1

History

> Obviously, we have a problem in predicting the nature and behavior of intelligent extraterrestrials, as we have no confirmed information about them. Until we do, we have only two methods of analyzing the possible consequences of contact: analogy with ourselves, and probability based on what we know about human history and behavior.
>
> *Michael A. G. Michaud*[1]

> That men do not learn very much from the lessons of history is the most important of all the lessons of history.
>
> *Aldous Huxley*[2]

It was December 11, 1996, and the vice president of the United States sat at the head of the table to my left, flanked by NASA administrator Dan Goldin and White House science advisor John Gibbons (Figure 1.1). Around the table in the Indian Treaty Room of the Old Executive Office Building across from the White House, where the vice president maintains his ceremonial office and staff, sat luminaries representing a variety of fields: scientists such as David McKay, Stephen Jay Gould, and Lynn Margulis; theologians including John Minogue of DePaul University and Joan Brown Campbell of the National Religious Partnership for the Environment; journalist Bill Moyers; and me, an astronomer and historian of science who had just published a book titled *The Biological Universe*.[3] Astronomer Carl Sagan, one of the pioneers in the search for life in the universe, had been invited but lay in a cancer center in Seattle, nine days from death.

The occasion of this unusual gathering was to discuss the meaning of the announcement four months earlier that possible fossilized life had been discovered in a Martian meteorite that had landed on Earth. Vice President Gore first turned to Gould and asked about the consequences if the discovery turned out to be true. Gould replied that it depended on whether past or present life on Mars represented an "independent genesis." In other words, if life had arisen independently in two places so near each other in the solar system, as opposed to having been seeded from Earth, this would indicate that the universe was filled with life. Gore then

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Figure 1.1 In the wake of the claim that the Mars rock ALH84001 contained nanofossils, a high-level discussion of the implications of finding life beyond Earth took place on December 11, 1996, in the Indian Treaty Room of the Old Executive Office Building adjacent to the White House. From right to left: Vice President Al Gore, NASA administrator Dan Goldin, astronomers Anneila Sargent and John Bahcall, historian of science Steven Dick, theoretical biologist Stuart Kauffman, biologist Lynn Margulis, astrobiologist David McKay, theologian Joan Brown Campbell, and NASA associate administrator Wes Huntress. Among those not visible are journalist Bill Moyers, Harvard biologist Stephen Jay Gould, and presidential science advisor Jack Gibbons, who was seated to Gore's left. US government photo.

turned to me and asked what would be the maximum consequences of life on Mars. I replied that humanity's worldview was at stake, as well as the possibility of a universal biology, just as Newton had formulated a universal physics. Around the table we went, with the vice president issuing rapid-fire questions ranging from science to theology and media. Three hours later the meeting was still going on, having overrun its allotted time.

No definitive conclusions were reached that memorable day, and the current consensus is that the purported Martian fossils are not real. But the episode painted a vivid picture of what would likely happen when life was actually discovered beyond Earth. I left the meeting exuberant, but also worried. The discussions revealed we were not prepared for the discovery of life beyond Earth in even the most basic way, and even for the most primitive forms of life, or fossil life. How

might we prepare for the implications? For starters, could the history of reactions to purported discoveries of life be of any help? I vowed to find out.

Numerous times in the past four centuries of telescopic astronomy Earthlings believed extraterrestrial life had been detected. And numerous times they were disappointed. Galileo's 1610 landmark telescopic lunar observations had barely been published when Kepler enthusiastically conjectured that one particularly circular crater must be an artificial construction of lunar inhabitants. Two centuries later the famous "Moon Hoax" of 1835 placed lunarians on the Moon, supposedly based on the latest telescopic observations of John Herschel. Sixty years further on, even as H. G. Wells was penning his *War of the Worlds*, astronomer Percival Lowell argued there were canals on Mars, built by a dying civilization managing its water resources. Though largely discredited by the time of Lowell's death in 1916, the idea had not dimmed so much that when Orson Welles broadcast his radio version of *War of the Worlds* on Halloween Eve, 1938, a considerable reaction ensued as some Americans believed a real Martian invasion was under way. Thirty years later, when strange pulses were detected from the heavens (soon dubbed "pulsars"), astronomers briefly but seriously considered the "Little Green Men" hypothesis. Finally, in 1996, NASA announced it had evidence of fossil life from Mars in the form of the now famous and infamous Mars rock dubbed ALH84001, resulting in the scenario described earlier in this chapter.

These episodes not only demonstrate a deeply ingrained human "will to believe" in extraterrestrial life but also provide an opportunity to examine, with some historical rigor, the human reaction to such perceived "discoveries." They represent the first approach, the relevance of history to the problem of impact. Analogy and the nature of discovery are two more approaches that we elaborate in the following chapters of Part I.[4] Keeping in mind that human reactions are always tied to cultural contexts, and mindful also of Huxley's pessimistic judgment that lessons of history are seldom learned, we nevertheless want to ask what lessons we might learn from these episodes about human reactions that might be useful when a real discovery of extraterrestrial life is made. Here history and analogy converge, since the future reaction must remain an exercise in analogy. And while analogy is far from predictive, this form of argument can provide useful guidelines, perhaps even more so when the analogy is another putative discovery of life beyond Earth.

Lunarians: The Great Moon Hoax/Satire (1835)

Passing over Kepler's seventeenth-century claims, which caused little stir because they were not widely known, we begin with the so-called Great Moon Hoax of 1835. Readers of the *New York Sun* for August 25 of that year could hardly miss the headline prominently placed at the top of the front page: "GREAT ASTRONOMICAL

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DISCOVERIES LATELY MADE BY SIR JOHN HERSCHEL, L.L.D, F.R.S., etc. At the Cape of Good Hope." Though the article, the first of a series of six that concluded on August 31, purportedly came from the "Supplement to the Edinburgh Journal of Science," readers could not be expected to have known that the journal had ceased to exist three years earlier. A few may have heard of John Herschel, who indeed was the son of the famous William Herschel, had published his *Treatise on Astronomy* in the United States to great acclaim the previous year, and was in fact at the Cape of Good Hope making astronomical observations.[5]

The first three days of the series reported on Herschel's telescope, his geological and botanical observations of the lunar surface, and the discovery of more complex, but not intelligent, life. By the time of the installment for Friday, August 28, readers were primed for the great revelation (Figure 1.2). According to the article, Herschel himself had observed large winged creatures, "wholly unlike any kind of birds, descend with a slow even motion from the cliffs on the western side, and alight upon the plain." The creatures:

> averaged four feet in height, were covered, except on the face, with short and glossy copper-colored hair, and had wings composed of a thin membrane, without hair, lying snugly upon their backs, from the top of the shoulders to the calves of the legs. The face, which was of a yellowish flesh-color, was a slight improvement upon that of the large orang-outang, being more open and intelligent in its expression, and having a much greater expansion of forehead.[6]

And then came an even more important revelation, for:

> these creatures were evidently engaged in conversation: their gesticulation, more particularly the varied action of their hands and arms, appeared impassioned and emphatic. We hence inferred that they were rational beings, and, although not perhaps of so high an order as others which we discovered the next month on the shores of the Bay of Rainbows, that they were capable of producing works of art and contrivance.

