

The History of the Twentieth Century

Episode 54

“A Martian Odyssey”

Transcript

[music: Fanfare]

In January, 1910, a breathtaking comet appeared in the morning sky, brighter than any celestial object but the sun and the moon. It attracted considerable attention from astronomers, but also from the newspapers and the general public, who had already been primed to expect a return of Halley’s Comet this year.

But this comet was not Halley’s Comet. It was an unexpected rogue comet, one that showed up just three months before Comet Halley and upstaged the better known comet, coming in brighter and putting on a much better show.

Welcome to *The History of the Twentieth Century*.

[music: Opening Theme]

Episode 54. A Martian Odyssey.

In today’s episode, I’d like to talk a bit about the astronomy of the early twentieth century. Astronomers of the day knew that the stars were distant suns like our own, and could use spectroscopes to get an idea of their chemical composition, but how stars were organized, if indeed they *were* organized, how they were formed and evolved, and what was their fate, these were largely mysteries in the early twentieth century. Indeed, as we have seen, astronomers did not yet understand how stars generated heat and light.

Within our own solar system, however, the layout of things was pretty well understood. Astronomers of the day knew that our solar system contains eight planets, Mercury through Neptune. Observation of their orbits gives you their masses; spectroscopy gives you some idea of what their atmospheres are made of. Astronomers knew the basic facts about asteroids, meteors, and comets. But they had a lot less observational data than we do today, partly because their equipment was less advanced. And, of course, they had 100 years’ worth less data to work with than modern astronomers have. So, an uncommon event, like the arrival of a comet, was exciting, because it brought with it the potential for gaining important new information.

The Great January Comet of 1910 appeared in January of that year, just as the January 1910 general election was getting under way in the United Kingdom, which we discussed in episode

46. It is also known as the Daylight Comet, because it was visible in daytime, but it doesn't bear the name of its discoverer, as is the normal practice. That's because there is no consensus as to who saw it first. It appeared very suddenly in the middle of January, by which time it was already close to the sun and quite bright. The first people to notice it may have been diamond miners in the Transvaal on their way to work in the early morning hours of January 12.

They spotted it with their naked eyes. By then, it was already bright enough to be plainly visible, even though it was so close to the sun it could only be seen just before dawn. Initially, it was only visible in the Southern Hemisphere, which may account for its surprise appearance, since there wasn't much astronomical observation being done in the Southern Hemisphere at this time.

The comet reached perihelion—that is, its closest approach to the sun—just days later, on January 17^t. As it moved to the other side of the sun in the days that followed, it became plainly visible just after sunset in the Northern Hemisphere. In fact, at its peak, you could see it in daylight, and people all over the world marveled at it. By early February, it had dimmed considerably, but its tail had lengthened, so that now it stretched across fifty degrees of sky.

By mid-February, it had faded from naked-eye view, but, as I said, it had attracted a huge amount of public attention, because it upstaged the long-expected return of the much dimmer Comet Halley, which appeared in mid-April.

Comet Halley is named after the English astronomer, Edmond Halley. And by the way, no one knows for certain how Halley pronounced his last name. Given the spelling, “Halley” seems the most likely, although it might have been “Hailey” or even “Hawley.” Americans often speak of “Hailey’s Comet,” which no doubt has something to do with the prominence of Bill Haley and His Comets, whose recording of the song “Rock Around the Clock” became the number one single in the United States in 1955, launching rock-and-roll music into the mainstream and fusing the name “Haley” with “comet” in the minds of millions of Americans, but that’s a story for another episode. Still, as I said, we don’t know for sure how Edmond Halley pronounced his name, so you can’t exactly say that “Hailey” is wrong.

Anyway, Edmond Halley did not discover the comet that is named after him. His contribution, in the year 1705, was in recognizing that the comets that European astronomers had observed in the years 1456, 1531, 1607, and 1682 were in fact repeated appearances of the same object, which returns every 75 years or so. Based on these observations, Halley predicted the comet would appear again in the year 1758. And although he lived to the age of 85, Halley did not survive long enough to witness his prediction confirmed, but it was. This was a big deal, because it made Comet Halley the first object other than the planets to be determined to orbit the sun.

