

The Second Machine Age

by

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Commentary by J. Craig Wheeler

I found the book a little disappointing in several regards.

One of the points is technical, but the perspective pervades the book. In the third chapter they talk about Moore's law and illustrate the power of plotting an exponential growth in a log plot, where it appears as a straight line, rather than in a linear plot, where it appears to have a "knee." The point is that if the growth of some aspect is roughly exponential, it is scale free. There is no knee. Their metaphor of the "second half of the chessboard" does not really make any sense. There is no finite chess board, unless it is the size of the planet, and even then if you ponder the Universe, the chess board could be infinite. They point out that Ray Kurzweil gives an excellent exposition of exponential growth in all sorts of aspects. That is one reason I use his book in my class.

My specific gripe in this regard is that they start off making their case by looking at the "human social development index" in a linear plot where it looks like the development of the steam engine "bent the curve of human history." They never plot that graph in log space. I don't have the data, so I can't be sure, but it would look much less dramatic. Perhaps there is a "kink" with the industrial age, but maybe not. Same for the second machine age. I think the major trend is long-term, approximately scale-free, exponential growth: no knee, no bend, no special epoch.

I have pondered how to express why we sense a "knee" in a scale-free exponential growth. I am not sure what follows captures the point, but let me try.

You get exponential growth when the rate of change of something is proportional to the present amount: dK/dt is proportional to K . I think what is going on is that "knowledge" roughly follows this pattern. The rate at which new knowledge is gained is proportional to the amount already known.

If K represents the collective knowledge of humanity, perhaps represented by the human social development index, the solution can, of course, be written as $K = K_0 \exp(t/\tau)$ where K_0 is the initial amount and τ is the (roughly constant) growth time. I don't know what K_0 is for knowledge, whether it started with assembling carbon atoms in cold interstellar molecular clouds, or the development of RNA, or fire, or stone tools, or the wheel, or agriculture, but for a long time, something roughly like this has held with knowledge begetting knowledge.

Was the industrial revolution truly a kink in the curve? Didn't that depend, back in history, on the development of fire and the wheel; knowledge building on knowledge? Similar questions arise for the second machine age. Clearly it is a big deal, but didn't it build on the development of modern science in the Renaissance, Thompson and the

electron, quantum mechanics? Wasn't the industrial revolution just a smooth step on what had been growing for millennia, and isn't the digital revolution more of the same? If there is no knee, no bending of the curve, no second half of the chessboard, then what is going on? I think the reaction to these rapid developments has to be expressed in some other human-order terms. It is not that there is a sudden change in the rate of exponential growth of knowledge, just a damn lot of it in my lifetime!

Here is how I have attempted to express this. From the expression for exponential growth, the amount of change in a specific amount of time $\Delta K = dK/dt \Delta t = K/\tau \Delta t$. When K was small, when t was small, long ago, the change in ΔK was small in a given time Δt . What I have in mind is that Δt represents a generation, or a human lifetime. If knowledge continues to increase by a roughly unbroken exponential law, same K_0 (whatever it is) and same growth time, τ , (so no knee, etc.), there will still come a time when the amount of change in my lifetime is huge. That is what is so dramatic, not a bend in the growth rate.

What I have not completely thought through is what makes ΔK "large." In some lifetimes, tools were invented, a pretty big deal. In others, steam engines, cars, airplanes, now computers and our digital world. All big effects in a human lifetime. The point is that even with (approximately) fixed τ and fixed $\Delta t =$ four score and seven, ΔK increases as K increases, and K is increasing exponentially even with no knee.

End of that sermon. That's my point of view, and I just don't think the authors of *The Second Machine Age* get it. Kurzweil (with whom I have other issues) does. That does not diminish many of their arguments about the economics, but I don't think they fully appreciate the context.

An aspect of this is that they repeatedly say, such and such has been predicted, but "it hasn't happened yet." This, to me, shows a shocking lack of appreciation for the power of the exponential growth of knowledge. No, we don't have fully conscious androids yet, but what is the timescale of "yet?" I don't take Kurzweil's timescales literally, but the amount of ΔK we can get in a lifetime is getting huge. The timescale for Kurzweil's Singularity or something like it is measured in decades, the lifetime of today's college students, within the life of my grandchildren. To say it has not happened "yet" seems to really miss a huge point.

The authors quote an admirable number of other books, but one, *Who Owns the Future?* by Jaron Lanier is conspicuous by its absence. Lanier also gives a great exposition on winner-take-all, network effects and what he calls "siren servers" that try to monopolize the network effect, and on the insidious effects of those long user's agreements that none of us read. He has an interesting, if sadly impractical, solution, which is micropayments. The notion is that if someone looks something up on Google or posts something on Facebook, Twitter or Instagram, and it is useful to advertisers and hence makes the companies money, you should get paid. Spotify works to get the money of paid subscribers back to the musicians. With our vaunted digital techniques, it should be

possible for people who are now giving content for free, and hence building the riches of the network kings, to get a piece of the action.

There are many interesting aspects here. People are clearly glad to use Google, Facebook, Twitter and Instagram because they receive a service for providing their content and giving up their privacy. In new enterprises like Uber and Airbnb the people on the bottom, the drivers and room providers, do get recompense, so it is all not just free loading by the big guys. The question Lanier raises is why can't we get more moving down. He fears that without some mechanism, the "spread" will increase, and the middle class will be in for a heap of trouble, just the issue *The Second Machine Age* addresses.