H. The Story of *Food*

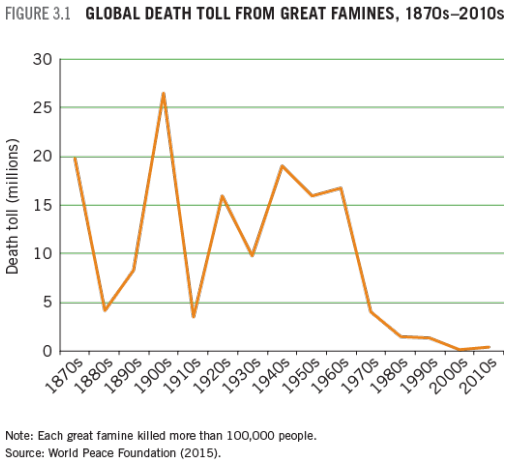
1. We now have a basic way of organizing technological history into four main segments: the long, stagnant period of "pre-industrial" history, the slowly accelerating period of progress that is "proto-industrial," the rapidly progressing periods of "industrial," and the latest "advanced industrial" period that we have yet to precisely define.
2. Charting the story of one of the key values of human life—*food*—can help us to see each of these phases of history more clearly.
3. This story begins at the dawn of human history, with what is sometimes called the "Agricultural Revolution" **c.3000 BC** in places like ancient Egypt. Simply put, this revolution means that human beings stopped hunting and gathering food, and instead developed ways of *producing it*, i.e. agriculture.
4. From that point onward for nearly *five* thousand years, there was almost no fundamental progress in food production!
5. Even in the proto-industrial period, there was little advancement. (One reason is that the steam engine was too heavy to use in agriculture.)
6. Finally when mechanical contraptions like the McCormick Reaper—as I think of it, the *Spinning Jenny of agriculture*—were paired with tractors powered by internal combustion engines, it became possible to at least mechanically harvest more food. The problem, however, was that the technology had not yet been invented to actually get the land to yield more crops in the first place.
7. The *industrial* story of food production really only begins when in **1910** a German scientist named Fritz Haber invented the "Haber Process" to create ammonia fertilizer for plants. The permitted previously unknown quantities of crops to be grown.
8. With mechanization of farms (using tractors and harvesters) and with the user of fertilizers, fewer and fewer people were needed to work on farms, and they moved to city.
9. This led to the challenge of how to transport all the food produced from the farm to the people in the cities without it spoiling. The Frigidaire Company was among the modern industrial companies that created the electrical "refrigerator." First train cars were refrigerated, then the coolers and freezers in stores, and then finally, in **1916**, the average American family could purchase a home refrigerator to help delay the spoiling of food.
10. Industrial abundance also led to changes in how people shop for food. Traditional markets usually had the food behind the counter. Only staff were allowed to handle it. Along with the increase in the quantity and variety of foods available came the rise of the modern "supermarket," such as the Piggly Wiggly, which first opened in **1916**.
11. Then came the final integrated set of advances that have generated advanced industrial super-abundance today. Because of the complexity of this set of advances, it is difficult to assign a date to it, but the "Green Revolution," as it was called, occurred generally between **1945** and **1970.**
12. It involves the combination of the application of irrigation (water distribution) and fertilization (plant food) techniques previously available in combination with herbicides (chemicals to kill weeds) and pesticides (chemicals to kill bugs) and finally hybridization initiatives to make plants more hardy (for different climates) and more productive of seeds and fruits and basically whatever parts are actually edible for humans.
13. The main architect of this **Green Revolution (1945-70)** was an agricultural scientist named Norman Borlaug. Because of his work, countries like Mexico and India, where previously famines were normal, became self-sustaining, and in the case of Mexico

Ancient Egypt, **c.3000 BC**, was one of the first cultures to develop agriculture and thus emerge as an organized civilization.

became an *exporter* of food. The significance of this advanced did not go unnoticed, and Borlaug was honored with a Nobel peace prize in 1970.