Most comets that appear in the inner solar system are not periodic, or have very long periods. The Daylight Comet, for example, is not expected to appear again until the 600th century or so. (And yes, you heard that right. Six. Hundredth. Century. Or so.) But a small number of comets have their orbits shifted by encounters with other bodies in the solar system into much shorter

orbits. These are called short-period comets. Such bodies tend to be small. Comets give off gases when they come close to the sun, meaning that short-period comets gradually get smaller and disintegrate. Comet Halley is believed to be only 10 to 20 percent of its original size. Even so, it is the only short-period comet visible to the naked eye.

Once it was established that Comet Halley reappeared at predictable intervals, historians and archeologists began to look for records of earlier appearances. And they found them. Appearances of Comet Halley are in the historical record as far back as 240 BC for certain, and possibly much further. Perhaps most famously, the comet's appearance in the year 1066 was recorded in the Bayeux Tapestry, where it is presented as an ominous portent for the English King Harold II, who would be overthrown later in the year by William the Conqueror.

The combination of its historical significance and its easy visibility has made Comet Halley the most famous of comets. It returned right on schedule in 1835, reaching perihelion on November 16. Two weeks after its perihelion, when the comet was still visible in the night sky, the American author, satirist, and friend of the podcast Samuel Clemens, who wrote under the pen name Mark Twain, was born. Samuel Clemens has already made a couple of appearances in this podcast, when we talked about the Boxer Uprising and King Leopold's crimes in the Congo.

It was well known that Comet Halley was due to make another appearance in 1910, and its arrival was much anticipated, not least by Samuel Clemens, who was quoted a few months before the comet's return saying, "I came in with Halley's Comet in 1835. It is coming again next year, and I expect to go out with it. It will be the greatest disappointment of my life if I don't go out with Halley's Comet. The Almighty has said, no doubt, 'Now here are these two unaccountable freaks. They came in together; they must go out together.'" Famously, and eerily, Samuel Clemens would pass away on April 21, 1910, the day after the next perihelion of the comet with which, he suggested, his life was intertwined.

This appearance of Comet Halley was one of the closer and brighter ones in the historical record although it had been totally upstaged by the much more spectacular Daylight Comet that had shown up to steal Comet Halley's glory just a few weeks earlier. Nonetheless, the 1910 appearance of Comet Halley was significant for a number of reasons. It was the first appearance of the comet since the invention of photography, for instance, so it became the first time the comet was photographed. It was also the first appearance of the comet since spectroscopy was invented, which gave astronomers an opportunity to work out what gases were present in the comet's tail.

As it turned out, one of the gases present in the comet's tail was cyanogen, $(\text{CN})_2$. It also turned out that the comet was coming so close to the Earth that the Earth would actually pass through the comet's tail on May 19. The combination of these two facts led the 68-year old French astronomer Camille Flammarion to speculate that cyanogen gas from the comet's tail might poison the Earth's atmosphere and be the end of life on Earth, because of course he did.

Flammarion was a guy who dabbled in science fiction and had over his career indulged in a series of speculations that ranged from colorful to nut job, like extraterrestrial intelligence and reincarnation and the transmigration of souls to other planets.

More sensible astronomers hastened to point out that the gas of a comet's tail is so thin as to qualify as a vacuum by Earth standards, and only a few molecules of cyanogen were likely to be deposited into our atmosphere, but it was enough to inspire some people to seal up the doors and windows of their houses that day, as charlatans went about peddling "comet pills" and gas masks to protect against the threat. In other words, not much different from how people in our time would have reacted under similar circumstances.

You may have heard stories about this. You may have heard that some people believed the world would end in 1910 when the comet passed, which is kinda, sorta true, but only a few gullible people actually fell for it, and it wasn't really all that big a deal.