The Saturday article, largely devoted to lunar features, ended with the report that Herschel and his team had discovered an immense stone structure, which they pronounced to be a "temple." The series concluded on Monday, August 31, with a description of this find.[7] Oblivious to the fact that no Earth-bound telescope could then – or even now – possess the power to distinguish buildings, much less gesticulating aliens, on the surface of the Moon, the public took the well-written series of articles at face value, eagerly awaiting each day's new revelations.

The articles appeared in the *Sun* anonymously, but within days the author was revealed as Richard Adam Locke (1800–1871), a 34-year-old reporter who had just joined the *Sun* that summer. Within weeks the article was exposed as a hoax, and so it was widely believed to be until 145 years later, when historian Michael Crowe convincingly argued that Locke was actually writing satire.[8] What was he

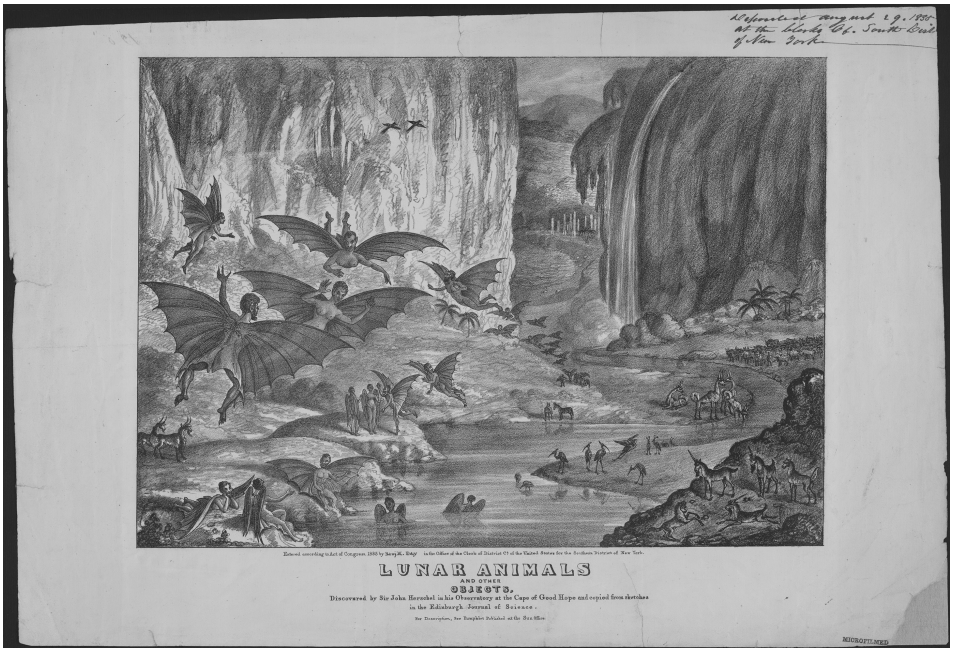

Figure 1.2 Illustration of winged lunarians in the *New York Sun* for August 28, 1835, part of a series of articles now known as the Great Moon Hoax, though in reality it was probably the Great Moon Satire. Library of Congress Prints and Photographs Division, Washington, DC.

satirizing? According to Crowe, his target was no less than the advocates of inhabited worlds, of which there were many, especially among German astronomers, but none more enthusiastic than Scottish astronomer Thomas Dick. Dick once calculated the number of inhabitants on each of the planets in our solar system, arriving at a figure of more than 21 trillion, not counting those on the Sun! Sincere as he was, such conclusions were ripe for satire, and Locke took the opportunity with aplomb.[9]

Our interest here is not so much in the motivations of the cub reporter Locke, but in the public and scientific reaction to his stories. The *Sun* was a fledgling tabloid newspaper with a circulation of about 8,000. During the Moon episode its circulation reached 19,000, and remained high thereafter. Moreover, the *Sun* sold 60,000 copies of the story in pamphlet form, as well as lithographs of the lunarians. Nor was interest confined to the United States; French, Italian, Spanish, and German editions of the brochure appeared, and numerous other newspapers reported the story both inside and outside the United States.[10] A detailed study of the series of articles concluded, "no other newspaper story of the age was as broadly circulated as Locke's moon series … By the time the series had run its course, the *Sun*

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had become the most widely read newspaper in the world."[11] Obviously the story was profitable for the *Sun* because it had great popular appeal even if not true, a situation that resonates with tabloid (and some might say mainstream) journalism today.

But it was not only the general public that fell for the story. Crowe again describes the effect: the *New York Times* pronounced the discoveries "probable and possible," while the *New Yorker* credited them as creating "a new era in astronomy and science generally." Religious journals debated the consequences, Yale was "alive with staunch supporters" including students and professors, and astronomy professors Elias Loomis and Denison Olmsted traveled to New York to unearth more details, though they later denied believing the story. Edgar Allan Poe, who had himself just written a fictional lunar account in *Hans Phaall – a Tale*, reported:

> Not one person in ten discredited it, and (strangest of all!) the doubters were chiefly those who doubted without being able to say why – the ignorant, those uninformed in astronomy, people who would not believe because the thing was so novel, so entirely "out of the usual way." A grave professor of mathematics in a Virginia college told me seriously that he had no doubt of the truth of the whole affair!

Poe also called the Moon Hoax series "decidedly the greatest hit in the way of sensation – of merely popular sensation – ever made by any similar fiction either in America or in Europe."[12]

An 1882 *History of New York City* remarked on the graphic details of the series, the ingenious descriptions, and the plausibility of the arguments that even fooled some men of science. Horace Greeley, editor of the *New Yorker*, recalled the "unquestionable plausibility and verisimilitude" of the series, and said that "nine-tenths of us, at the least," were fooled by it. P. T. Barnum declared that "the majestic, yet subdued dignity" of Locke's work "at once claimed respectful attention; whilst its perfect candor, and its wealth of accurate scientific detail, exacted the homage of belief from all but cross-grained and inexorable skeptics."[13]

Not everyone was taken in. John Herschel himself was reported to be "in general amused," though by early 1837 he complained to his sister Caroline (herself a famous astronomer), "I have been pestered from all quarters with that ridiculous hoax about the Moon – in English, French, Italian and German!!" His wife wrote Caroline:

> Have you seen a very clever piece of imagination in an American newspaper, giving an account of Herschel's Voyage to the Cape … & of his wonderful lunar discoveries [of] Birds, beasts & fishes of strange shape, landscapes of every colouring, extraordinary scenes of lunar vegetation, & groups of the reasonable inhabitants of the Moon … it is only a great pity that it is not true but if grandsons stride on as grandfathers have done, as wonderful things may yet be accomplished.[14]

The first thing to note in this fascinating episode in public reaction is that the media played an important role, and indeed was the very vehicle through which the idea originated and was propagated. And, as contemporaries commented, the series was extremely well written, guaranteed to capture the imagination. Second, it mattered not that scientists knew conditions on the Moon did not support such observations; as Crowe puts it, "It was not that Locke lacked the skills of a satirist; it was rather that pluralist preachings and pronouncements had so permeated the thought of his contemporaries that they first failed to see the articles as satire, and failed again as they branded them a 'hoax.'"[15] Third, the episode may have damaged the reputation of a fledgling science in America, causing astronomical news from the United States to be received with great caution abroad.[16] Fourth, it is perhaps relevant that after 76 years Halley's comet was due to arrive in the fall of 1835, and was eagerly anticipated as the first apparition over the United States; by August enterprising businessmen had already set up a telescope near City Hall in New York City. In fact Yale astronomers Loomis and Olmsted claimed the honor of first sighting Halley's comet on August 31, the last day of the Moon series.[17] The public was perhaps primed for celestial news. We hold these lessons in mind as we turn to a quite different episode and a quite different culture, 100 years on.

