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## Baby boomer inventions that changed the world

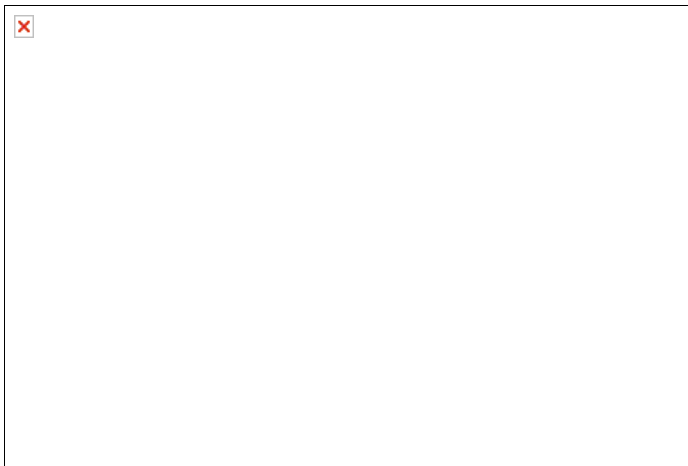
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– Patrick J. Kiger is the co-author of two books, “Poplorica: A Popular History of the Fads, Mavericks, Inventions and Lore that Shaped Modern America” and “Oops: 20 Life Lessons From the Fiascoes That Shaped America”. This article originally appeared on *Second Act*. The views expressed are his own. –

Try this free-association exercise. When you hear the word inventor, what names pop into your head? Chances are, you'll think of some long-dead genius from the 19th or early 20th century, such as Thomas Edison, creator of the phonograph, motion pictures and the first practical light bulb, or Alexander Graham Bell, inventor of the telephone.

Or maybe, if you're a little more knowledgeable about the history of technology, you'll summon up Nikola Tesla, inventor of the alternating current mode of power generation, whose brainchild flows through the outlet that lights your home and illuminates the computer screen upon which you are reading this. Or you might think of Guglielmo Marconi, the early 20th century tinkerer credited with inventing the wireless communication technology that led to everything from garage door openers to the smartphone clipped to your belt.

The inventors of the baby boom generation, in contrast, mostly have labored in comparative obscurity, putting the lie to 19th century philosopher Ralph Waldo Emerson's observation that the world would beat a path to a person's door if he or she built a better mousetrap.

You might recognize 64-year-old Robert Jarvik, the inventor of the artificial heart, and 53-year-old Ajay Bhatt, a co-inventor of the USB port, but only because they've been plucked out of the lab and featured in TV commercials. (In Bhatt's case, his employer, Intel, reportedly had to hire an actor to portray him because he was too busy actually working.) You also might recognize Dean Kamen, the

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59-year-old inventor of the Segway Personal Transporter, but probably without realizing that Kamen — the boomer generation's equivalent of Thomas Edison — also is responsible for hundreds of other inventions, including the implantable insulin pump and the portable dialysis machine.

But ask the average person to name who dreamed up the Web, DNA fingerprinting or the lithium-ion battery, and most likely you'll draw a blank stare. That anonymity is deceptive. Boomers' inventions — ranging from the now-ubiquitous World Wide Web to the synthetic cell and the nanoscale motor — promise to reshape the world of the 21st century as surely as Edison's and Tesla's set the stage for the 20th.

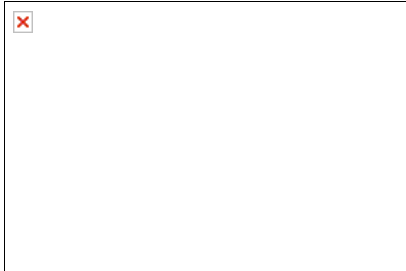
Here are 25 of the most intriguing scientific and technological innovations, and the boomers who created them.

#### 1. The scanning tunneling microscope

IBM physicist Gerd Binnig was born in 1947 in Germany, where as a child he played in the ruins of buildings destroyed by Allied bombs during World War II. As a high school student, he had to choose between two loves — physics and writing and playing songs for rock bands. While the world could have used another Teutonic rock virtuoso like Klaus Voorman, we're better off that Binnig chose physics. In 1981, he helped develop a device that allowed scientists for the first time to visualize individual atoms, an advance that has paved the way for the development of super-small nanotechnology. Binnig, along with fellow scientists Heinrich Rohrer and Ernst Ruska, received the 1986 Nobel Prize in Physics.