[music: *Vanishing*]

In the morning of June 30, 1908, a huge explosion, which modern scientists estimate in the 5 to 15 megaton range, ripped through the sky in an uninhabited area of central Siberia. This explosion has come to be known as the Tunguska explosion or the Tunguska event, and was likely caused by a meteor. If so, it was the largest and most violent meteor strike in recorded human history, and we are very, very fortunate that it happened to hit one of the most sparsely populated regions of the planet, and there were no known human casualties, although people dozens of miles away saw the flash of light, felt the heat, and were knocked off their feet by the shock wave.

As we have seen, there was a great deal of social and political turmoil in Russia during this period, and let's just say it isn't going to get any better for a while yet. As a result, there is no record of anyone investigating the Tunguska event for many years to come. The first scientists known to visit the region did not arrive until 1927, almost twenty years later. Even after that long, the investigators found millions of trees that had been knocked down by the explosion, within a range of about thirty by forty miles.

From the beginning, the event was believed to have been caused by a meteorite, but the scientists were surprised to find no crater. At the center of the blast area, the trees still stood upright, although they had been stripped of their branches and scorched, which suggested not a ground impact, but an explosion in the air above the forest.

To this day, no one knows for sure what happened, but the strongest hypothesis is the explosion of a stony meteorite about 100 meters across (or 300 feet) at an altitude of some five miles above the ground. It is believed that a meteor strike on this scale is a once-in-300-years event.

But no one knows for sure, which makes the event a tempting topic for science fiction writers and others who indulge in scientific speculation. When the theoretical basis of antimatter emerged in the 1930s, there were those who speculated the explosion was caused by a small quantity of antimatter striking our atmosphere. When UFO speculations became widespread in the 1950s and 60s, it was suggested that an extraterrestrial spacecraft had exploded. When the theoretical basis of black holes emerged in the 1960s and 70s, it was suggested that a tiny black hole had been responsible, although the pattern of the explosion and the absence of debris seem to rule out all of these other speculations.

Strangest of all, in the 1984 Ivan Reitman film *Ghostbusters*, one of the characters describes the event at the climax of that film as “the biggest interdimensional cross-rip since the Tunguska blast of 1909,” whatever *that* means. And it’s a pretty good movie, so let’s pretend we didn’t notice that he got the date wrong.

[music: *Vanishing*]

In the late nineteenth century, the greatest Italian astronomer was Giovanni Schiaparelli. Schiaparelli spent most of his career at the Brera Observatory in Milan. Schiaparelli was the first to make the connection between the regular meteor showers that our planet experiences and comets, suggesting that the source of these meteors was debris shed by the comets as they pass through the inner solar system, a suggestion that would eventually be shown to be entirely correct. He attempted to map the planet Mercury, a challenging task, given the relatively limited telescopes of the time, and the closeness of Mercury to the sun. There was no astrophotography, as yet, so astronomers had to look through the telescope with their own eyes and sketch what they saw, or thought they saw. Based on his observations, Schiaparelli concluded that Mercury’s rotation was locked with its orbital period, meaning the planet always kept the same face toward the sun. This was accepted as scientific fact until my day, even, but in 1965 was found to be not true after all.

Schiaparelli also discovered an asteroid in 1861, and named it Hesperia, which is an ancient Greek word meaning “land of the evening star,” a poetic reference to Italy, which lies west of Greece. Hesperia was the 69th asteroid to be discovered.

But Schiaparelli is best known today for his work on the planet Mars. In 1877, a year when Mars approached especially close to the Earth, Schiaparelli mapped the planet. His maps showed a Mars with lighter and darker patches that he labeled as “land” and “sea.” He also observed a network of dark, narrow lines, which he called “canali,” which is Italian for “channels,” a word that in Italian can mean either natural “channels” or artificial “canals.” This work sparked a lot of interest, and other astronomers turned their attention to the Red Planet. But understand that close approaches between Mars and Earth only happen once every two years and fifty days. So that means maybe a week or two of prime observing conditions, then two years for astronomers to discuss and argue about what they saw, and then another opportunity to make more observations.

