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Hard to be an optimist

January 1, 2017

It's New Year's Day and the paper is full of predictions. The question of the day is how 2017 will go and especially can the U.S. survive the Trump earthquake? But, being a scientist, I find myself always trying to think longer term -- what are the basic problems the world faces, the *roots* of the issues that fill the papers? Will my grandchildren likely grow up in a good and prosperous world as I dearly wish?

Unfortunately, I am filled with foreboding and I don't think this is just an old man's gloom.

More precisely, I think essentially *all* the problems we face can be traced to one basic cause: the explosive increase of the human population -- Malthus's famous contention in *An Essay on the Principle of Population*.

World population has increased by a factor of 3.4 in my lifetime. Recycle, buy solar panels -- fine, but nothing any of us can do is going to control our vast and still growing numbers and all the problems this unprecedented multitude brings.

The Dismal Science and the future of work

July 20, 2015

Hard to be an optimist

January 1, 2017

Let the mystery be

April 13, 2018

Can an artificial intelligence machine be conscious?

April 11, 2019

Can an artificial intelligence machine be conscious, part II?

July 12, 2019

Letter to my Grandchildren

(this paragraph was added the following December) First of all, some numbers. I used to like to say at cocktail parties "One out of every two people is alive today", meaning, take all humans who have lived at any time since the origin of homo sapiens and half of them are alive now. This turned out to be false, but, using the classic estimates in the book *Atlas of World Population History* by Colin McEvedy and Richard Jones, I came up with a better, more plausible, summary statistic. After some thought, it seemed more practical to estimate *person-years*, not numbers of people. This is the integral of the population curve, the area under the curve, and does not depend on longevity estimates. Moreover, it feels like the best way to measure total human existence. Then what I found is this: from the origin of homo sapiens through 1400 CE, about 650 billion people-years were lived (about half before the year 0, half after); from 1400 to the year 2000 CE, another 650 billion people-years were experienced; and if the mean lifetime of everyone alive today is 85 years (assuming medical advances prolong many lives while people in less advanced economies live fewer years), then the people alive today will experience a total of roughly 650 billion people-years. Ignoring some corrections (counting people alive at the year 2000 who may or may not have died by 2017), we can say that about 1/3 of all human existence is taking place NOW! This, to me, is mind boggling.

I think the challenge of living with 7+ billion fellow humans is best displayed in the following diagram:

March 1, 2020

Ridiculous Math Problems

April 1, 2020

Reading Spinoza

April 19, 2020

Nothing is simple in the real world

July 8, 2020

The Astonishing Convergence of AI and the Human Brain

October 1, 2020

Ruminations on cosmology and time

March 1, 2021

The Shape of Rogue Waves

June 27, 2021

Draft of a Blog Book

August 16, 2022

Black hats and white hats

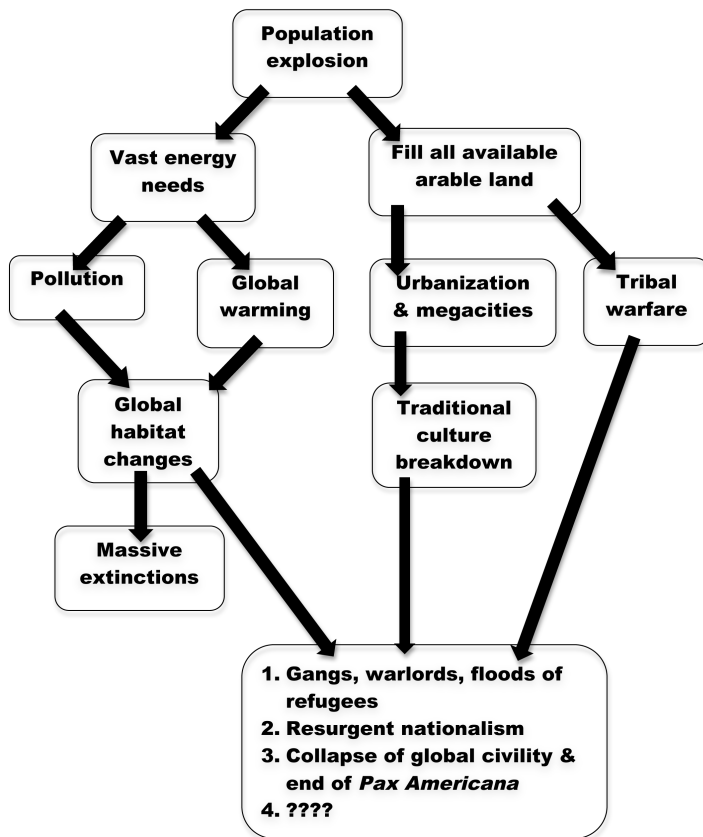
December 12, 2023

Consciousness, Robots, and DNA

January 3, 2024

STATEMENT

April 1, 2024



Letter to my Grandchildren-2

August 30, 2024

Black hats and white hats-II

January 20, 2025

It feels to me almost like a mathematical theorem: each arrow a virtually inevitable consequence. But to elaborate, to address the most frequent nostrums people offer, I want to add a series of footnotes.

- Nostrum one: "Population is leveling off due to the *population transition* and will stabilize very soon". I don't think the evidence for this is very strong. As mentioned above, in my lifetime, the world population has increased from 2.2 billion to 7.5 billion (see **THIS** for historical data and **THIS** for current data), which gives an increase by a factor of 3.4. Yes, the urbanization of over half the world has decreased birthrates but they are still very high in Africa (and can even grow higher if Bill Gates eradicates some ghastly tropical diseases). Birthrates are strongly depressed in some countries like

Russia and Japan due, it seems, to social malaise that could readily lift (it only took the gamekeeper to wake up Lady Chatterly's feelings and bump the birthrate). And the Chinese birthrate was only suppressed by draconian government measures that have now been lifted (after all, they can settle people in Tibet and Xinjiang, sparsely populated by non-Han Chinese peoples). The UN, with shaky extrapolations, allows for a range of 9.5 to 13 billion in 2100 (check out the [many tables here](#)). I wouldn't bet on an imminent population plateau.

- Nostrum Two: "Urbanization will spread a middle class life style in which it is no longer rational to have large families." In fact, urbanization has rather been driven by desperate landless people seeking some employment somewhere and has resulted in unplanned and ungovernable megacities, riddled with crime. To give some perspective, there were no cities with population over one million until the early 19th century ([reference here](#): London and Beijing) and when I was born, the largest city was New York with around 8 million. But as of 2015 there were 36 megacities with over 10 million inhabitants, some in every continent including Jakarta, Karachi, Mumbai, Manila, Mexico City and Lagos with over 20 million each. In fact, the [UN estimates](#) that rural population has plateaued as workers seek employment in cities. But, as many movies have documented, the slums in these cities are not happy places and often are effectively controlled by criminals as social norms disintegrate.

- Nostrum three: "The world will come to its senses, replace fossil fuels by renewables and then climate problems will shrink away". Actually, I think the massive air pollution in India and China will prove to be more effective in forcing a phasing out of coal in these most populous countries than weak international agreements with no enforceability. But so much of the climate changes are irreversible, e.g. the melting of arctic ice starts a vicious cycle because open water absorbs more sunlight. Even though the mathematical models are crude approximations and are based on inadequate data, they do all suggest that once a change starts, it has an inertia and is not easily reversed. I see no way to doubt that the changes in glaciers, coral reefs, the ranges of sea life all point to the same world-wide climate change, a change that is going to intensify. It's interesting that Freeman Dyson who views the Paris accords as a step in the wrong direction, has written that the most plausible solution to the CO₂ problem is to create mutated trees that gobble up CO₂, making some chemically stable compounds that can be buried or used in other ways ([see his review here](#)). As for extinctions caused ultimately by over-population, everyone should read Elizabeth Kolbert's meticulously documented book "The Sixth Extinction".