#### 2. DNA fingerprinting

Sir Alec Jeffreys was born in 1950 in Oxford, UK, and attended Oxford University, where he earned a doctorate in biochemistry. He went on to become a professor of genetics at the University of Leicester, where in 1984 he discovered sequences within strands of DNA that differ from one individual to the next in a way as unique as the ridge patterns on fingertips. "We could immediately see the potential for forensic investigations and paternity, and my wife pointed out that very evening that it could be used to resolve immigration disputes by clarifying family relationships," Jeffreys recalled in a 2004 interview. Just as importantly, Jeffreys also developed a technique for identifying those sequences. His invention revolutionized criminal justice and the courts by making it possible to link criminal suspects to crime scenes and to absolve those falsely accused. DNA fingerprinting also has helped solve historical mysteries. For example, such analysis proved that Louis XVII, the son of executed French King Louis XVI and Queen Marie-Antoinette, died in 1795, and did not somehow escape prison and survive, as various imposters of the "Lost Dauphin" had claimed in the 1790s.



#### 3. The Jarvik 7 implantable artificial heart

Dr. Robert Jarvik, born in 1946 in Michigan, was a prodigy who invented a surgical stapler and other medical devices while still a teenager.

While Jarvik was an undergraduate student at the University of Utah in 1964, his father needed to have surgery for his ailing heart. That family ordeal helped influence Jarvik, who went on to earn his medical degree at Utah, to turn his

curiosity, inventiveness and problem-solving skills toward finding a method of saving patients with stricken hearts until they could receive a transplant. While he wasn't the first to develop an artificial heart, Jarvik's 1982 creation, the Jarvik 7, was the first such device that could be implanted inside a person's body. Jarvik continues to work toward the development of a device that could serve as a permanent replacement organ.

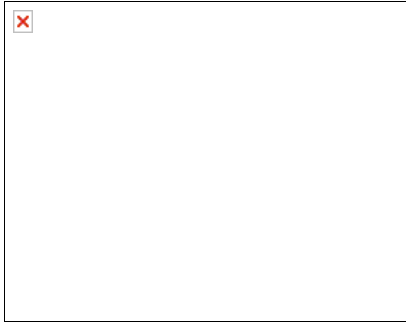
#### 4. Bacterial cement

Sookie Bang was born and raised in South Korea. She graduated from Seoul National University in 1974 and earned a Ph.D. in microbiology from the University of California-Davis in 1981. As a professor and researcher at the South Dakota School of Mines and Technology, her specialty is bioremediation — for example, using bacteria as an ingredient in a sealant to fix cracks caused by weathering and freezing water in concrete buildings' exteriors. Bang and colleagues figured out how to speed up a naturally occurring process in which bacteria extract nitrogen from urea, which produces carbon dioxide and ammonia as byproducts. The CO<sub>2</sub> and ammonia then react with other

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ingredients — water and calcium — to form calcium carbonate, which is better known as limestone. The patch created by the bacterial process seals the crack from the inside out and integrates with the porous concrete, making the repair more effective.



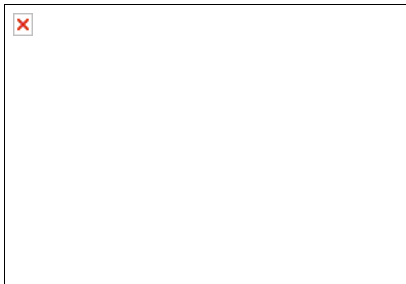
#### 5. The Apple II

Steve Wozniak, who was born in 1950, and his future partner Steve Jobs, born in 1955, both grew up in the San Francisco area and got to know each other as summer interns at electronics manufacturer Hewlett-Packard. Though neither finished college, they helped launch a technological revolution that transformed our culture. In 1977, they created and marketed the Apple II personal computer, which included color graphics, a sound card,

expansion slots, and other features that made it the earliest machine to resemble today's PCs. It arguably did more than any other product to usher in an age in which computers would become as ubiquitous as TVs and telephones.