When Schiaparelli's work was translated into English, "canali" became "canals," a word that in English most *definitely* suggests artificial structures.

So, in the late 19th century, there were bursts of new observations, and new claims, about Mars on a regular two-year schedule. Mars and Earth came pretty close together in 1892 and 1894, and some astronomers claimed to have seen seasonal changes on the Martian surface. Now, Mars has a period of rotation only slightly longer than Earth's—about 24½ hours. The planet has an axis tilted about the same as Earth's, meaning Mars has seasons, in much the same way that Earth does. Mars also has polar ice caps that get bigger in the winter and smaller in the summer. All of this was well established, and it made Mars sound a lot like Earth.

But now, new observations were coming in that were even more exciting. As winter became summer in one hemisphere, and the polar ice cap shrank, according to some astronomers, the canals and the "seas" in that hemisphere got darker, which made some speculate that these dark patches might actually be vegetation; forests or grasslands that lay dormant in the winter, but came to life when the ice caps melted and water flowed along the canals. (In our day, we know that Mars sometimes has huge dust storms, which obscure the surface features of the planet, which could explain why the dark patches might become more or less visible at different times. But they didn't know that back then.)

Some astronomers observed small circular spots at the points where the canals crossed one another, and these came to be called "oases."

I mentioned back in episode nine that early theories on the formation of the solar system suggested that the sun threw off material as it shrank, and this material condensed into planets, which implied that the farther a planet was from the sun, the older it was, which would suggest in turn that Mars is much older than the Earth. By the late 19th century, some people, even some serious astronomers like Schiaparelli, were prepared to put all these pieces together and construct an intriguing picture: perhaps Mars was much like Earth. Perhaps life had evolved there, even intelligent life.

I should emphasize that it was always a minority view among astronomers, but in the late 19th century, the fact that even a minority were prepared to take this idea seriously captured the public imagination.

And no one took it all more seriously than Percival Lowell. Percival Lowell was an American, born in Cambridge, Massachusetts in 1855, scion of the wealthy and accomplished Lowell family of Boston. His brother Abbott became President of Harvard University for more than twenty years; his sister Amy was a Pulitzer Prize-winning poet. Percival himself graduated from Harvard University in 1876 with a degree in mathematics. He spent time in the Far East, and wrote several books about Korea and Japan. He returned to the United States in 1892, and took up astronomy, which would be his main pursuit for the rest of his life. And he developed a particular interest in Mars, which was sparked by reading Camille Flammarion's book on the

Red Planet, and yet, that is the same Camille Flammarion who will scare a few people into thinking Comet Halley is going to poison the Earth's atmosphere eighteen years from now.

In 1894, Lowell founded an astronomical observatory, the Lowell Observatory, on Mars Hill, outside Flagstaff, in the Arizona Territory. Lowell himself chose the location for its elevation—7200 feet above sea level—and for its distance from large population centers, making the location ideal for astronomical observation, and this was really the first astronomical observatory that was located primarily for optimum viewing, rather than the convenience of the astronomers.

Lowell spent the next fifteen years of his life studying and mapping the Red Planet, and his observations and claims were far bolder than anyone else, even Schiaparelli, was willing to make. Lowell observed Mars himself, and produced drawings of canals that ran thousands of miles across the face of the planet in straight, sharp lines. He also claimed that from one set of observations to the next, two years later, he had found new canals that had not been there before, and even that some single canals had turned into double canals—in the same way that on Earth, we might upgrade a single-track railroad into a double-track railroad.

In the first decade of the twentieth century, Lowell published two books in which he laid out the most detailed and comprehensive claim yet of life on Mars made yet. He argued that Mars was the home of life, and not only life, but intelligent life and an advanced civilization. This was because the planet was much older than Earth, which had allowed more time for life, intelligent life, and finally civilization to develop and prosper.

