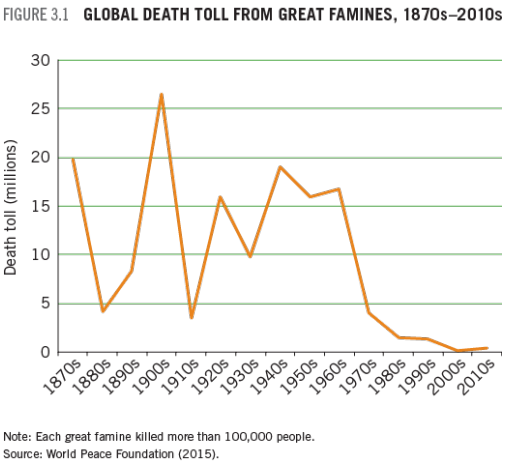
1. We now have a way of organizing the history of technology into four main chapters: pre-industrial, proto-industrial, industrial, and *advanced* industrial.
2. We will now look at how the story of *food* helps us to understand these chapters more clearly.
3. The story begins at the dawn of human history, with what is sometimes called the "Agricultural Revolution" **c.3000 BC** in places like ancient Egypt. At that point in history, human beings stopped hunting and gathering food, and instead developed ways of *producing* it, i.e. agriculture.
4. From that point onward, however, 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. The *industrial* story of food production really only begins in **1910**, when a German scientist named Fritz Haber invented the "Haber Process" to create fertilizer for plants. This made it possible to grow a lot more plants on the same amount of land.

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

7. Soon, because not as many people were needed on farms, they moved to cities, and the new challenge of industrial life became how to get the food to them without it spoiling. The Frigidaire Company was among the modern industrial companies that created the electrical "refrigerator" in **1916**. Soon it became normal for the average American family to have a home refrigerator to help delay the spoiling of food.
8. The advanced industrial chapter of this story happened because of the **Green Revolution (1945-70).**
9. This involves the combination of irrigation (water distribution) and fertilization (plant food) with herbicides (chemicals to kill weeds) and pesticides (chemicals to kill bugs) and finally hybridization (combining different types of plants so that they make more food).
10. The person most responsible for this **Green Revolution** was a 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 became an *exporter* of food. Borlaug received the Nobel peace prize in 1970.
11. 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).
12. On the other hand, super-abundance 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.

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

13. 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 important in America in **1994.**
14. 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**.
15. People sure do argue a lot about food today, but that's because *we have the luxury of arguing about it!*



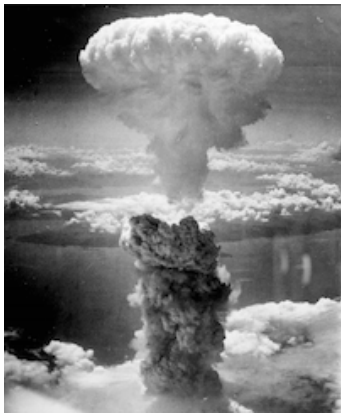

Because of scientists like Norman Borlaug, famines are essentially a thing of the past in our world.

I. A Very Brief History of Medicine

1. For thousands of years, people treated diseases by giving those who suffered roots, herbs, mushrooms, and every other kind of natural cure imaginable. Sometimes it worked, but nobody knew whey.
2. Scientific knowledge of health and disease only became possible when the microscope was invented 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").
3. Microscopy led to the first scientific theory of medicine, called "germ theory."
   a) **c.1798**, a British scientist named Edward Jenner and others began to experiment with fighting microbes. Jenner used a weak version of smallpox to treat humans who were infected with that disease. 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.
5. In addition to the treatment of disease, modern scientific medicine helps us survive physical injuries.
   **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)** The most amazing example of fixing a broken part of the body is the method of transplants. In **1967** a South African doctor 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!

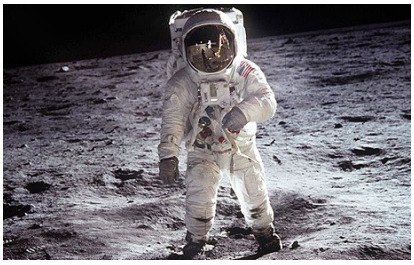
J. The *Advanced* Industrial Period of Technology

1. We now live in the "advanced industrial" period because of three inventions:
   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. A single atomic bomb can destroy an entire city, it is true, but an atomic power plant can generate the electricity for many cities.



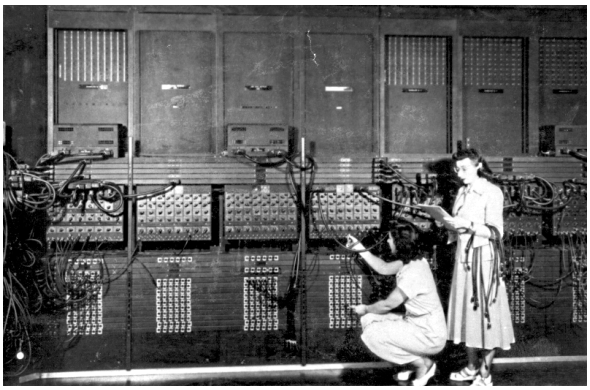
The use of the atomic bomb in **1945** signaled the beginning of a new era of technological development.

4. Human beings began to develop another technology during World War II: rockets. After the war, space exploration proceeded with remarkable progress until **1969**, when Neil Armstrong become the first man to walk on the moon.
5. Sadly, as with nuclear power, space exploration has not advanced very much. 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.
6. The one technology that truly distinguishes our advanced society from any previous time is *computers*. This technology does continue to advance.



Space travel is not yet normal, but maybe you will be able to walk on the moon in your lifetime!

7. In **1946** a government project to calculate how to position cannons in times of war 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.
8. 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*!
9. So how does it all add up? Thanks to all these advancements, we have the highest quality of life and the highest life expectancy ever!
    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.