#### 6. Viagra

Dr. Gill Samuels was born in 1945 in Bury, Lancashire in the UK. As she told a newspaper interviewer in 2005, "I always wanted to know how things worked. My mother used to despair of me as a child. If she gave me a doll, I'd take it to pieces to see how it had been put together." She went on to earn a degree in physiology from Sheffield University and experimental neuropharmacology from Birmingham University, and joined pharmaceutical maker Pfizer in 1978 as a research scientist. While at the company, she worked on the development of a number of drugs, including Viagra, a revolutionary treatment for male sexual dysfunction. "It's changed people's lives," she has said. "I've had letters from men saying that it stopped them wanting to kill themselves." In 1989, she became Pfizer's director of cardiovascular biology, and in 1995 became director of science policy. She also has been a board member and advisor to the World Health Organization and various science education groups.



#### 7. The World Wide Web

Sir Tim Berners-Lee, born in London in 1955, grew up around computers; his parents both were mathematicians who worked on the Ferranti Mark I, the first computer to be sold commercially. Berners-Lee also liked to tinker with electronics and built his own computer while he was an undergraduate physics student in the mid-1970s. After graduation, he became a

software consultant for CERN, the European Particle Physics Laboratory, in Switzerland. While at CERN in the 1980s, he tackled the problem of how to organize and link different sources of information — text, pictures, sound and video — and make them easily accessible to users of the then-new internet. Berners-Lee came up with the concept for what became the Web, which he laid out in a 1989 paper. He developed a software language to create web pages and the first web browser, which he made available to others in 1991. Since then, his invention has spread across the planet and become perhaps the most powerful means of communication ever developed.

#### 8. The ambulatory infusion pump

Dean Kamen, born in Long Island, N.Y., in 1951, was an inventive prodigy. While still a college student at Worcester Polytechnic Institute in 1972, he decided to come up with a solution for a problem that his older brother had encountered as a medical student — the dilemma of how to deliver precise, controlled doses of medication to patients for long periods. Kamen invented a programmable device that patients could wear on their bodies wherever they went. His creation has changed the lives of many diabetics, freeing them from having to worry about injecting themselves with insulin at the right time.

#### 9. The portable dialysis machine

After inventing the ambulatory infusion pump, Dean Kamen tackled another medical dilemma — the need for patients with severe kidney disease to travel to dialysis centers for the treatments they needed to survive. Kamen invented a portable dialysis machine with few moving parts that regulated flow by controlled air pressure rather than by counting drops in a drip chamber, as the bulky existing devices did. Kamen's device even enables patients to give themselves dialysis treatments at home, while they sleep. In 1993, the engineering publication Design News recognized Kamen's creation as "Medical Product of the Year."



#### 10. The Segway Personal Transporter

Dean Kamen attracted intense media curiosity in the early 2000s when word got out that Silicon Valley investors were flocking to a revolutionary new device, code-named "Ginger," that Kamen was developing in secrecy. When the invention was unveiled in 2001, many were shocked to discover that it was a scooter. But Kamen's Segway PT was designed to be much more than

simply a two-wheeled form of recreation, but rather a convenient form of transportation that would reduce pollution and traffic congestion. The electric-powered Segway PT incorporates sophisticated electronics and a gyroscope that enables it to self-balance, and it's able to maneuver based on the driver's subtle body shifts. While Segway PTs have yet to become ubiquitous, Kamen's concept of environmentally friendly personal transportation already has spurred competitors such as Toyota to develop similar vehicles.

#### 11. Optical character recognition and text-to-speech technology

Ray Kurzweil, born in 1948 in Queens, N.Y., dreamed of becoming an inventor even before he started elementary school. By the time he was 15, he had built and programmed his own computer to compose original songs — an achievement that led to his appearance on the TV show *I've Got a Secret*. After graduating from Massachusetts Institute of Technology with a double degree in computer science and literature in 1970, he founded his own company in 1974 and led the creation of a system that enabled computers to read and recognize printed or typed characters, regardless of the font or print quality. In 1976, he developed the Kurzweil Reading Machine, the first device capable not only of deciphering printed and typed documents, but of reading them aloud as well. Kurzweil's innovations not only made it possible for vast printed libraries and storehouses of documents to be digitized and made available on the internet, but he also made it easier for blind people to access the printed word.