But as the planet grew older, Lowell suggested, it had grown drier. Liquid water was now scarce on the planet, and its inhabitants had built, and were continuing to build, an elaborate system of canals to transport water from its last remaining source on Mars—the polar ice caps—to the inhabited regions of the planet, in an increasingly desperate effort to stave off their inevitable extinction.

It was a compelling image. Romantic, even. Serious astronomers had a different reaction. To them, Percival Lowell was moving into Camille Flammarion levels of nutjobbery. Among their objections to Lowell's work was that, first, Lowell's maps of the supposed canals on Mars didn't even match Schiaparelli's. Second, no other astronomer could confirm any of this. Even astronomers who had access to more powerful telescopes than Lowell's could make out no more than some vaguely defined light and dark regions on Mars. Nothing at all like Lowell's complex drawings with their geometric precision.

And so, the world of serious astronomy stopped taking Lowell seriously. As you can imagine, this was quite a letdown to Lowell, who had thought he was really onto something. Lowell never gave up believing in his theory of Mars, but by 1910 he was ready to give up studying and writing about the planet. The final blow was the death of the last serious astronomer willing to take Lowell seriously, Giovanni Schiaparelli, in July, 1910, at the age of 75.

And so, Lowell turned his attention away from Mars and toward other problems in astronomy. You can imagine the happy dance that the staff at Lowell Observatory did when they got the news that the boss was going off his Mars kick. The whole Mars thing was beginning to tarnish the reputations of anyone who so much as *worked* at Lowell's observatory. Now the cloud was lifting, and Lowell Observatory can do respectable research again. By the way, did the boss say what project he's taking on next? Planet X? You have *got* to be kidding me....

[music: *I. X. 1905*]

All right, so let me give you a little background on Planet X. In the 1840s, there was a mathematician in France named Urbain Le Verrier. His interest was in analyzing the motions of the planets mathematically, using the laws of motion and gravitation developed by Isaac Newton. But Le Verrier noticed a problem in the orbit of the planet Uranus. Uranus was, at that time, the most distant planet known, and the first and only planet discovered in modern times. It had been discovered, by accident, by the English astronomer, Sir William Herschel, in 1781.

Uranus, according to Le Verrier's calculations, had been moving, first, a little too fast, and then, a little too slow. Le Verrier began to wonder if this was not evidence of gravitational pull from an unknown large planet farther out in the solar system. Le Verrier calculated where that planet would have to be, and sent his work to a German astronomer, Johann Gottfried Galle. Galle received Le Verrier's letter, and that very night pointed his telescope at the spot in the sky where Le Verrier had calculated the new planet would lie, and found it, almost exactly where Le Verrier had predicted. It was named Neptune.

This would become one of the great moments in the history of science. Motion and gravitation had been reduced to simple formulas, and these formulas had been used to deduce the existence of a new world. Le Verrier has been called "the man who discovered a planet with the point of his pen."

Almost as soon as the discovery of Neptune was announced, though, other astronomers began arguing that Neptune alone could not explain these discrepancies, and proposed that there must be yet another planet beyond the orbit of Neptune. Le Verrier himself scoffed at this notion. *He* spent the rest of *his* life pondering discrepancies in the orbit of Mercury, and proposed that there was a small planet even closer to the sun than Mercury, which he dubbed "Vulcan," after the Roman god of fire. And after the Neptune thing, Le Verrier had a lot of credibility, and many astronomers searched for Vulcan, but it was never found. Still, a planet that close to the sun would be awfully hard to see from the Earth, since the sun's light would tend to obscure it. Le Verrier would pass away in 1877, convinced to the end that Vulcan existed. By Percival Lowell's time, in 1910, Vulcan was still regarded as within the realm of possibility.

And I suppose I should take care to point out that this Vulcan is no relation to the Vulcan from *Star Trek*. Gene Roddenberry won't even be born for another eleven years, so please put that out

of your mind. But remember the non-existent Planet Vulcan, because it's going to come back into the narrative in a future episode.