The Martians Are Coming! The Great Martian "Panic" (1938)

On Halloween Eve, October 30, 1938, an event occurred so famous in radio history that we are still talking about it. Broadcasting coast to coast from Madison Avenue in New York City, 23-year-old American actor, writer, and producer Orson Welles – only three years away from producing and starring in his classic film *Citizen Kane* – directed and narrated *War of the Worlds* as part of the CBS series *The Mercury Theatre on the Air*. Based on H. G. Wells's 1898 novel by the same name in which Martians invade London, Welles's radio version transferred the action from London to Grover's Mill, New Jersey, about an hour's drive south of New York City. The 62-minute broadcast was presented as a series of news bulletins, which (despite warnings at the beginning of the show) many took to be real. It is the reaction to this event that makes it an important part of radio history – and of special interest for studying the reaction to possible extraterrestrial contact in its most extreme and direct form.[18]

There is no doubt that the reaction was considerable. The *New York Times* front-page headline the next day was "Radio Listeners in Panic, Taking War Drama as Fact," adding in the subtitle "Many Flee Homes to Escape 'Gas Raid from Mars' – Phone Calls Swamp Police at Broadcast of Wells Fantasy." It went on to say that

"A wave of mass hysteria seized thousands of radio listeners between 8:15 and 9:30 o'clock last night when a broadcast of a dramatization of H. G. Wells's fantasy 'The War of the Worlds' led thousands to believe that an interplanetary conflict had started with invading Martians spreading wide death and destruction in New Jersey and New York."[19] Many other newspapers carried similar accounts. A study published in 1940 by respected Princeton University professor and public opinion researcher Hadley Cantril, entitled *The Invasion from Mars: A Study in the Psychology of Panic*, confirmed the idea of a widespread "panic" reaction, and the concept was propagated in both scholarly and popular culture over the next 70 years.[20]

It is important to understand that by this time the idea of intelligent Martians had pervaded popular culture for four decades, thanks to the claims of American astronomer Percival Lowell that he had observed canals of artificial construction on the Martian surface. Indeed, according to Lowell, his 18-inch telescope in Flagstaff, Arizona, revealed a network of canals crisscrossing the entire planet. Lowell published his ideas in numerous reports, articles, and three major books – *Mars* (1895), *Mars and Its Canals* (1906), and *Mars as the Abode of Life* (1908) – and spread his ideas at numerous lectures, where his personal charm and enthusiasm usually won the day, at least among the public.[21]

Notably, although Lowell's ideas fired the popular imagination, there was no hint of panic caused by Martians reputed to be active on their home planet tens of millions of miles away. Historian William G. Hoyt, analyzing the press clippings in the Lowell Observatory archives, concluded that the initial public reaction "ranged from simple uncritical wonder through more or less credulous curiosity to skeptical but tolerant amusement." Another historian found that Lowell's theory of Martian canals unleashed a firestorm of controversy. "The public was fascinated, while professional astronomers generally viewed him with suspicion; some were openly hostile." Historians such as Michael Crowe have examined the scientific controversy in detail, but the important point is that a claimed remote detection of intelligent life on Mars resulted in much discussion and interest from both the public and astronomers, but no panic.[22]

This would change with H. G. Wells, or more specifically when Welles took up Wells. Wells first set pen to paper for his *War of the Worlds* in 1897, and it is no accident that Wells's invaders came from the Mars of Percival Lowell, whose Martian canal controversy had by 1897 reached England. Moreover, Wells believed Lowell's theory; as late as 1908, he cited "the work of my friend, Mr. Percival Lowell," as testimony that *War of the Worlds* was not too farfetched. Pronouncing Lowell's case for canals created by intelligent Martians "very convincing," Wells even discussed the forms that such Martians might take.[23] Although Lowell's claims were discredited by observations made during the close approach of the planet in

1909, Mars remained a favorite setting for the alien through many decades. And the idea of a Martian invasion of Earth lived on in popular culture also (Figure 1.3).

Which brings us back to Halloween Eve, 1938. For several decades sociologists, psychologists, and media specialists have questioned the extent of the "panic"

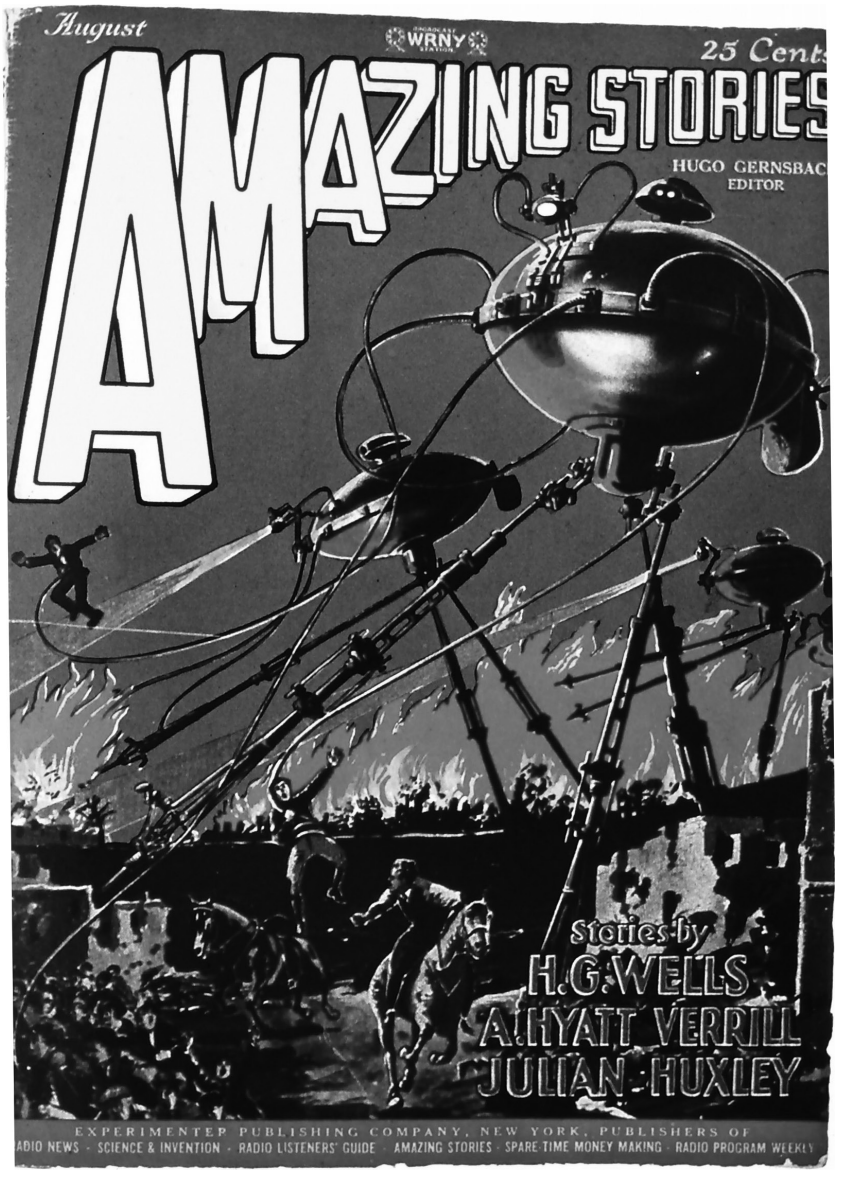

Figure 1.3 Cover from *Amazing Stories* of August 1927, illustrating the Martian invasion in H. G. Wells's *War of the Worlds*, the basis for Orson Welles's infamous Halloween Eve 1938 radio broadcast. Copyright 1927 by Experimenter Publishing Company.