14. What does it all mean for us? It means there is no good reason for anyone to starve ever again. Indeed, deaths due to famine in the world have almost plummeted almost to zero (see chart below).
15. On the other hand, superabundance is not an unalloyed good. It comes with costs and challenges. For instance, we now have too much junk food and processed food, and it's harder for people to make good nutritional choices today. A number of food-related diseases like diabetes affect modern populations much more today than any other time.
16. As a result of the challenges involved in having so many chemicals in our food chain, many people now choose "organic" food, which started to become a prominent social phenomenon in **1994.**
17. On the other hand, scientists continue to try to use science to improve food, and now create more and various kinds of "genetically modified organisms" or "GMOs" since **1990**.
18. Controversies seem to abound about modern industrialized food. Perhaps only the world's greatest experts on any particular topic can say with regard to any particular question. Regardless, thanks to the creation of modern, advanced industrial food, *we have the luxury of arguing about it!*

The spraying of crops with pesticides and herbicides is part of the "Green Revolution" that makes modern *super-abundance* possible.



Because of scientists like Norman Borlaug, famines are essentially a thing of the past in our world.

I. A Very Brief History of Medicine

1. Among the greatest life-furthering advances in technology in modern times has been the advancement of scientific medicine.
2. Although the ancient Greeks, starting with Hippocrates **c.400 BC**, aspired to create such a science, and much collective wisdom was accumulated over the centuries in various cultures about how to treat illnesses and injuries with roots, herbs, mushrooms, and every other kind of natural cure, the cause of disease was not understood.
3. The first development that made a scientific understanding of health possible was the development of the microscope, by the Dutch scientist Antonie Van Leewenhoek **c.1668**. Leewenhoek was the first to see minuscule organism which he called "microbes," and which we today know as "bacteria" (and "viruses").
4. Microscopy led to the first scientific theory of medicine, called "germ theory."
   a) **c.1798**, a British scientist named Edward Jenner and other began to experiment with fighting microbes on their (microscopic) level. Jenner used a weak version of smallpox (a horrific, deadly disease) called "cowpox" (yes, it was taken from cows!) to treat humans who were infected. It turned out that the body's immune system learned from being in contact with the weaker disease, and became strong enough to fight the worst form of it. This was the first successful vaccine in history.
   b) Soon other scientists were gaining new insight into how to fight germs. Louis Pasteur of France became the most famous.
      i. "Pasteurization" is a process now widely used to remove germs from certain kinds of food.
      ii. Pasteur also developed a vaccine for rabies (transmitted by rabid animals) according to the Germ Theory **c.1857.**
      iii. Also relying on Germ Theory, the Scottish scientist Alexander Fleming developed the first *antibiotic*, known as penicillin, **c.1928.**
      iv. Each time an advance of this kind was made, countless lives were saved. Vaccines and antibiotics have saved people from many diseases from smallpox and rabies to polio and hepatitis.
5. In addition to the treatment of disease, modern scientific medicine has become incredibly advanced in the treatment of physical trauma.
   a) **c.1846**, an American dentist named William Morton pioneered the use of nitrous oxide for anesthesia (making patients unconsciousness to save them from experiencing physical pain during surgery).
   b) **c.1895**, a German scientist named William Rontgen developed the method of x-ray photography, allowing doctors to see inside the body and to better treat injuries like broken bones.
   c) In the most recent and spectacular advance in a long line of similar achievements, a South Africa doctor named Christiaan Barnhard performed the first heart transplant in **1967**. The doctor and his team literally replaced the heart of a sick person with a healthy heart from a donor (a person who had died but agreed to give their organs to science). The recipient was able to continue living!

J. The *Advanced* Industrial Period of Technology

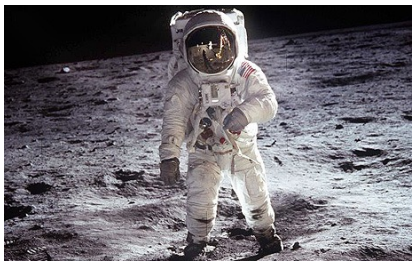
1. If the rate of progress of industrial times had continued, we would perhaps be living in a "*super*-industrial" period. Sadly, progress has not been consistent, and although we have three kinds of new technology, they have not all shown rapid progress:
   a) nuclear power
   b) space exploration