#### 12. The Kurzweil 250 musical synthesizer

The first customer who bought one of Ray Kurzweil's reading machines was pop music superstar Stevie Wonder. The two men became friends, and during a visit to Wonder's studio in 1982, the musician asked the inventor if it would be possible to create an electronic machine that would have the ability to control and manipulate sound the way existing synthesizers could, but that also was capable of replicating the sounds of acoustic instruments such as piano and guitar. With Wonder as an advisor, Kurzweil went to work. In 1983, he unveiled the Kurzweil 250, a digital musical instrument that was able to duplicate the sound of a grand piano. Kurzweil went on to develop a succession of other digital keyboards that have been used by artists such as Paul McCartney and Earth, Wind and Fire.

#### 13. The Flex-Foot prosthesis

Van Phillips was born in 1954 and grew up in Lake Forest, Ill. He was a broadcasting student at Arizona State University in 1976 when he had a horrific waterskiing accident in which a motorboat ran over him and severed his left leg just above the ankle. Phillips was outfitted with an artificial leg, but the clumsy, stiff prosthesis made it difficult for him to engage in his favorite sports. But his predicament turned into a game-changer for him and scores of other disabled athletes. Phillips switched schools and enrolled in a biomedical engineering program at Northwestern University, where he earned an undergraduate degree in 1981. He then went to work inventing a new type of artificial limb, inspired by the C-shape of a cheetah's hind leg, that would be flexible, resilient and strong, and would enable its users to run and jump. Made of lightweight carbon graphite, it had an L-shaped foot that acted like a spring, allowing the user to push off as if it were a flesh-and-blood

appendage. Phillips' device and others based on its concept now are used by amputees around the world, including an estimated 90 percent of Paralympic athletes.

#### 14. Controlled drug release technology

Robert S. Langer, born in 1948 in Albany, N.Y., earned his undergraduate degree in chemical engineering at Cornell and a doctorate from MIT in 1974. He went on to become one of the most prolific researchers and inventors in the history of medical technology. According to his MIT web page, he has authored more than 1,100 scientific papers and has received approximately 760 patents worldwide. As a graduate student at MIT, he began working on a way to use plastics to administer cancer drugs at a controlled pace inside patients' bodies. Langer's efforts eventually led to the development of devices such as magnetically controlled drug release implants, transdermal ultrasound drug delivery and other innovations in treating cancer, heart disease and other conditions. His citation for the 2008 Millennium Technology Prize noted that an estimated 100 million patients worldwide have benefited from his work.

#### 15. Synthetic skin products

Gail K. Naughton, who was born in 1955 in New York, earned an undergraduate degree in biology in 1976 from St. Francis College in Brooklyn and a Ph.D. in hematology from New York University Medical Center in 1981. In the early 1980s, she began working with laboratory cell cultures and found a way to "trick" cells into responding as if they were actually inside a human body. For example, growing tissue could be pulled and stretched so that it secreted proteins to make the tissue stronger. Eventually, Naughton's discovery led to synthetic skin that can be used to temporarily cover a patient's burn wounds until the body recovers sufficiently to grow skin on its own, and another variation for treating diabetic foot ulcers that grafts itself onto the patient's own tissue and becomes part of the patient's body. Naughton's work has helped lead to a growing range of treatments that encourage nerve regeneration, heal bone and cartilage, and help patients regain their health in other ways. She holds close to 100 patents. In addition to her scientific career, Naughton also earned a master's degree in business from the University of Southern California in 2001, and since 2002 has served as dean of the College of Business Administration at San Diego State University.