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reported in newspapers and supported by Hadley Cantril's study. Sociologist William Sims Bainbridge was among the earliest to criticize Cantril's conclusions, albeit almost a half century later. Writing in 1987 in the context of the sociological concept of "collective behavior," he clearly stated, "the most striking impression conveyed by Cantril's book was a false one – that real mass panic followed the broadcast. By quoting the stories of a few people who claimed to have been very frightened, Cantril implies that there was widespread panic. There wasn't … the whole affair was more a news media craze than a mass panic."[24] Bainbridge (as well as *Time* and *Newsweek* at the time) suspected those who *were* panicked were likely affected by war anxiety in Europe, fanned by the American media. Bainbridge also makes the point that panic is most likely when an ambiguous threat is seen as immediate; in other words, had Welles kept the original location of the invasion in England rather than the environs of New York City, there would undoubtedly have been little effect in the eastern United States. Reaction to Lowell's Martian canals confirms this idea; no one panicked when he suggested Martians on Mars.

The idea of mass panic from the Welles broadcast has been gradually thoroughly debunked. On the sixtieth anniversary of the broadcast in 1998, sociologist Robert Bartholomew reviewed the criticisms of the panic scenario, which included problems with Cantril's estimates of the actual number of people affected, as well as erroneous reports in the media that nevertheless went on to become part of popular culture. He concluded that perhaps tens of thousands rather than millions of people were panicked; in any event his lesson learned is that the mass media significantly influenced public perception of the event.[25]

But such a vivid part of popular culture is hard to excise. On the seventy-fifth anniversary of the broadcast in 2013, two professors of communication criticized PBS for perpetuating the "myth" of the "War of the Worlds" panic in a broadcast in its American Experience series. Among other things they also took Cantril to task for methodology and sloppy terminology, arguing he did not distinguish a state of excitement from a state of panic where people rioted in the streets. They conclude that the newspaper coverage was "dramatic and sensational – but ephemeral." They chalk up the sensational newspaper coverage to competition between newspapers and fledgling radio, which was beginning to draw advertising away from print media. In his book *Getting it Wrong: Ten of the Greatest Misreported Stories in American Journalism*, W. Joseph Campbell comes to the same conclusion, and states that

> the panic and mass hysteria so readily associated with the *War of the Worlds* program did not occur on anything approaching a nationwide dimension. The program did frighten some Americans, and some others reacted in less than rational ways. But most listeners, overwhelmingly, were neither frightened nor unnerved. They recognized the program for what it was – an imaginative and entertaining show on the night before Halloween.

He attributes the myth of the panic to anecdotal news reports that were never confirmed. Why were they not retracted? In Campbell's estimation, they represented an irresistible opportunity to rebuke radio, a rival source of news and advertising, as unreliable and untrustworthy.[26] This view has come to be the consensus among scholars, including Bartholomew, who also places the reporting of the "War of the Worlds" broadcast in the context of other media-driven panics and hoaxes such as the Moon Hoax, the Halley's comet scare of 1910 (due to reports of poisonous gases in its tail), and mythmaking during Hurricane Katrina.[27]

And yet, all this notwithstanding, whether excited or panicked, in small numbers or large, there is no doubt that the "War of the Worlds" broadcast had its effect, both on the night of the broadcast and in contemporary popular culture. And there is no doubt it could happen again on scales large and small. In fact, it did happen again, several times in a rebroadcast in Chile in 1944, one in Quito, Ecuador, in 1949, and on several occasions since. The latter resulted in another front-page *New York Times* headline for February 14, 1949: "Mars Raiders Caused Quito Panic; Mob Burns Radio Plant, Kills 15."[28] Panics related to anniversary rebroadcasts of "War of the Worlds" still occasionally occur, as do other mass panics involving erroneous reports of environmental contaminants, nuclear accidents, and other cultural concerns. Bartholomew's lesson is that only a small portion of the population needs to act on erroneous information over a short period to create large-scale disruptions to society. *Sociological study of the causes and effects of collective behavior are thus critically important to the study of the potential societal impact of discovering extraterrestrial life.*

"A bit of 'scruff'": Pulsars and Little Green Men (1967)

Both the 1835 Great Moon Hoax/Satire and the 1938 "War of the Worlds" broadcast were creatures of the media from beginning to end. By contrast, we now turn to an episode of extraterrestrial discovery that originated with serious scientific research. In the fall of 1967 astronomers at Cambridge University's Mullard Radio Astronomy Observatory made a puzzling discovery. Such discoveries are not unusual in the annals of astronomical history, but this one stands out because it involved a mysterious new class of object and was for a period of weeks seriously considered as a possible signal from extraterrestrial intelligence. It involved new technology, a low-frequency radio telescope that had begun operation only months before. The unusual telescope, built of wooden poles and wires and covering an area near Cambridge the size of 57 tennis courts, was built to observe exotic objects called quasars, located far outside our Milky Way Galaxy in the far reaches of the universe. The telescope was the brainstorm of Cambridge astronomer Anthony Hewish, while graduate student Jocelyn Bell had sole responsibility

for operating the telescope and analyzing the data, under his supervision. The data were recorded on long strips of paper that were visually inspected. "Six or eight weeks after starting the survey I became aware that on occasions there was a bit of 'scruff' on the records, which did not look exactly like a scintillating source, and yet did not exactly look like man-made interference either," Bell wrote. "Furthermore I realized that this scruff had been seen before on the same part of the records – from the same patch of sky (right ascension 1919)." In late August, Bell showed the charts to Hewish, and by the end of September, Hewish suspected they had located a flare star similar to the certain dwarf stars under investigation by Bernard Lovell at Jodrell Bank. But by November 28, more observations had been made, and Bell recalled: "As the chart flowed under the pen I could see that the signal was a series of pulses, and my suspicion that they were equally spaced was confirmed as soon as I got the chart off the recorder."[29] The pulses were only 0.3 seconds, separated by about 1.3 seconds, phenomena not only unknown in the astronomical world but also difficult to explain by any natural physical process.

