

Still looking for those droids

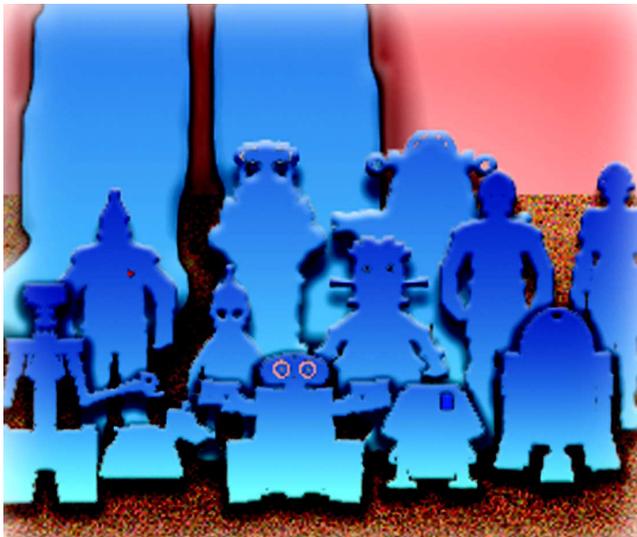
The Robots Are Coming

Judging by the news, they should be here already. But the driverless cars, smart houses, drones, hospital delivery carts, dancing toys, and self-propelled vacuums are just the beginning. About time, too, as the imminent arrival of those long-awaited mechanical servants has been proclaimed as often as flying cars over the last couple of decades.

Only now has **robotic** technology finally reached the point where such dreams are reaching fruition, but the robots that will actually work for us will be significantly unlike the shiny bots of science fiction. If we are to thrive or even survive, it is important to understand our expectations and how reality will differ.

Ancient dreams

People have been fantasizing about smart machines doing our heavy lifting for a very long time – dreams that still only Hollywood can fulfil. **Hephaestus**, the lame smith-god of the Greeks, better known by his Roman name **Vulcan**, famously used golden prosthetic leg braces to walk. And, according to Robert Graves, author of *I, Claudius*, “he once made a set of **golden mechanical women** to help him in his smithy: they can even talk, and undertake the most difficult tasks he entrusts to them. And he owns a set of **three-legged tables with golden wheels**, ranged around his workshop, which can run by themselves to a meeting of the gods, and back again.”



So the early Greeks foresaw both C3P0 and R2D2 – not bad for the Bronze Age! Metal servants appeared in other myths, such as **Talos**, a bronze man who ran around guarding the isle of Crete, mechanical watchdogs, and even a robotic eagle sent by Zeus to torture Prometheus. But **automatons**, as self-operating mechanical devices were known, were actually made by the Greeks and Romans, too. Usually these were novelties ranging from cuckoo clocks and moving idols to self-driving carts. Yet their greatest creation – never even hinted at in ancient documents – was the incredible **Antikythera mechanism**.

Only corroded bronze scraps of it were discovered in a shipwreck in 1900. But they came from an analog computer of amazing sophistication. Using a system of brass gears, its dials showed positions of the sun, moon and planets; calculating the month, year, Olympic and various eclipse cycles – and more functions are still being discovered. Moreover, it is unquestionably unique: nothing like it has ever been found, before or after in the historical record until astronomical clocks were invented in the late Middle Ages. As someone once said, it was like finding parts of a Formula 1 race car sitting in a blacksmith’s shop.

During the Middle Ages, tales featured oracular **brazen heads** that could answer questions rather than full-figured robots. The gunpowder-chemist Friar Roger Bacon was said to have one, but like those supposedly owned by Pope Sylvester II and the wizard Faust, it was thought to operate by black magic.

The first modern functioning human replica in the West was, not surprisingly, built by **Leonardo Da Vinci** in 1495, who also constructed a mechanical lion. Encased in the armor of a German knight and operated by levers and pulleys, his humanoid figure could stand, sit up, and move its arms, neck, and jaw realistically. Fortunately, considering that Leonardo also invented the **battle tank**, its sole purpose was to amuse his noble patron during a celebration.

