgotten. Alarmed by the rapid growth of world population, neomalthusian prophets predicted catastrophic famines during the 1970s that never occurred.

**Conclusion.** The fact that Malthus was wrong should not be interpreted to suggest that a large human population is desirable, or that growing human populations do not sometimes contribute to environmental degradation. On the contrary, increases in human population are often accompanied by environmental problems. However, it is time to put Malthus' morbid specter of mass starvation and unremitting poverty due to unrestrained population growth to rest.

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