What's happening now? The street gangs in many cities, e.g. Chicago, are out of control. The Tribal warfare in many areas, especially the Middle East, show no signs of abating (haven't Jewish people been fighting the other tribes in Palestine for three millennia -- since

the book of Exodus?). As for refugees, it seems to me significant that the refugees seeking asylum in Europe today come from so many countries, not merely Syria but from all over Northern Africa and the Middle East. If indeed Bangladesh (population 150 million) becomes the victim of massive floods as many expect, where on earth would their refugees go?

As a mathematician, all this reminds me of the Lotka-Volterra equation. For those who aren't mathematicians, this is a famous model of competing species taught in all introductory differential equation classes. It deals with foxes and rabbits and produces cyclical behavior in which the number of foxes explodes until they reduce the rabbit population to nearly zero, then the foxes starve until the rabbits reproduce and their population in turn explodes, etc. etc. In our case, humans are the foxes and all the rest of the earth -- animal, vegetable and mineral -- are the rabbits. We have gone through half the cycle: the ascendancy of the foxes/humans but not the second half, their collapse. Let us all pray the model fails to predict the future.

Jared Diamond has outlined all the ways previous cultures have blundered into terminal decline in his book "Collapse". The book makes instructive reading for us today. But there are also wild cards that could have a huge impact on the world my grandchildren and great-grandchildren live in. One is CRISPR technology: our rapidly developing skills to modify the genes of all flora and fauna, to *design* new variations of all life forms including our own. This is surely the opening of *Pandora's Box* and, just as surely, its

temptations are likely to overcome our scruples. This was said best by Oppenheimer: "When you see something that is technically sweet, you go ahead and do it and you argue about what to do about it only after you have had your technical success. That is the way it was with the atomic bomb." The other wild card is the possibility of settling in outer space, an option Dyson has written about. Both of these seem more realistic to me than Kurzweil's wild talk of "[the singularity](#)". No matter what transpires, the well known curse (some call it Chinese, some Russian, some Victorian English) "may you live in interesting times" seems to apply.

The blog above has been translated into Latvian by Arija Liepkalnetis from Riga and "AlphaCast". You can find it at [this URL](#).

My vision colleague Alan Yuille wrote me:

Look at the Cambridge Centre for the Study of Existential Risk if you want real pessimism -- [the link](#)

Yes, indeed, those guys wallow in it.

Since the above was written, I have received several skeptical emails about the possibility of continued population growth. My son Jeremy wrote:

... I felt that (your essay) gives short shrift to nostrums 1 and 2, which are really the same nostrum: urbanization everywhere seems to lead to a rapid drop in fertility to

below replacement level. This is not necessarily due to a middle class life-style: it seems to hold true for urban rich, urban poor and everyone in between, in small cities and megacities, in a variety of different cultures. A 17th-century author observed that London's population depended on constant migration from the countryside, otherwise it would shrink since deaths outnumbered births. Most of world population growth right now comes from rural Africa, but Africa is urbanizing rapidly. Clearly world population right now is dangerously high and growing, but the demographic transition can lead to a much lower population in a few generations, without need for a massive die-off. This is not to write off overpopulation, but to me, other risks seem even more likely to destroy our species in the next century than overpopulation.

And a good friend, Andrew Love wrote:

What we know is that population growth rates have been declining (not quite as rapidly as birth rates, with which they are often confused) everywhere?see your cited graph. And that for all except Africa, they are either sub zero population growth (ZPG) or, without heroic extrapolation seem to be approaching ZPG. My college classmate and leading U.S. demographer, Joel Cohen (and no Pollyanna) tells me just the other day that half the world is at ZPG or below. That's a datum with respect to which one might be

encouraged to make predictions, since it lies comfortably in the past. And which only a true believer could simply ignore.