Percival Lowell's Planet X was not Vulcan. It was the name Lowell gave for the possible undiscovered planet beyond Neptune, because, although Le Verrier was having none of it, a number of astronomers during the late 19th and early twentieth centuries were following his example and making mathematical predictions of a new planet. Lowell would spend the final six years of his life searching for Planet X, which he expected would be large enough to be visible as a disc in his telescope. He never found it. Percival Lowell died in 1916, at the age of 61, and his friends and family would attribute his demise to the twin disappointments of the rejection of his Mars studies and his failure to find Planet X.

Those of you who have read ahead in the history of the twentieth century know that a ninth planet will be discovered in 1930, and it will be discovered at the Lowell Observatory. But that, too, is a story for a future episode. For now, I'll just note the irony that Lowell Observatory actually took two photographs of Pluto in 1915, while Lowell was still alive, but no one recognized this at the time. Lowell was looking for a planet large enough to show a disk, while Pluto was so small that it was just a point of light, even in Lowell's telescope, and there was nothing about it to distinguish it from all the other stars in the photograph.

[music: Mahler *Symphony No. 1*]

Scientific speculation about the possibility of intelligent life on Mars attracted the interest of writers of fiction at once. The earliest writers of the type of fiction that would later come to be called "science fiction" were already at work in the 19th century, and speculations about life on Mars led naturally to imaginative tales about humans from the planet Earth traveling to Mars—Camille Flammarion wrote one in 1889, entitled *Urania*—or tales about being from Mars—"Martians"—traveling to Earth, which began appearing in 1896.

The most famous science fiction novel of all time on the subject of Martians coming to Earth is, of course, *War of the Worlds*, by HG Wells, published in 1898, making Wells one of the first writers, but not the *very* first, to take up this theme. Wells embraced the idea of a Mars much older than Earth, with a Martian race much older and more developed, who covet our younger and greener world. No mention of canals, though, since this was before Percival Lowell published his books.

We've already talked some about *War of the Worlds*, all the way back in episode 2 of this podcast, where we looked at it in the context of the invasion novels that were popular in Britain during this period. But instead of Britain being invaded by Russia or Germany, Wells has it invaded by Martians, who land in the heart of the British Empire, and are depicted armed with weapons far superior to anything the British have available to defend themselves with, and conquer implacably, with no regard for human life.

Gee, do you think he might have been making a statement about colonialism?

So *War of the Worlds* was very much in tune with other novels of the time, although Wells managed to combine an invasion story, a Martian story, and a pointed critique of colonialism into one compelling package, which is probably the reason why this book is still remembered and enjoyed in our time. Or, to put it another way, HG Wells was a genius.

But Wells would by no means be the last author to write a story about Martians. I'll skip over a string of forgettable books and jump ahead to 1912, when the American writer Edgar Rice Burroughs published *A Princess of Mars*, the story of John Carter, a Confederate Civil War veteran from Virginia, who discovers a cave in Arizona that transports him to Mars, called "Barsoom" by the Martians. Burroughs followed the lead of Percival Lowell, and imagined a Mars that had once been lush and fertile, now dying, with the surviving Martians relying on the canals, fighting endless wars for control of water. Carter, as an Earthman from a planet with a much higher gravity, is far stronger physically than the natives, and becomes a swashbuckling hero.

Although Burroughs would eventually become even more famous after creating the character Tarzan, he would write many "Barsoom" stories, and they would cast a long shadow over twentieth-century science fiction.

By the 1920s, astronomers were coming to understand that the atmosphere of Mars was very thin, contained little or no oxygen, and was very cold. But science fiction writers could not let go of Percival Lowell's vision. Mars made a great location for stories about extraterrestrial intelligence. Why make your characters travel to other star systems when there just might be aliens on the planet right next door. By the 1930s, "Martian" was an everyday word and a familiar concept, even to people who never read science fiction. "Martian" was practically a synonym for "alien" or "extraterrestrial," and was much more commonly used than either of those words. Even today, everyone knows what "Martian" means. How often do people use the words "Venusian" or "Jovian?"

