

Demographic doomsday deferred

Why the "ultimate population explosion" will probably not occur on Friday, November 13, 2026.

by Joel E. Cohen

One of the cheap pleasures of my childhood was reflecting that the ten dollars in my savings account would grow, at the 3-percent annual interest rate then current, to a glorious twenty dollars in 23 years. Every 23 years after that, my money would double again. Before my twenty dollars materialized, other events altered my bank balance. But my daydreaming acquainted me with the power of steady exponential growth.

People have long thought that compound interest applies to human populations, left to themselves, as well as to money in the bank. In 1755, Benjamin Franklin estimated that the population doubling time of the American colonies was 25 years, and that before long "the greatest number of *Englishmen* will be on this side of the water."

Astronomers, like bankers and demographers, also like to play with big numbers. In the 1976 *Quarterly Journal of the Royal Astronomical Society*, Laurence Cox computed that, doubling every thirty years, mankind (and womankind) would weigh about two-thirds as much as the earth only a thousand years from now. By the year 4000, continuing at this rate, humankind would weigh as much as twenty solar masses.

These fantasies are no more realistic than those of my childhood. They assume a fixed rate of growth of the human population. A fixed rate of growth means that the number of people who will be added to the population during the next year, say, minus the number who die, will be some constant multiple of the number of people living at the beginning of the year.

Currently, for example, the roughly 4.6 billion people in the world increase by nearly 80 million a year. The current growth rate is about 1.7 percent per year. If there were only one billion people in the world and the growth rate were constant at 1.7 percent, the population would increase by only 17 million people a year.

Biologists who study the growth of plant and nonhu-

man animal populations have observed that for nearly all species the growth rate declines as the number of individuals increases beyond a certain level.

How has the growth rate of human population changed over the last two thousand years?

To answer that question firmly, it would help to know how big the human population has been. When the Romans censused the Empire about two thousand years ago, they did so largely for administrative purposes. All the citizens who didn't have to pay taxes were omitted. There are hardly any reliable contemporary sources for population figures before the Renaissance.

The absence of data, however, is a challenge rather than an obstacle to historical demographers. Scholars estimate that the global human population grew from approximately two or three hundred million people in A.D. 1 to perhaps half a billion in 1650.

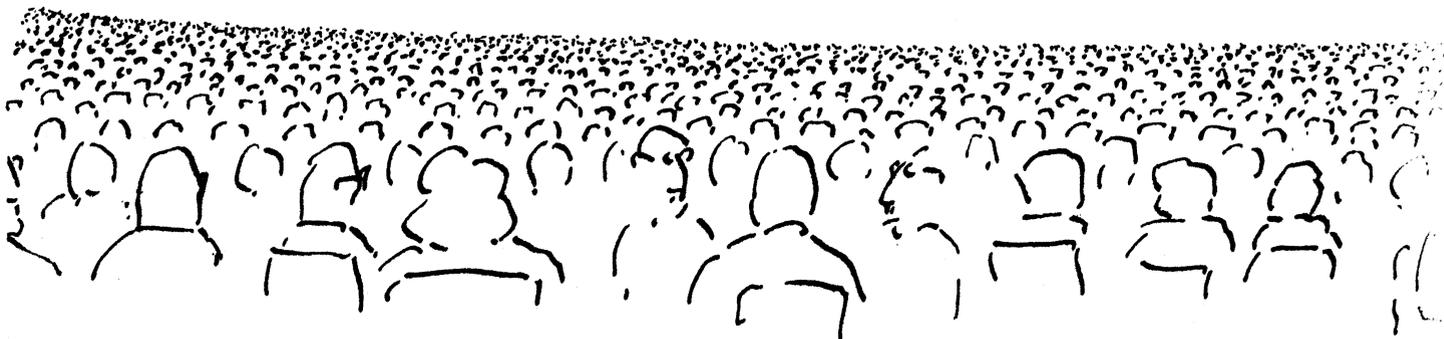
What is more embarrassing is our ignorance of the present size of the human population. Until the census of China was completed last year, the first since 1964, estimates of the size of that country alone varied by the total population size of the United States. Even now, for logistic, financial, or cultural reasons, some populations have never been censused. Others, such as Lebanon's, cannot be censused for political reasons. The real uncertainty about the present size of the world's population must be in the hundreds of millions.