Most striking (and a concept of quite general significance) is ... that averages and gross figures often conceal more than they reveal. In this case a little mental disaggregation tells us that population issues and policy implications are largely best understood as geographically and politically local, rather than worldwide. So, for Africa, largely matter of birthrate and related issues. For U.S., largely a matter of immigration. For Europe, native born demographic collapse and immigration. And so on.

For general reference and caution re apocalyptic predictions I suggest as only a sample the dismal record of your parson Malthus, Paul Ehrlich (The Population Bomb, and sequel The Population Explosion, together with his infamous bet with Julian Simon), The Club of Rome, Dennis Meadows etc. (The Limits to Growth).

In any event the forces suppressing birthrates (and ultimately population growth) which seem to be associated with prosperity, improvement in health, education, advancement of women, technical improvement in birth control, agricultural improvements, etc. appear to be far more powerful than any particular and transitory policy initiative? even such as China's one child policy. And I shall hazard the prediction that China's current

benign population trend will survive
revocation of that policy.

I certainly agree that predictions for population are full of pitfalls. But I think the more than 3-fold increase of population in my lifetime bears out a large part of Ehrlich's ideas. Where he went wrong was not to consider that science could more than double grain yields. His bad predictions also illustrate the weakness of crude differential equation modeling. *But this weakness also applies to the UN predictions of future population scenarios.* Checking the web, I find that the birthrate in India is still about 2.5 (above ZPG), in Pakistan about 3.25, in China, while the one child policy stood, it was 1.66 and it seems likely to spike now that this has been lifted. I just don't trust the current low birthrates in Europe, Russia and Japan to stay low. This has so much to do with fashion and the zeitgeist, optimism vs. pessimism. It should also be noted that the median age of humanity now is under 30, whereas if the population were stable and healthy, it would have been near 40.

My biggest fear is not that the present population size couldn't be stabilized at some slightly higher level, but that managing a world that size requires reasonably rational governments to deal with the huge number of problems it creates (e.g. managing megacities with vast slums, need for new jobs, rising expectations for meat and consumer goods). And I don't see many countries with reasonably rational governments. For example,

there is no plan to deal with the abysmally poor sanitation situation in India nor any plan for the serf-like classes created there by the caste system, e.g. the more than 150 million Dalits.

Larry Gonick, (the author of multiple graphic educational texts, a former student and collaborator on the book *Indra's Pearls*) wrote:

This post is pretty much in line with what I thought on election night: "It's the beginning of the end of the world." We certainly live in perilous economic and environmental times. You have to admit, though, that countries like India have maintained themselves fairly successfully under more difficult circumstances than those now faced by the United States. I still think that political leadership (and followership) will play a major role in affecting outcomes. Still, if your flow chart is correct, there's not much to discuss.

That's why I looked back at an earlier post, about Igor Shafarevich. Without knowing the particulars, I think you may be too generous to him. Maybe because of my Jewish forebears, I can't take at face value his particular association of his traditions with the land itself, "narrowly" construed. This association is a barely veiled threat against anyone from Russia who, like the Jews, were expressly forbidden to own land. One may also be permitted to doubt that he identifies himself with a wretched muzhik, lazily scratching out a bare, inefficient living between the snowdrifts

while his master's whip decorates his back, but rather with the aristocrat who owns that land, funds the church, etc. etc.

I also don't know what to make of his dismissal of the undoubted discrimination against Jews in the top Russian math institutes. Frenkel's "Love and Math" gives a first-hand account from the 1980s. When Shafarevich calls himself a "moderate" nationalist rather than an extremist, one has to remember that when moderate nationalists gain power, they enable or fail to restrain the extremists. We're about to find that out here, I'm afraid.

We all would like to preserve some semblance of the youthful environment we grew up in (bland, suburban, '50s Arizona, in my case), but this is quite different from adherence to a movement dedicated to preserving a "national identity" that is usually a modern construction and false in many respects—just like the "greatness" that you-know-who so airily promises. You're absolutely right that nativist movements are spreading everywhere, but my inclination is to understand them only to the extent that understanding helps to resist them successfully.