#### 16. The nanoscale motor

Alex Zettl, born in 1956, received his undergraduate degree in physics at the University of California -Berkeley in 1978 and his Ph.D. in physics from the University of California-Los Angeles in 1983. Zettl, who joined the faculties at Berkeley and the Lawrence Livermore National Laboratory, became a pioneer in nanotechnology, a field involving the creation of incredibly small materials and devices. In 2003, a team led by Zettl created a functioning electric motor that was just 500 nanometers across. It was about 300 times smaller than the diameter of a human hair — so tiny that it could ride on the back of a virus. In 2007, he led the creation of a similarly tiny radio receiver that played Eric Clapton's song "Layla" to demonstrate its abilities. Zettl's work sets the stage for a future in which nanoscale machines may perform intricate surgical operations, speed up computers and generate solar energy more efficiently.

#### 17. The suspended-load backpack

Lawrence Rome was born in Boston in 1952 and earned an undergraduate degree in biology from Dartmouth in 1974 and a Ph.D. in biology from Harvard in 1981. He later became a biology professor at the University of Pennsylvania. In the mid-2000s, Rome led the development of an ingenious backpack that utilizes the up-and-down movements of a wearer's body to generate electricity to power cell phones, computers and other devices. It's an invention that may turn into a lifesaver for soldiers, rescue workers and others who depend on headlamps, GPS systems and mobile communications equipment in places where there are no outlets or generators to recharge them.

#### 18. The Universal Serial Bus port

Ajay Bhatt was born in 1957 in India, where he received an undergraduate degree in electrical engineering from the M.S. University in Baroda. After emigrating to the U.S., he earned a master's degree in electrical engineering from the City University of New York in 1984, where he worked on technology to power the Space Shuttle. After joining Oregon-based electronics giant Intel in 1990, he was working on his PC at home one night when he got an inspiration. What if connecting peripheral devices to a computer could be as simple as plugging an electrical cord into a wall

outlet? Bhatt and his team eventually turned that idea into the Universal Serial Bus, which made it vastly easier for people to use a wide array of computer-related gadgetry, from printers and keyboards to external hard drives and digital cameras. Bhatt became most famous, however, playing himself in a humorous Intel commercial that portrays company staffers swooning in his presence as if he were a rock star.

#### 19. Improved rechargeable lithium-ion batteries

Yet-Ming Chiang was born in 1958 in Taiwan and emigrated with his family to the U.S., where he earned an undergraduate degree in materials research and engineering at Massachusetts Institute of Technology in 1980 and a doctorate in ceramics from MIT in 1985. In 1990, he became the youngest tenured professor in the history of his department at MIT. Starting in the mid-1990s, he began grappling with how to improve the performance of lithium-ion batteries, which had been invented back in the 1970s by chemist and materials science researcher M. Stanley Whittingham. Chiang eventually hit upon the idea of using a nanoscale phosphate cathode material with high electronic conductivity. His innovation gives today's lithium-ion batteries greater power and longer lives at a relatively low cost.

#### 20. Ethernet

Robert Metcalfe was born in Brooklyn in 1946 and earned undergraduate degrees in engineering and management at MIT before receiving a Ph.D. from Harvard in 1973. He joined Xerox's Palo Alto Research Center (PARC), a hotbed of creativity that spawned numerous inventions, such as the graphical user interface that led to both the Mac and Windows operating systems. While at PARC in the mid-1970s, Metcalfe worked with others to develop a technology that allowed people to hook up a group of computers with switches and coaxial cable and to send packets of digital data through the network. The system they developed has become so ubiquitous that about 250 million new Ethernet switch ports are shipped annually worldwide, enabling a vast number of computer users to share documents, printers and connections to the internet.

#### 21. The Nakao Snare

Dr. Naomi L. Nakao was born in Jerusalem in 1948 and earned a medical degree from Stony Brook University in 1976. In addition to being a practicing gastroenterologist, she is an inventor of medical technologies who holds more than 50 patents. In 1991, she developed a solution for the problem of lost polyp syndrome. When a polyp, the precursor to colon cancer, was removed during a colonoscopic procedure, about 10 to 15 percent of the time it slipped away and was lost in the colon, requiring the doctor to search for it. That caused a patient additional discomfort, and if the doctor couldn't recover the polyp, it was impossible to do the needed tests to determine if it was cancerous. Nakao invented the Nakao Snare, a tiny device that both severs the polyp and captures it in a net. She received a patent for the invention in 1993. Nakao subsequently founded a company, Granit Medical, which brings her medical innovations to market.

