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| 1. Mark your confusion by highlighting or underlining anything you don’t understand. 2. Show evidence of a close reading with 8+ annotations (questions, connections, predictions, reactions, summaries, clarifications, challenges) 3. Write a 1-page response.   Possible Writer’s Notebook questions:   * Do you agree that technology will continue to improve the world? * Does technology come with dangers of its own? * Do you see any flaws in the author’s reasoning? * Do you think economics are a good “ruler” to use in measuring the success of societies? * Pick a word, sentence, or passage and respond to it. |

**What Today’s Economic Gloomsayers are Missing**

By Joel Mokyr, *The Wall Street Journal,* August 8, 2014

There is nothing like a recession to throw economists into a despondent mood. Much as happened in the late 1930s—when there was a fear of so-called secular stagnation, or the absence of growth due to a dearth of investment opportunities—many of my colleagues these days seem to believe that "sad days are here again." The economic growth experienced through much of the 20th century, they tell us, was fleeting. Our children will be no richer than we are. The entry of millions of married women into the workforce and the huge increase in college graduates that drove post-1945 growth were one-off boons. Slow growth is here to stay.

What is wrong with this story? The one-word answer is "technology." The responsibility of economic historians is to remind the world what things were like before 1800. Growth was imperceptibly slow, and the vast bulk of the population was so poor that a harvest failure would kill millions. Almost half the babies born died before reaching age 5, and those who made it to adulthood were often stunted, ill and illiterate.

What changed this world was technological progress. Starting in the late 18th century, innovations and advances in what was then called "the useful arts" began improving life, first in Britain, then in the rest of Europe, and then in much of the rest of the world.

Why did it happen? In brief: Science advanced. One reason science advanced so rapidly is that technology provided the tools and instruments that allowed "natural philosophers" (as they were known then) to study the physical world. An example is the barometer. Invented by a student of Galileo's named Torricelli in 1643, it showed the existence of atmospheric pressure. That scientific insight spurred the development of the first steam engines (known as atmospheric engines).

In 1800 another Italian, Alessandro Volta, invented the "pile"—the first battery. It served primarily as a tool for chemical research, allowing chemists to map out the newly discovered world of elements and compounds that unleashed the chemical industries of the 19th century.

In that fashion technology pulled itself up by its bootstraps: An invention in one area stimulated progress in another. The germ theory of disease and the subsequent revolution in medical technology might never have occurred without improved microscopes.

Compared with the tools we have today for scientific research, Galileo's look like stone axes. We have far better microscopes and telescopes and barometers today, and the digital codification of information has penetrated every aspect of science. It has led to the reinvention of invention. Words like "IT" or "communications" don't begin to express the scope of the change. Huge searchable databanks, quantum chemistry simulation and highly complex statistical analysis are only some of the tools that the digital age places at science's disposal.

The consequences are everywhere, from molecular genetics to nanoscience to research in Medieval poetry. Quantum computers, though still experimental, promise to increase this power by orders of magnitude. As science moves into new areas and solves problems that were not even imagined, inventors, engineers and entrepreneurs are waiting in the wings to design new gizmos and processes based on the new discoveries that will continue to improve our lives.

In the speculation on what the new technologies will look like and do, robots and artificial intelligence remain front and center, at once wished for (who likes making beds?) and feared as job-killers. We haven't seen a fraction of what is possible in information and communication technology. But the most unexpected advances may come from less glamorous corners, such as material science.

Materials are the core of our production. The terms Bronze and Iron Ages signify their importance; the great era of technological progress between 1870 and 1914 was wholly dependent on cheap and ever-better steel. But what is happening to materials now is a leap far beyond any of the past, with new resins, ceramics and entirely new solids designed in silico, (that is, on a computer) developed at the nanotechnological level. These promise materials that nature never dreamed of and that deliver custom-ordered properties in hardness, resilience, elasticity and so on.

One example is graphene, a sheet of very thin carbon whose molecules can be arranged to make it either the strongest or the most flexible material on earth. It conducts electricity and heat better than any material ever discovered. In the future graphene is likely to replace silicon in transistors, solar cells and other applications we cannot yet imagine.

Genetic modification is another area of expanding frontiers. Plants will be designed to fix nitrates in the soil or to absorb more carbon dioxide from the atmosphere and that can adapt to more extreme temperatures and rainfall. These could be our best defense against environmental degradation, climate change and other nasty side effects of earlier, cruder agricultural techniques. "Nanobombs" that physically penetrate bacterial membranes are the next weapon in mankind's never-ending war on microbes.

The breakthroughs are not "on the horizon." They are here. The economy may be facing some headwinds, but the technological tailwind is more like a tornado. Fasten your seat belts.

So: If everything is so good, why is everything so bad? Why the gloominess of so many of my colleagues? Part of the story is that economists are trained to look at aggregate statistics like GDP per capita and measure for things like "factor productivity." These measures were designed for a steel-and-wheat economy, not one in which information and data are the most dynamic sectors. They mismeasure the contributions of innovation to the economy.

Many new goods and services are expensive to design, but once they work, they can be copied at very low or zero cost. That means they tend to contribute little to measured output even if their impact on consumer welfare is very large. Economic assessment based on aggregates such as gross domestic product will become increasingly misleading, as innovation accelerates. Dealing with altogether new goods and services was not what these numbers were designed for, despite heroic efforts by Bureau of Labor Statistics statisticians.

The aggregate statistics miss most of what is interesting. Here is one example: If telecommuting or driverless cars were to cut the average time Americans spend commuting in half, it would not show up in the national income accounts—but it would make millions of Americans substantially better off. Technology is not our enemy. It is our best hope. If you think rapid technological change is undesirable, try secular stagnation.

*Mr. Mokyr is professor of economics and history at Northwestern University. His most recent book is "The Enlightened Economy: An Economic History of Britain 1700-1850" (Yale, 2012)."*