If you want to see a devastating account of how such a movement is playing out in Hungary, do read Susan Faludi's superb recent book, *In the Darkroom*. You won't regret it.

In connection with Larry's comments, I want to add that Fijavan Brenk has translated this post into Russian [on her blog](#) as well as putting up the Shafarevich post in Hungarian [here](#). As for whether and to what degree one might call Shafarevich "anti-semitic", this is a question on which there will never be a consensus so further words accomplish nothing. But I want to emphasize that that post was not meant to justify any or all nationalist movements. It was rather to describe my coming to better understand some of the emotional aspects of nationalism that affect an awful lot of people. Larry and my childhoods seem to have shielded us to a large degree from these emotions. But the speed with which conditions of life everywhere are changing is making them awfully powerful world-wide.

My former student and colleague Prof. Song-Chun Zhu wrote me some pointed comments:

Human reproduction is a topic that people in academics dare not to touch, as it is deemed politically incorrect if a social scientist or policy maker tries to optimize any sort of collective utility function that makes sense to the society (or human race) as a whole, but immediately violate basic civil rights of individuals.

But let's face it. Human reproduction is a key factor that defeats our immigration system and welfare system. Controlling the global population should be part of the solution to fighting global warming.

The Chinese government has just done this against strong criticism from the

West. Most people inside China view birth control a policy necessary for the environments and improving quality of living people. The birth rate in China has dropped drastically in the past 2 decades.

The left wing in the US has been largely inconsistent on such topics. They have overly emphasized social justice, but totally ignored the boundary conditions of the economic equations. And we are about to reach such boundary conditions i.e. the limits. This might explain why they lost the election.

What is a solution to this? If, following the left wing suggestions, you should use smaller cars, live green, when you minimize your living space, you only yield living capacity to other countries, or invite more people migrating to your country. Do you remember a Ph.D student George at the Harvard Robotics Lab in the early 1990s? The hard disk in the lab was shared among all students and postdocs. When George first came to the lab, the computer manager suddenly found all free space was gone. George loaded gigabytes of junk files to occupy the disk, and then only he knew what to delete when he needed space to store his real data.

I know someone at UCLA. He once told me that he is the 12th child in his family. Then I asked him where he came from. He is a Palestinian living inside Israel. That immediately explains all.

Terrorism: Most of the terrorists in the

middle east are youth who have no job in the desert, but think how many children each family produce? Bin Laden has so many brothers, wives and children.

Immigration: Some people was discussing whether we should change the law that grants automatically citizenship for people born in the US. This law invites illegal immigrants, also the anchor babies (many pregnant women just fly to the US to give birth)

Global warming: Think about emission and pollution in China and India, primarily produced by the new middle class who desire to live American style life.

The equilibrium of this game is a disaster that you are pointing to, unless people change the rule of the game.

My close Indian friend for 50 years, Prof. Seshadri, wrote me these thoughtful comments:

Dear David

Population growth is indeed a very serious problem but I can't say that this is the root cause. For me the tragedy is the very success of science which we all admire. The industrial revolution led to impoverishment in India and it must be the same in other colonies of Western powers. The success of Western medicine is also a reason for the population growth. On the other hand one cannot say that

Britain or the Western powers deliberately brought about the Industrial revolution. I would call it an accident of history. However, since human nature is not going to change, I agree with you of being pessimistic of the future.

Seshadri

I wouldn't put the finger on science and medicine. Human dominance goes back to stone tools, harnessing fire, skinning animals for clothes, basically the fact that we have a bigger frontal cortex with which we plan, plan and plan some more. The discovery of electricity and microbes are just more recent events that have further enhanced our control of the world -- *though not our wisdom.*

ALSO ON DAVID MUMFORD

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