#### 22. The CMOS active pixel image sensor

Eric R. Fossum was born in 1957 in Connecticut and earned an undergraduate degree in engineering from Trinity College before receiving his Ph.D. in engineering from Yale University in 1984. While working at NASA's Jet Propulsion Laboratory (JPL) in California in the mid-1990s, he invented the "camera on a chip" that enables digital cameras, cell phones and other devices to take pictures. He left JPL in 1995 to co-found Photobit Corp., which grew to a business with 100 employees and \$20 million in revenues before it was acquired by Micron Technology in 2001. Since then, he has worked as a corporate executive, consultant and researcher. Fossum has published more than 240 technical papers and holds more than 130 U.S. patents.

#### 23. Foxfibre naturally colored cotton

Sally Fox, who was born in 1955 in Palo Alto, Calif., took up spinning at age 12, using babysitting money to buy her spindle and making thread from all sorts of found materials, from the cotton in medicine bottles to her dog's fur. She went to Gambia as a Peace Corps volunteer before returning to the United States to receive a master's degree in integrated pest management from the University of California-Berkeley in 1982. While working to develop pest-resistant strains of cotton, she learned about naturally colored strains of cotton that native peoples in Central and South America had spun for centuries. That cotton wasn't suitable for modern machine spinning, but Fox got the idea of breeding and marketing her own varieties of higher-quality colored cotton, which was not only more attractive than bleached white cotton, but more environmentally friendly as well.

## 24. The automated external defibrillator (AED)

Seattle-area engineers Carl Morgan (born in 1947), Tom Lyster (born 1952), John Harris and Clint Cole (both born in 1962) teamed with Gen Xer Brad Gliner to develop the concept of an automated device that would guide an ordinary, untrained bystander in reviving a person stricken with cardiac arrest. When their then-employer, a company that made equipment for emergency workers, declined to back their idea, they quit and formed their own company, Heartstream, in 1992. They maxed out their credit cards and nearly went under before attracting a \$5 million investment from a venture capital fund that enabled them to move forward. The inventors came up with a paradigm-shifting discovery: Instead of shocking a small woman and a big man with a standard dose of electricity, as medical guidelines called for at the time, they developed a new, safer technology that automatically calculated how much of a shock the person actually needed. Even after gaining U.S. Food and Drug Administration approval for the AED in 1996, they had to battle to persuade the American Heart Association to change its defibrillation standards so that the device could be used without liability risk. But they succeeded, and today, federal regulations require airplanes to have AEDs, and they are found in many public places.

## 25. The disposable cell phone

Randice-Lisa Altschul was born in 1960, one of five children of an immigrant English mother and a German father in New Jersey. She had such a gifted intellect that by seventh grade, she stopped attending school; instead, the district provided a tutor for her. Despite having little technical background, she became a successful inventor of games and toys for both children and adults, and by age 26 she was a millionaire. One of her numerous brainstorms: a breakfast cereal that comes in the shape of action figures, which soften when milk is added. In 1996, Altschul was driving down a highway when she got the inspiration for the invention for which she would become best known — a disposable, pre-paid mobile phone, about the thickness of three credit cards, and made from recycled paper products. While other companies picked up on her lead and began making their own disposable phones, she gets credit for the idea.

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Okay '43 is technically not boomer, but close enough. Most of these other guys rely on this guy:

Vinton Gray "Vint" Cerf[1] (/ˈsɜːrf/; born June 23, 1943) is an American computer scientist, who is recognized as one of [4] the fathers of the Internet, sharing this title with American computer scientist Bob Kahn.[5][6] His contributions have been acknowledged and lauded, repeatedly, with honorary degrees, and awards that include the National Medal of Technology,[1] the Turing Award,[7] the Presidential Medal of Freedom,[8] and membership in the National Academy of Engineering.

In the early days, Cerf was a program manager for the United States Department of Defense Advanced Research Projects Agency (DARPA) funding various groups to develop TCP/IP technology. When the Internet began to transition to a commercial opportunity during the late 1980s,[citation needed] Cerf moved to MCI where he was instrumental in the development of the first commercial email system (MCI Mail) connected to the Internet.

By the way, he endorsed Gore in 2000.

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