What to make of this observation? Hewish at first thought it must be man-made. Radar reflected from the Moon, satellites in peculiar orbits, and local effects were eliminated when another telescope confirmed the results, and it was established that the source was outside the solar system, but inside the Galaxy. As early as September a "Little Green Men (LGM) hypothesis had been jokingly raised when some of the group dubbed it the 'LGM star.'"[30] As astronomer Alan Penny has documented in his history of the event, Bell wrote in her thesis, "The possibility that the signals were from some intelligent civilization in the universe was not ruled out: hence the unfortunate nickname 'little green men.'" After the November 28 observations, when the regularity and unexplainable brevity of the signal was realized, the LGM explanation became more real. Cambridge astronomer Martin Ryle, the head of the radio observatory, later wrote, "our first idea was that other intelligent beings were trying to establish contact with us." By mid-December, by Penny's account, the LGM explanation was moving up in the list of possibilities. Hewish wrote, "As the days went by excitement rose when we found that the pulses were coming from a body no larger than a planet situated relatively close to us among the nearest stars of the galaxy. Were the pulses some kind of message from an alien civilization? This possibility was also entertained for lack of an obvious explanation for signals that seemed so artificial." He continued, "all kinds of thoughts went through our minds: it was such an artificial signal that I had to seriously consider that the signal was being sent to us … I had a test for the little green men idea though I had to pinch myself to take it seriously."[31] Hewish's test (which he began December 11) was to make timing (Doppler) measures to determine if the signals were on a planet orbiting a star, in which case the signal would shift back

and forth in frequency. "Without doubt," he recalled, "those weeks in December 1967 were the most exciting in my life."[32]

By early January 1968. it was clear that the Doppler shifts in the signal showed only the orbital motion of the Earth, not of a planet with extraterrestrials. The discovery on December 21 of similar signals coming from the radio source Cassiopeia A also mitigated the possibility of extraterrestrial life as an explanation, since two civilizations would likely not be signaling at the same frequency. In February 1968 the data were reported in *Nature*, where Hewish, Bell, and their coauthors speculated that the signals could be caused by radial pulsations of exotic stellar evolutionary endpoints known as white dwarfs or neutron stars. Theorist Thomas Gold at Cornell quickly published a model that explained pulsars as rotating neutron stars; though Walter Baade and Fritz Zwicky had predicted neutron stars in the 1930s, their prediction had been forgotten. The rotation of these exotic objects, the aftermath of the collapse of a massive star (though not so massive as to produce a black hole), is the explanation accepted today.

From the first observations of unusual "scruff" and its discussion in August to the realization in late November of the extreme brevity and regularity of the signals, the LGM hypothesis seems to have been taken lightly. But in the wake of the November observations, for three weeks in December 1967, and until another similar source was found at the same frequency, the LGM hypothesis seems to have been considered quite seriously. The hypothesis was taken seriously enough that Martin Ryle expressed concern that the news should not leak out, a concern he amplified a few years later when Frank Drake sent a message to M 13, the Great Cluster of Hercules. On December 21 Hewish and Ryle had discussed between themselves what to do if it was an ETI signal: "you can't just publish it or release it like a news flash; we thought we would inform the Royal Society and get it handled nationally as it was too big a thing to deal with ourselves."[33]

Pulsars were not the first or the last case of unexplained radio signals. Frank Drake's Project Ozma (1960), the first radio telescope search for extraterrestrial intelligence, saw unusual signals, quickly explained as local interference. In the midst of the discovery of the new class of exotic objects known as quasars, in 1963–1964 Russian astronomers Nikolai Kardashev and Evgeny Sholomitskii argued that the unusual spectrum of a regularly varying radio object known as CTA-102 might be generated by artificial signals. Soviet radio astronomer Joseph Shklovskii vividly recalled the announcement: "There was a great uproar over it," he wrote. "I'll never forget the press conference that the Shternberg Institute gave to announce the great discovery. The entire courtyard of the institute was crammed with luxurious foreign cars belonging to some 150 of the leading accredited correspondents in Moscow … The director of the institute, Dmitry Martynov, basked in the limelight." This "CTA-102 affair" remained unexplained for some years,

until it was determined to be a type of quasar with an unusually large redshift. But anomalous observations continued: in 1977 astronomers at Ohio State University detected a still unexplained "Wow!" signal; in 1997 astronomers at the National Radio Astronomy Observatory briefly had an anomalous signal; and in 2015 radio astronomers searched for signals after the *Kepler* spacecraft detected unexplained light variations in the star known as KIC 8462852.[34]

These episodes, taken together with pulsars, illustrate several characteristics likely to be present in a real discovery of extraterrestrial intelligence by astronomical observations: confusion, doubt, and uncertainty about what to do. As we see in Chapter 9, these incidents played a role in urging scientists and others to think about consequences if a detection were made. Beginning in the mid-1980s, as NASA was ramping up its own SETI program, the International Academy of Astronautics, in conjunction with the International Institute of Space Law, developed and approved the "SETI Post Detection Protocols," the thrust of which was to confirm the observations, then tell everyone.[35] How such principles would play out in real life is anyone's guess.

Extraordinary Claims: Fossils from Mars? (1996)

Deep in the summer of 1996 a startling announcement came from NASA, the American space agency. Life had been found on Mars! Or at least evidence of past life. On August 7, with little more than a day's notice, reporters descended on a hastily called press conference at NASA Headquarters in Washington, DC, to which the participants themselves had been hurriedly summoned. A carefully planned announcement for the following week had been upstaged by a three-paragraph leak in the industry newspaper, *Space News*, and the exhausted scientists had flown in from around the country. Among the many officials in the audience were the heads of the National Science Foundation (NSF), the National Academy of Sciences, and Gerald Soffen, the project scientist for the *Viking* spacecraft, which had landed on Mars 20 years earlier. First to the podium was NASA administrator Dan Goldin, who had already briefed President Bill Clinton and other top political officials. He waxed eloquent about NASA, American science, and the breathtaking conclusions about to be announced, and reported that the president had asked that the discovery be given top priority.[36]

NASA Associate Administrator for Space Science Wes Huntress then turned the podium over to the scientists, a team of nine led by geochemist David McKay of NASA's Johnson Space Center. Now they presented their evidence to a hushed audience. Organic molecules had been found in a meteorite that was blown off Mars 16 million years ago, had landed in the Antarctic 13,000 years ago, was found there by a meteorite-collecting team funded by the NSF and the Smithsonian

Institution 12 years ago, and had been recognized as Martian only two years ago. Almost three years of exhaustive study had led the researchers to their momentous conclusions. The claim of organic molecules on Mars was already a step beyond the *Viking* results. But there was much more: mineral "carbonate globules" of possible biological origin; evidence of tiny magnetic minerals that on Earth are secreted by certain bacteria; and, finally, pictures of strange, hauntingly wormlike structures that they argued might be microfossils (Figure 1.4). In short, the assembled scientists suggested, life had existed on Mars sometime in the planet's distant past, when Mars was warmer and wetter.

This was not exactly the Martian civilization of Lowell, Wells, and Welles, but compared to the ambiguous results of *Viking* 20 years before, the claim that a Martian meteorite had landed on Earth bearing evidence of past life on that fabled planet was little short of miraculous. Nor was it to be a mere three-week hypothesis as in the case of Little Green Men and pulsars. The very possibility of life on Mars, even past life, set the world afire, igniting media hype, public imagination, scholarly discussion, and scientific curiosity alike. The reaction played out over timescales short and long, and arguably is still strongly felt today, long after scientists reached consensus that the rock most likely does not harbor fossils.

