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**A REVIEW OF ‘THE SECOND MACHINE AGE’, OTHER CHANGES SHAPING OUR FUTURE, AND HOW TO DEAL WITH THEIR CHALLENGES**

The technological changes racing through our civilization are accelerating, vastly increasing the bounty of humanity, but also increasing inequality. This will automate some jobs in the future, while creating others and making still more vastly more valuable, by complimenting the skills of that work. But where will the net world be? How large will the bounty of technology become, and how will that bounty be distributed? In short, the future looks bright, across the chasm. I predict that while the next few decades will be truly grueling for many Americans, beyond that, the gains to humanity’s bounty will outweigh rising inequality.

The one thing everyone agrees on is that technology is changing our world, and that those changes are accelerating. Erik and Andrew of ’The Second Machine Age’ deftly portray how exponential improvements compound to create mind-blowing advancements. These advancements are making production cheaper, knowledge more available, and our world richer. They are also competing with human labor. Robots are automating manually repetitive tasks, and virtually all tasks where one need only follow a set of clearly defined rules.

All this rapid change leads to another problem, it is hard to retrain workers when they are constantly being automated by machines. A stark example is oil field workers.

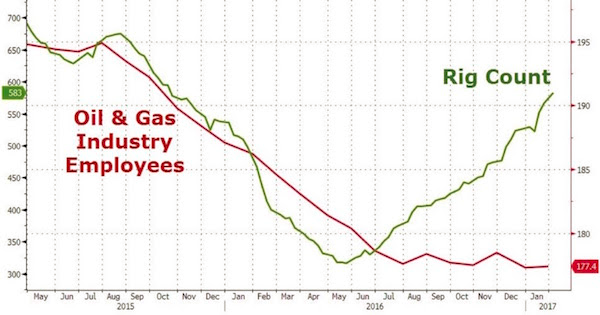


Figure 1: Oil Rigs vs Employees, both in thousands. (5)

Why are fewer people employed when there are more and more rigs? The answer is automation. A new robot, called ‘Iron Roughneck’, takes pipe maintenance, a job that used to take 20 people, all high paying six figure, highly specialized jobs, and now allows that task to be done with just 5 people. This is rapidly replacing workers, who find their skills difficult to transfer. This has happened before, from agriculture to industry, but that change happened over decades. This major shift is just in the past few years, and is repeated across countless industries. This makes retraining workers extremely difficult. As Keynes put it, technology is allowing us to “economiz[e] the use of labor [while we outrun] the pace at which we can find new uses for labor.” (Brynjolfsson and McAfee, 174)

All is not lost for these workers. There lives are still better than medieval kings, with running water and electricity. Even over two decades ago, there lives now have the internet. However, these recent advancements are being outweighed by growing costs in basic needs, mainly education, health care, and housing. These growing burdens in particular are increasing the inequitable distribution of the gains from our most recent and stunning achievements.

What can be done? Quite a lot, in fact, however not very much is needed. A few simple changes (simple, but hard), would go a long way. First, education: our education system equips children to be obedient. We need, as McAfee and Brynjolfsson describe, more experiential learning, less structure, and greater opportunities for children to experiment, fail, and learn from life. Fortunately, there are a plethora of established and effective programs, from GripTape (stipend to high school students plus mentorship to work on project to their choice) to Montesorri Schools to Dual School (workshops and mentorships with high school students to work on projects of their choice), which provide just such an experience (4). These programs currently exist and thrive in various niches, we should embrace their success.

Second, Housing: There is too little supply and a fast growing demand: both for living space and for the land on which it is built. Fortunately, this is beginning to shift as demand for urban living slows and demand for suburban living begins to grow. As The Economist explains in their 2018 ‘The World In’ edition, ‘The Future is In the Countryside’; technology is bringing more of the city’s comforts, from home delivery to fast Wi-Fi, to the countryside, making it more desirable to live in these cheaper and less crowded communities. This is beginning a shift to live in places with much more available land, and thus cheaper housing.