But as science made Mars appear a bleaker and bleaker place, the Martians of science fiction became progressively rarer, their civilizations farther in decline. In 1934, the American writer Stanley Weinbaum published "A Martian Odyssey," a story of an explorer on a Mars thought to be dead who meets and befriends one of the last of the Martians, one of science fiction's earliest examples of a truly alien alien. In 1938, the British writer C.S. Lewis published *Out of the Silent Planet*, about humans traveling to Mars, called "Malacandra" by the natives. *Out of the Silent Planet* is pretty explicitly written as a reply to *War of the Worlds*; Lewis suggests that Martians have a lot more to fear from Earth people than the other way around. Lewis's Martians are also a dying race; Lewis explains the canals as actually deep, deep canyons at the bottom of which there can exist enough water and air pressure for living creatures to survive.

By the 1950s, with the prospects for life on Mars looking bleaker than ever, you find science fiction stories in which the Martians are now extinct, but leave behind cities and artifacts for human archeologists to study. But then there's American writer Ray Bradbury, who made a name for himself in science fiction by writing stories about Mars. Bradbury unapologetically embraced the now scientifically obsolete Mars of Edgar Rice Burroughs, the Mars of deserts and canals, and used it as his setting for stories that ranged from straightforward voyages of exploration to eerie tales of modern people encountering the Martians of millions of years ago to nuclear war and apocalypse to retellings of Edgar Allan Poe, only set on Mars. These stories were stitched together into a collection entitled *The Martian Chronicles*, published in 1950, and inextricably linked the name of Ray Bradbury to Mars like no other writer.

In 1965, the American space probe *Mariner 4* became the first human vehicle to fly past Mars. It sent back a handful of pictures, revealing that the surface of Mars was rugged and full of craters, not much different from the Moon. This was the last nail in the coffin for the canals, which were now conclusively shown to be the products of optical illusion at best, or self-delusion, at worst.

Over the rest of the twentieth century, Mars was mapped in some detail. Giovanni Schiaparelli and Percival Lowell both got craters named after them, one each on Mars and on the Moon.

Modern science holds that the planets of the solar system were formed at approximately the same time, so Mars is no longer thought of as older than Earth, but there is evidence that water and oceans did once exist on the planet, before Mars dried up and turned desert. In that respect, at least, Lowell was right.

As for the science fiction writers, Mars was no longer a reasonable place to plant an alien civilization, though it remains the most Earthlike planet in the solar system, apart from Earth, and when the scientists began talking about a Mars of the distant past with oceans, and possibly even life, Mars begins to look like fair game for terraforming. In the 1990s, the American science fiction writer Kim Stanley Robinson published three novels telling a sprawling tale of humans engineering Mars into a pretty nice place for humans to live. They are titled *Red Mars*, *Green Mars*, and *Blue Mars*. Robinson's terraformers build canals on Mars, inspired by Percival Lowell's sketches, and the stories of Mars come full circle by the end of the century.

Truly spoke the American astronomer Carl Sagan, on his TV program *Cosmos*, that "Mars has become a kind of mythic arena onto which we have projected our Earthly hopes and fears."

We'll have to stop there for today, but I hope you'll join me next week on *The History of the Twentieth Century*, as we take a look at Mexico. In 1908, the Mexican President, Porfirio Díaz, told an American reporter he would not run for re-election in 1910, which would bring to an end his thirty-year presidency. Is he serious? What next for Mexico if he is? That's next week, on *The History of the Twentieth Century*.

Oh, and one more thing. Comet Halley passed through the inner solar system a second time in the twentieth century, in 1986. Humans sent no fewer than five space probes to study the comet during this approach, so many that they came to be called the “Halley Armada.”

But the comet’s orbit was highly unfavorable this time around. Its perihelion was behind the sun, as seen from the Earth, making the comet all but impossible to look at during its brightest days. It is believed to have been the least visible appearance of the comet in all of human history. While that’s unfortunate, the good news is that its next appearance is predicted to be much, much better. That will come in July, 2061.

[music: Closing Theme]