The flurry of events the claimed discovery set in motion, both before and after the announcement, are best analyzed as they unfolded. Before anyone dared make

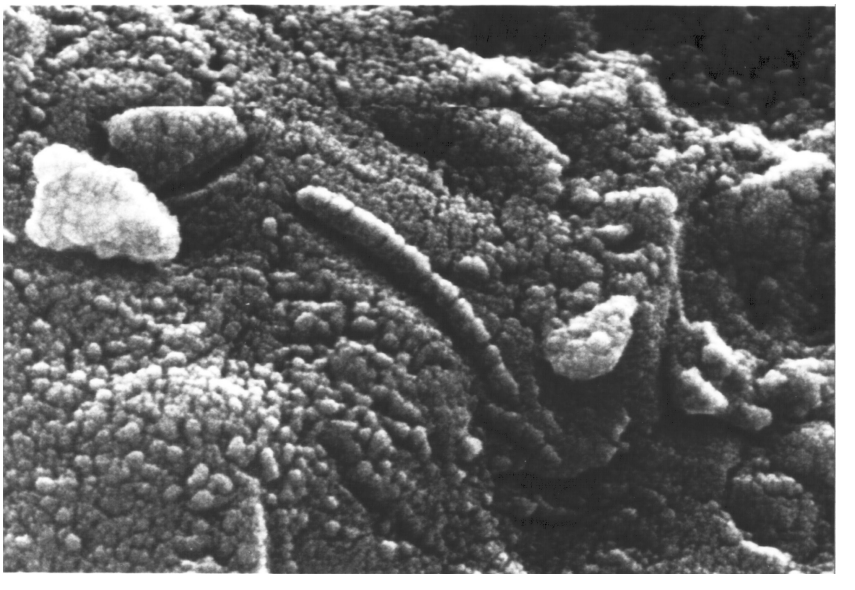

Figure 1.4 Structures interpreted as nanofossils in the Mars rock ALH84001. The consensus today is that they are not biogenic. Credit: D. McKay (NASA /JSC), K. Thomas-Keprta (Lockheed-Martin), R. Zare (Stanford), NASA.

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an announcement, almost three years of intense study of the Mars rock had been undertaken, in which the possibility of biogenic origin gradually dawned and was then closely held within a circle of scientists until the evidence was considered compelling enough for publication. That evidence consisted of four parts. None of the parts, the participants pointed out, was conclusive in itself, but taken together they could be interpreted as biogenic. First, the multidisciplinary science team reported, the fractured surfaces of the rock contained large, complex organic compounds in the form of what are known as polycyclic aromatic hydrocarbons, PAHs for short. Even though the NASA team undertook analysis that showed to its satisfaction that the PAHs were not contamination from Earth, this was not proof of life since organic molecules could have originated in nonbiogenic processes on Mars.

But then the plot thickened when inside the fractures the team also discovered carbonates, mineral deposits that may be produced by living creatures on Earth, as in the case of limestone. Within the carbonates they also found magnetite, pyrrhotite, and greigite, minerals that are produced (among other ways) by certain "magnetotactic" bacteria on Earth. Finally, using a high-resolution scanning electron microscope, the team suggested the existence of microfossils in the carbonates and other mineral grains; at only 20 to 100 nanometers they were 100 times smaller than the smallest known bacteria on Earth. All of this work had been done over three years beginning in 1993 when the rock was first recognized as Martian in origin and began to be studied in detail. An article was submitted to the prestigious journal *Science* in April 1996, was accepted in July, and was to be published in mid-August, at which time NASA would make a public announcement. The long gestation time for the claim is notable; no reputable scientist wanted to make a claim that had to be retracted, and this was the mother of all claims.[37]

Another notable point, as historian of science James Strick has observed, is "the JSC [Johnson Space Center] team's unusually secretive behavior during the time the work was being done and even after the paper had been submitted and was under review for publication in *Science*." Everett Gibson, one of the team leaders, stated that the team considered the Clinton administration and NASA Headquarters in Washington a "sieve" that would leak any important story to the press. McKay put it more circumspectly when he said the team members wanted their case to be as strong as possible before they went to their superiors, much less to the public. And they were worried about priorities in discovery – many other groups had samples from the same meteorite and the NASA team did not want to be scooped. A slightly different story comes from Michael Meyer, then the exobiology discipline scientist at NASA Headquarters. He recalls that during the Lunar and Planetary Science Conference in Houston in March 1995, Gibson and McKay "excitedly insisted I come to their lab. Basically they presented the data they had to date and were coming to the life conclusion in ALH84001." After the fall of 1995, when the

evidence was piling up, however, the science team likely did not keep NASA managers informed of the details outside of the Johnson Space Center, for the reasons given earlier. These interactions show the complexities that will undoubtedly arise at the participant and institutional level in any announcement of the discovery of alien life.[38]

This semi-secretive situation could not last. Already in April 1996, word had been received at NASA Headquarters, where Wes Huntress decided not to act further until the paper had been accepted by *Science*.[39] When it was accepted in mid-July for publication in mid-August, Huntress immediately went to NASA administrator Dan Goldin. Goldin assembled a team from NASA public affairs, as well as key policy people and scientists to decide how to handle the information. They were concerned with containing the information before it was published in *Science*. But they also had political concerns: the Republican National Convention would take place at about the same time as the *Science* publication, and Goldin considered the timing of the announcement a political decision above his pay grade. On July 30 he and Huntress went to the White House to discuss the matter with Chief of Staff Leon Panetta, who immediately set up a meeting with President Clinton, followed immediately by a meeting with the vice president. In what seems like reverse order to what should have taken place, Goldin then ordered Gibson and McKay to come to Washington. There, on the last day of July, they underwent several hours of Goldin's skeptical scrutiny; Goldin did not wish to have egg on his face (or NASA's collective face) any more than the scientists. But his fears of a premature leak were well founded. The details of the leak are well known, an initialized copy of the galley proofs of the article having gone (according to Gibson) from him to Goldin, Gore, Clinton, White House advisor Richard Morris, and a hooker who tried to sell it to the media. NASA Headquarters began receiving calls from the news media around August 1, inquiring if there was any substance to the story.[40] Goldin attempted damage control by pushing up the announcement by eight days, to August 7.[41]

Late in the afternoon of August 6, the die was cast. NASA sent out a "note for editors," which began: "A team of NASA and Stanford scientists will discuss its findings showing strong circumstantial evidence of possible early Martian life, including microfossil remains found in a Martian meteorite, at a news conference scheduled for 1:00 pm EDT, August 7, at NASA Headquarters, 300 E. St. SW, Washington, DC. The team's findings will be published in the August 16 issue of *Science*." A short time later Administrator Goldin issued an unusual four-paragraph statement: "NASA has made a startling discovery that points to the possibility that a primitive form of microscopic life may have existed on Mars more than three billion years ago. The research is based on a sophisticated examination of an ancient Martian meteorite that landed on Earth some 13,000 years ago." The statement

went on to characterize the evidence as "exciting, even compelling, but not conclusive," and to emphasize that this was all about bacteria-like structures, not "Little Green Men."[42]

The rushed press conference on August 7 was a spectacle to behold, with a 1.3 ounce piece of the Mars rock displayed in a place of honor at the front of the room along with the participating scientists, and the rest of the room crammed with reporters, scientists, and onlookers hoping to see history in the making (Figure 1.5). All the major TV stations were broadcasting live. Speakers included not only the scientists making the claim (Figure 1.6) but also J. William Schopf, a UCLA professor and specialist in microfossils on Earth, representing the many scientists who were skeptical of the claim. Schopf had been invited to Houston in early 1995 to look at the evidence, and was skeptical. He remained skeptical at the press conference, describing the entire body of evidence as "circumstantial," saying it did not constitute proof consistent with the normal standards of science. In fact, he had tried to avoid participating in the press conference, citing Carl Sagan's dictum that "extraordinary claims require extraordinary evidence"; having been persuaded by Administrator Goldin to participate, he minced no words about his continued

Figure 1.5 Press conference August 7, 1996, at NASA Headquarters announcing the possibility of fossilized life in the Mars rock ALH84001. The photo, taken by NASA photographer Bill Ingalls, stunningly captures the excitement and media frenzy likely to occur with any announcement of life beyond Earth. Credit: NASA/Bill Ingalls.