c) computers

2. The first of the milestones of the period of advanced technology is the use of the atomic bomb in **1945** as part of World War II.
3. This technological milestone marks an evolution towards a whole new level of power generation, as demonstrated by the size of the explosions created by the bombs that use this kind of power. A single atomic bomb can destroy an entire city. An atomic power plant can generate the electricity for many cities with greater efficiency than any other form of power.
4. Unfortunately, the science of atomic energy has stalled for now. Atomic power is generated using a process called "fission," which creates nuclear waste as a byproduct. This is an environmental concern. And the potential for radiation to harm humans and the environment when a fission reactor malfunctions or is damaged makes most people view this form of energy unfavorably.

The use of the atomic bomb in **1945** signaled the beginning of a new era of technological development.

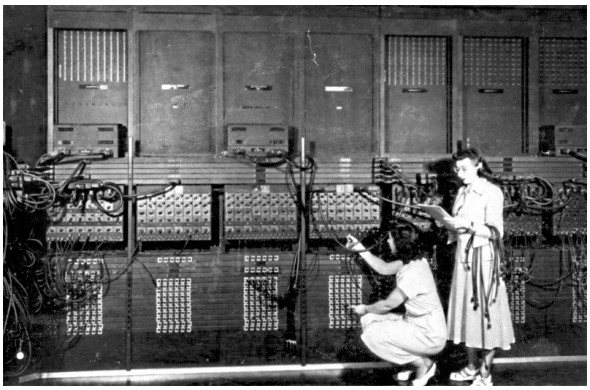
5. A form of nuclear power call "fusion" will eventually be developed that can overcome the limitations and environmental problems associated with fission. If and when we get there, we probably *will* reach a super-industrial stage of development. This is truly something to look forward to.
6. One area of human endeavor that will benefit enormously from the invention of nuclear fusion is space exploration and space travel.
7. Human beings began to develop rockets during World War II, and thereafter, space exploration proceeded with remarkable progress until **1969**, when Neil Armstrong become the first man to walk on the moon.
8. This is a tremendous milestone, and wonderfully symmetrical in a way. The Steam Engine was invented **c.1769**, the transcontinental railroad was completed in **1869**, and man first walked on the moon in **1969.** ***These milestone are the mnemonic basis of the timeline.***
9. However, as with nuclear power, space exploration has stalled. Modest efforts are underway to take the next step: manned space travel to Mars, but it has been nearly 50 years since the greatest accomplishment in the field of space exploration took place.



Space exploration has largely stalled since the amazing feat of placing a man on the moon in **1969**, but new private ventures hint at renewed space exploration, and the eventual *normalcy* of space travel.

10. The one technology that truly distinguishes our advanced society from any previous time is *computers*. This technology, driven by private innovation, has advanced by leaps and bounds and continues to push forward.
11. In **1946** a government project to calculate how to position artillery pieces (modern "cannons") in times of war more efficiently led to the design of the most famous early computer called the "ENIAC" (Electronic Numerical Integrator and Computer). It was 130 feet long and weighed 30 metric tons. It was nicknamed a "Giant Brain". It could perform mathematical calculations 2400 times faster than a person.
12. Since that time, computers have advanced with incredible speed. The most amazing modern computer, the *smartphone*, is 40,000,000 times smaller than the ENIAC, but 1700 times *more powerful*!

13. One of the strange points about technological progress is that it is driven by competition, including between nations, which sometimes translates into war. Rockets, computers, and atomic energy were all pushed forward because of **World War II.** *(Maybe we are having less progress, because we have fewer cultural conflicts today!)*
14. Regardless, we do live in the most technologically advanced society of all time, with the highest quality of life and the highest life expectancy.
    a) During pre-industrial times, humans lived on average 25-35 years.
    b) During the proto-industrial period that increased to 40.
    c) During industrial times, it catapulted to previously unheard-of level of 70 years.
    d) Now, with our latest advances, we are close to 80 as an average lifespan.



"Programmers" work to configure the ENIAC to perform a mathematical calculation. It was large and clunky by our standards, but once configured, it could perform a complex mathematical calculation 2400 times faster than a human being.