A second force which would go a long way towards reducing housing prices is a relaxation of zoning regulations. In many large cities, these local ordinances prevent denser structures from being built, restricting the amount of affordable housing that can be built. Relaxing these ordinances would allow for a much greater supply of houses, and thus reduce the price of housing overall.

Third, Medicine: Health Care appears set to rise in cost astronomically, this is largely due to a rise in quality, however it is also the result of regulation. As McAfee and Brynjolfsson describe, patents give too much protection, preventing competition on key medicine. Another bottleneck to innovation is the FDA. The FDA approves new drugs through a lengthy process, however this process was setup to test and approve curative medicine (stuff that heals you when you get sick). It was not designed to review preventative medicine (stuff that reduces your changes of getting sick), and thus it is extremely slow and difficult to prove the effectiveness of preventative treatments under the current system, which means it can be a decade from lab to patient. This is despite a quite shift in medical research that is producing many more preventative treatments than curative treatments. From Rapamycin (3) to CRISPR (2), biology is fast moving from research to application as our understanding of human biology grows. Building processes to more rapidly test and validate these treatments is possible, and would increase the competition in many health care marketplaces. With a few changes to our laws and the continued progress of science, even medicine need not be as expensive as it now is.

In short, technology is good because it raises our wealth, how that wealth is shared is largely cultural. We should continue to drive technology, while tweaking our culture and laws to find a desirable balance between the gains we create and the way in which those gains are shared.

The authors of “The Second Machine Age” biggest mistake is discounting Basic Research. They purport that even without new ideas, we can continue to innovate indefinitely, even at an accelerated pace, by recombining existing ideas. This is only true in our ability to create a quantity of new ideas. Eventually, these new combinations will only be variations of the same idea. Without new discoveries in the Basic Sciences, we can create infinite arrays of clothing, with new styles, colors, patterns, and images. At the end of the day it remains cloth and fabric thrown together.

A truly unique breakthrough, such as cloth that can change its appearance, texture, and flexibility at will: that would require advancements in our understanding of physics, chemistry, and material science. These cannot take place without new insights into our world and advancements in basic research. Many important technologies, from Faster Than Light communication and travel, to nanobots capable of countering infection of the microscopic scale, are not possible by recombining existing ideas, they require new insights. Although still futuristic, so was a self driving car at one point. These massive changes can only be powered by Basic Research. The authors touched on the solution later in the book: we need to increase investments in research. I would concur, and amend it to be ‘massive increases’.

This research can take centuries to manifest all their benefits, Newton’s theories would not power our satellites and give us GPS for centuries. But these discoveries do run out, and do need to be replenished.

Gordon resists many of the claims of future technology fueled growth, arguing that innovation is drying up. Despite his claims, he discredits himself by admitting how difficult it is to predict the nature of the future. We don’t know where future innovation will come from, but we continue to push Basic Research forward, and there are already many brand new discoveries, from medical advances from CRISPR-Cas9 to NASA’s Zero Energy Consumption Engine, that we are just beginning to search for commercial application for. Gordon also believes ‘most of the fruitful applications’ of computers have already been realized in just 40 years, while he allowed 70 years for plumbing to take full effect. Computers are vastly more complex than plumbing, so it is a safe bet that fully realizing their potential will very well take at least as long, if not longer than plumbing. The other aspect of computers is that they continue to change their nature. Plumbing has more or less remained constant. Computers, even as they are more widely adopted, continue to change. The computers of today are not only smaller than the ones of the 1980s, they are actually structured very differently: Graphical Processing Units are common in today’s PCs, but were mostly absent in computers until the early 2000s. In short, computers are not a breakthrough that we are adopting, but rather a broad range of technologies that continue to change. Humanity isn’t done innovating yet.

It was thought steam would resign everyone to unemployment or a cog on the factory floor, instead whole new industries sprung up. We should expect even more rapid changes in our current Technological Revolution. A focus on research and education is particularly important, for there will be disruption in the years to come, however we will produce the bounty to manage such disruption, if we choose to use it.

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