Figure 1.6 NASA Administrator Dan Goldin and happy scientists making the claim of the discovery of Mars nanofossils at the August 1996 press conference. Seated left to right: Richard Zare, David McKay, Everett Gibson; standing left to right: Hojatollah Vali, Dan Goldin, Kathy Thomas-Keprta, and Chris Romanek. Perhaps revealingly, skeptic Bill Schopf was part of the press conference, but not in this picture. Credit: NASA/Bill Ingalls.

skepticism, saying that the evidence was not even close. But the others at the table begged to disagree. To some extent it was a debate about what constitutes evidence in science, an argument likely to be repeated in any discovery of extraterrestrial life. NASA's official position on the discovery was summarized in a lengthy but carefully worded press release prepared before the press conference.[43]

The furious reaction to the announcement can be analyzed over both the long and short terms. Even as the press conference was taking place, at 1:15 P.M. President Clinton spoke from the South Lawn of the White House, with science advisor Jack Gibbons at his side. "This is the product of years of exploration and months of intensive study by some of the world's most distinguished scientists," he began.

> Like all discoveries, this one will and should continue to be reviewed, examined and scrutinized. It must be confirmed by other scientists. But clearly, the fact that something of this magnitude is being explored is another vindication of America's space program and our continuing support for it, even in these tough financial times. I am determined that the American space program will put its full intellectual power and technological prowess behind the search for further evidence of life on Mars.

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He went on to say he had asked the vice president to convene, before the end of the year, a bipartisan space summit on the future of America's space program, in part to pursue answers to the questions raised by the new discovery. He reinforced what he termed the "aggressive plan" for the robotic exploration of Mars, symbolized by the *Pathfinder* spacecraft launching later in the year. And he concluded by saying "if this discovery is confirmed, it will surely be one of the most stunning insights into our universe that science has ever uncovered. Its implications are as far-reaching and awe-inspiring as can be imagined. Even as it promises to answer some of our oldest questions, it poses still others even more fundamental."[44]

Then, on the scale of hours, days, and weeks, came the reaction in the mass media. Before the press conference was finished CNN quoted a source close to NASA saying it was arguably the biggest discovery in the history of science. Radio, television, and nascent internet media all carried the news as their top story. The next day the *New York Times* again had a front page headline related to extraterrestrial life: "Clues in Meteorite Seem to Show Signs of Life on Mars Long Ago: Startling Find of Organic Molecules from Space." The *Los Angeles Times* editorialized "Maybe It's a Lively Universe: Finding Fuels Speculation, along with Mars Fever," waxing eloquent about the human imagination and future space missions to Mars. Inevitably, the claims would also play a key role in reviving the search for life, as reflected in the headline of the "Science" section of the *New York Times* a few days later: "After Mars Rock, A Revived Hunt for Other-Worldly Organisms."[45]

Over the next few weeks, other newspaper articles speculated about the broader impact of life on Mars, many broaching the question of theological implications. The *Washington Post* for August 11 reported that the consensus among theologians queried was that proof of life on other planets, whether microbial or intelligent, would confirm the expansive nature of God – an old argument from the tradition of natural theology. Some did admit, however, that Christianity would have to rethink its central dogmas of redemption and incarnation, which implied that Jesus Christ came only to this world to save humans from sin. James A. Wiseman, chairman of the Department of Theology at Catholic University, admitted that some people's faith might be shaken, and that changing the "geocentric and ethnocentric mind-set" would take immense amounts of discussion and rethinking, tantamount to Copernicus persuading the world that the Earth revolved around the Sun. A professor of theological ethics at Duke University Divinity School turned things around, saying that the discovery did not challenge Christian and Jewish theism with its expansive God, but "the high humanism that has been characteristic of our lives since the 17th century, namely that the human species is what it's all about, that everything exists to serve us." Some of those queried pointed out that Christian fundamentalists, who take the Bible literally, might have a problem with extraterrestrial life. But James Garrett, a professor at Southwestern Baptist Theological Seminary, a bastion of

Southern Baptist conservatism, said that although the Bible does not mention life on other planets, "we need to be cautious saying that life on other planets is precluded because [the Bible] also says that God is the creator of all." A week later, the Los *Angeles Times* ran an article, "Theologians Find Awe in Possibility of Life on Mars." "We believe a God who is capable of creating one world is capable of creating many worlds," said Rabbi Alexander Schindler, former head of the Union of American Hebrew Congregations. "It does not change our fundamental faith. It doesn't touch it in the slightest." Among others, the *Times* also quoted Richard Payne, dean of the Institute of Buddhist Studies in Berkeley, as saying that Buddhist cosmology puts the Earth "as just one small part of a larger inhabited reality" filled with a variety of sentient beings. The core Buddhist truths, he emphasized, would hold true anywhere in the universe.[46] Further examples of theological reaction could be multiplied, but suffice it to say that around the world, in small-town and city newspapers, on summer beaches and among university scholars, the implications of the Mars rock were debated in a way likely to be echoed by any discovery of extraterrestrial life.

Within five weeks, congressional hearings were held on life on Mars, hearings that mentioned in passing H. G. Wells, Orson Welles, and the blockbuster movie of the summer, *Independence Day*, explicitly acknowledging "the cultural fascination with life in outer space."[47] And on the scale of months and years, the more technical and scholarly examination of the evidence and its implications was carried out. Even as the scientific debate was ongoing, the scholarly discussion of the implications proceeded apace. Such discussions were carried out around the world, in settings both formal and informal. One example is the symposium convened in November 1996 at George Washington University in Washington, DC. Titled "Life in the Universe: What Can the Martian Fossils Tell Us?" the symposium focused not on the science, but on the cultural, intellectual, and societal implications of the discovery. To that end, the speakers included not only scientists, but also a philosopher, two theologians, a historian of science, a policy analyst, a science fiction writer, and the NASA administrator. Again, the questions they addressed are likely to be those addressed in any such discovery: about theory and observation in relation to verified knowledge, religious meaning, the role of the media, the historical context of the discovery, and the place of extraterrestrial life in the imagination.[48]

Among the most consequential events, the one I described at the opening of this chapter, was the vice president's Space Science Symposium held in December 1996, four months after the original announcement and spurred by President Clinton's interest. In preparation for this high-level event, the Space Studies Board of the National Academy of Sciences, at the request of the White House and NASA, first held a workshop to discuss the implications of the Mars rock. Convened in late October within three months of the original announcement, it conveyed the message that the Mars rock findings should be part of NASA's much

larger "Origins" program to determine our place in the universe. The more intimate December meeting with the vice president focused on implications of the discovery, with only minimal attention to budget implications.