Over the following centuries, many such clever automatons were invented, such as figures playing musical instruments or writing and singing birds. Disney’s **Lincoln animatronic figure** and **Enchanted Tiki Bird** attractions are their direct descendants, and like earlier automatons, were strictly limited to a small, predetermined set of actions in one place. It would take the development of electronic computers to free bots from their mechanical shackles.

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In the meantime, however, dreamers kept dreaming. The word “**robot**” aptly derives from a Czech term for a worker coerced into mindless drudgery. It first appeared in an avant-garde play by Karel Capek in 1921. The play was called **R.U.R.**, for “Rossum’s Universal Robots,” the name of the company that manufactured these biological androids. It is a strange, grim drama, not only foreseeing a robot-driven world but the robots’ inevitable rebellion. The show presciently touched many issues that will vitally concern us in all our future dealings with robots.

In *R.U.R.*, the mere invention of artificial servants is enough to doom the human race. Once they are no longer needed, people lose all purpose and ambition. Many just stop reproducing long before trouble begins. But some humans violently resist being made redundant, so governments turn the robots into soldiers to put down anti-robot resistance. They do so with ruthless efficiency: the androids revolt and kill off all remaining humans. But then they have to figure out a way to keep going without us. If this all sounds depressingly familiar, it’s because various elements of the plot have since become **sci-fi staples**.

Programming morality

The most resolutely optimistic view of robots was put forward in the mid-twentieth century by the great science fiction writer, **Isaac Asimov**. He envisaged thinking machines with a hard-wired moral code. His famous **Three Laws of Robotics** were an attempt at a simple, universal hierarchy of absolute, unbreakable principles to guide robots through any situation. Basically, they dictated that robots could not hurt or allow people to come to harm, and within those constraints, robots had to obey orders and protect their own existence. Most of his robot stories dealt with various twists, sabotage, or extensions of the code.

Asimov’s idea was that the Laws “just work”. Robots with them built-in could not help but be trustworthy, loving, faithful and kind because they were programmed that way. His fiction did a great deal to make the idea of mechanical slaves more acceptable. For a time, many naively hoped that our servants could be naturally morally superior to their creators.

With the advent of **electronic computers**, experimenters started trying to set them free. But the first attempts to apply machine logic to problems of sensing and motion instantly showed that creating smart, reactive machines would not be easy. Early on, it was thought that if all possible variations of a situation could be described, rules could be programmed into the devices to guide all their reactions. But to create scripts for even the simplest situations, like ordering in a restaurant, proved daunting, and such machines were incapable of coping with anything novel.

Meanwhile, in 1950, mathematician Alan Turing proposed an easy way to test if machines could think. If a

machine could respond by text to conversations with a human judge so the person was unable to tell if it was machine or man, it passed. Though widely criticized, the **Turing test** posed a workable goal, ideally requiring computers to process a great deal of data on the fly and respond appropriately to unexpected inputs. So developers turned to ways of mimicking the human brain or at least develop algorithms that could do much the same things. They would have to teach computers how to learn for themselves.

This research is still ongoing. Efforts to imitate ways people move and react has had practical results, shown in the **DARPA Grand Challenge**. This is a contest put on by the defense research-funding agency between autonomous vehicles, who in earlier contests raced on an off-road course, and more recently, operated in a mock city or emergency situation. The trials led directly to all those driverless cars being developed that are starting to appear on the roads.

Morality in robots, however, is nowhere in sight. Yet it may prove absolutely vital, if it’s not too late – already there are calls to **ban** the building of autonomous killer machines, which are now within reach. More people are beginning to wonder if artificial intelligence is a good idea at all. They’re not anti-progress **Luddites** either; when people like **Stephen Hawking, Bill Gates, Elon Musk, and Steve Wozniak** express serious doubts, it might be wise to listen.

Certainly some sort of limits, moral or otherwise, appear necessary. Ominously, the first **homicide-by-robot** occurred *exactly* 58 years to the day after the premiere of *R.U.R.* The unlucky victim was 25-year-old Robert Williams, a worker at a Ford Motor plant. On January 25, 1979, Williams was picking up parts from a spot where a robot was also gathering pieces. For whatever reason, the one-ton industrial droid slammed the man’s head into the side of a bin without warning, killing him instantly. His family was awarded \$10 million; the fate of the bot is not known.

Next issue -- how robotic thinking is unlike human, what their limits are, and their impact on our world.

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