Not deterred by the shakiness of the numbers, Heinz von Foerster, Patricia Mora, and Lawrence Amiot in a 1960 issue of *Science* collected the best estimates they could find of human population size over the last two thousand years.

They found that the numbers of births minus deaths per year, the net increases, were not equal to some constant growth rate times the existing population size.

They found that, contrary to run-of-the-mill biological populations, the net increases in human beings per year

Harvard Magazine 86(3):50-51, January-February 1984



were not equal to some decreasing growth rate times the existing population size.

Instead, they found that the net increases per year in human beings over the last two thousand years were equal approximately to a constant times the square of the existing population size. The growth rate of the human population was thus approximately directly proportional to the size of the population, as if the more people there were, the easier it became for people to survive and reproduce.

In concrete terms, although it took from the beginning of human history until about 1650 for the population count to reach half a billion, it has taken less than an additional 350 years to pass 4.5 billion. Since 1930 the count has increased by 2.5 billion.

These brute facts conceal the most startling aspect of what von Foerster et al. found. Exponential growth, the financial dream of my youth, is tame from a mathematical point of view because at every time the quantity growing (money or people) is finite, though it may be large.

If a quantity increases in proportion to the square of its present magnitude, however, it soon becomes infinite. Mathematically, the solution of the differential equation that describes human population growth (up to 1960) has what is known as a singularity—a time by which it goes through the ceiling. Any ceiling.

(For another example of a singularity, consider a fixed quantity of matter compressed into an ever smaller volume. The density of the matter approaches infinity—has a singularity—as the volume approaches zero.)

Possibly von Foerster and friends were not serious in posing that the human population would continue to have a growth rate proportional to its present size. Perhaps they intended to dramatize the inevitability of a change in human population growth. In any event, for the human population, they estimated the date of that singularity, the ultimate population explosion, as Friday, the thirteenth of November, 2026 (plus or minus five years or so).

Will these doomsayers, with logarithmic graphs and singularities, prove more accurate than the medieval chiliasts and millenarians who exhorted their flocks to abandon this earth for the higher kingdom soon to come? How much of human behavior does their differential equation really know?

Even as von Foerster et al. wrote, orthodox demographers, such as those in the Population Division of the

United Nations, debated among themselves whether the world population growth rate would decline in the decade of the 1960s or of the 1970s.

"The Concise Report of the World Population Situation in 1979: Conditions, Trends, Prospects and Policies," published as Population Studies No. 72 by the United Nations in 1980, is surely among the less ballyhooed documents of our time, and equally surely describes one of the most important transitions in human history.

Around 1965, shortly after the announcement of doomsday in Science, the annual rate of growth of the less developed regions of the world peaked at nearly 2.4 percent and began declining toward its present level of about 2.1 percent. The population growth rate in developed regions of the world was already declining by 1965. Around that time, the human population reached, and then retreated from, its all-time high annual growth rate of 2 percent. At its present growth rate, 1.7 percent per year, the world's population still doubles every 41 years.

Whether by the force of nature or by the choice of reason, whether by selfishness, lack of housing, or concern for the next generation, humankind has begun to practice or to experience the restraint that governs all its fellow species.

This is a fact to celebrate, but with modesty.

What amazes an observer of the sciences of man is this: no one knew precisely when the peak of the human population's growth rate would occur, and no one knows why the growth rate has subsequently declined at the rate it has. We are mariners who mark the level of a tide that is drawn by a moon we cannot see.

Just as few people predicted that the 3-percent interest rates of my childhood would climb as they have, few people predicted the timing or speed of decline in population growth rates. In spite of the decline in growth rates, the net numbers of people added to the world's population each year continue to increase, with nine-tenths of the births occurring in the poor countries. Just as unforeseen events altered my bank balance before my twenty dollars materialized, it seems likely that unforeseen contests will alter the balance of relations between the demographically stabilized wealthy people of the world and the still rapidly increasing poor. □

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