In keeping with the focus on implications of the discovery, President Clinton had encouraged an exploration of the religious dimensions of the problem because of his interest in religion, and Administrator Goldin later stated it was "crucial that we … have broad consultation with the American people. When you have science – free flying science – funded by tax dollars, you want to avoid crossing ethical boundaries." It was not immediately obvious what ethical boundaries would be crossed by fossils from Mars, but there was reason to be concerned about religious reactions. Some scientists, such as Richard Zare, whose Stanford team had found the organic molecules in the Mars rock, were unsettled by fundamentalists angry about the religious implications during his discussions on ABC's *Nightline* and other television shows. The theologians at the meeting were generally reassuring, arguing that religions would find a way to adapt. The discussions in the Indian Treaty Room lasted three hours, as the participants debated the origins of life (represented by Stuart Kauffman), the astronomical aspects (John Bahcall), and the media reaction (Bill Moyers). The meeting took on the air of an intellectual salon, but with the possibility of real implications for NASA programs.[49]

In fact, on the scale of years and decades, the fallout to the research community in terms of new budgets and new directions of research was considerable. According to David H. Smith, a senior program officer at the Space Studies Board of the National Academy of Sciences deeply involved in astrobiology from a policy perspective, the events of 1996 "had a profound long-term impact on both scientists and policy makers." In particular, he emphasized that when the Clinton administration on February 6, 1997, announced its proposed budget for FY 1998, it contained new funding for the initiative known as "Origins," including initiation of a new program in astrobiology.[50] This was also the beginning of the NASA Astrobiology Institute, which in May 1998 awarded large grants for astrobiological work to 11 institutions, and has been thriving ever since in the sense of funding cutting-edge research. Moreover, the NSF, the principal sponsor of the Antarctic Meteorite Collection Program under which the Mars meteorite was found, initiated new astrobiological activities in early 1997. *The lesson is that any discovery as exciting as finding life beyond Earth will result in increased funding to elaborate that discovery*.

It is notable that these events had a lasting impact even though there was much skepticism about the Mars fossils; indeed, the consensus after a few years was that they were not fossils at all. At the 10-year anniversary of the announcement, aerospace analyst and planetary scientist Jeff Foust characterized the evidence as "inconclusive at best, and outright discredited at worst."[51] Some of the scientists involved with the discovery, including David McKay, at that point still believed

their evidence, but admitted they had not convinced the scientific community. With few exceptions, on the tenth anniversary the media had lost interest. Nevertheless, the impact on astrobiology remained palpable because the questions remained compelling. It was once again possible to talk freely about life on Mars; indeed, the robotic exploration of Mars was arguably redirected toward the problem of life directly as a result of the attention given to the Mars rock. Astrobiology became infused with life, helped along by the first discoveries of exoplanets around Sun-like stars. Smith attributes the lasting impact in the field to massive interest among scientists, the public, and the press, combined with the rapid response of the scientific community providing context within the broader exobiology program, and fortuitous timing relative to the budget-planning cycle. Furthermore, he finds that prior plans existed that could quickly be implemented once funding became available. These are perhaps all lessons for a future discovery.[52]

At another level is the question of how the Mars rock discovery affects individuals. When *USA Today* asked readers to share their views five days after the announcement, the responses ranged from "no impact at all" because they already believed there was life in the universe, to "exciting me greatly" because "we start to wonder where our futures are."[53] *This range of responses is likely to represent the reaction to other such discoveries in the same way individuals react to different events in different ways on any subject.* Although it might seem impossible to gauge the "overall impact" on any society, much less the world with its myriads of societies, it is historically apparent that aggregate opinions do affect culture.

The impact of the discovery of microbial life, whether alive or fossilized, is sometimes denigrated as uninteresting compared to the discovery of more complex life. The case of the Mars rock indicates this is far from true, both inside and outside science. Internal to science, such a discovery could be no less transformational than for other societal domains. In the aftermath of the Mars rock announcement two scientists from the Department of Microbiology and Immunology at the Stanford University School of Medicine argued for some "unicellular prejudice," writing that "the detailed description of even one-cell Martian life forms would profoundly alter our understanding of life itself."[54]

The Lessons of History

Unfortunately, one of the great lessons of history is that we do not learn the lessons of history. As a recent author put it while contemplating historical patterns in a much broader context, history "goes unheeded, as it always has and as it always will, because history teaches us that we do not learn from history, that we fight the same wars against the same enemies for the same reasons in different eras, as though time really stood still and history itself as moving narrative was nothing

but artful illusion."[55] Even in an optimistic frame of mind, in a world in which we might apply lessons learned if only we paid attention, the problem is determining exactly what those lessons are.

At base, the reactions we have described in this chapter are a question of human behavior, whether as individuals or groups. Studies of the psychology and sociology of discovery, and human reactions to them, are therefore in order to illuminate future possibilities. Meanwhile, we have seen that in our first two cases of claimed extraterrestrial discovery (the Great Moon Hoax/Satire and the "War of the Worlds" broadcast), the media played a precipitating role, the first associated with the rise of tabloid journalism, the second with the concerns of the traditional print media with the rise of the new radio media. The Great Moon Hoax/Satire illustrates a phenomenon all too common even today in tabloid journalism – exploitation in the service of moneymaking, with little regard to the truth. The Orson Welles broadcast of *War of the Worlds* illustrates that the print media can be biased due to internal concerns perceived or real. Although the "panic" was much less widespread than thought, "the famous broadcast suggests that when circumstances are right, the media can create panic and other effects that are unpredictable, disruptive, and wide-ranging."[56]

The media also played an important role in both reporting and sensationalizing the Mars rock claims of nanofossils. The Little Green Men hypothesis of pulsars, on the other hand, generated no media reaction at the time because the anomalous astronomical observations were closely held among the astronomers involved, and in the aftermath the LGM hypothesis was little more than a curiosity. The lesson here is not that such a discovery should be kept secret; with email, the internet, and other social media, news of the discovery of life beyond Earth would spread like wildfire in the twenty-first century.

The case of Mars rock ALH84001 offers the most robust example in the modern era of what might happen following the claim of life beyond Earth. While it is true the Mars rock announcement and subsequent events were relevant to a specific time, culture, and set of circumstances, in broad outline, these events are likely to be mimicked by any discovery of extraterrestrial life. The reaction of government institutions, the media, and the public will occur side by side with the reaction among scientists, who will subject the discovery to their exacting standards. Science is like that; scientific articles, after all, are published only after thorough peer review, then open to withering criticism, which the evidence will either survive or not.

It is our contention, then, that history provides one realistic guide to what will happen when the discovery of extraterrestrial life is announced in the coming years, decades, or centuries. But that discovery will be far from immediate; rather it will consist of an extended process characteristic of all discoveries. In the next chapter we turn to the nature of discovery, and the many possible scenarios of discovery, as another means of illuminating the reaction to the discovery of extraterrestrial life.