How Willy Ley rallied the U.S. to explore space

The German-American space pioneer pursued every avenue to make the science, technology, and the future of space exploration available to American citizens. From Marsha Freeman's just-released book.

In 1969 the United States achieved the age-old dream of sending men to explore Earth's nearest neighbor, the Moon. The handful of German space pioneers who designed and built the rockets to reach that milestone worked tirelessly during the 1950s to rally the nation to support such a great project. Many of them had started their research on space exploration in the 1920s, working with the father of space travel, Hermann Oberth.

The just-released book How We Got to the Moon: The Story of the German Space Pioneers *by Marsha Freeman, relates the story of both the technical and engineering work that made the Apollo program possible, and also the campaign carried out over a period of 40 years through the printed word, radio, movies and television, and personal appearances by this handful of men that laid the basis for the announcement in 1961 by President John F. Kennedy which committed the nation to go to the Moon.*

Over the past ten years, these men, including Wernher von Braun, Arthur Rudolph, and Krafft Ehricke, have been vilified in the press and hounded by the U.S. Department of Justice as Nazi war criminals. How We Got to the Moon *traces the source of this slander campaign to Soviet intelligence and its U.S. condominium partners, who were determined to destroy the technological optimism created by the space program. The death of President Kennedy 30 years ago enabled the cultural paradigm-shift that ended the space program's role as a science- and education-driver for the United States a few years later, at the end of the Apollo program.*

Following is an excerpt from Chapter VIII, which describes the extraordinary efforts of one of the German space pioneers, science writer Willy Ley, to pursue every available avenue to reach the American public and organize support for the exploration of space. Sadly, one could hardly imagine turning on the radio or television set today and hearing a prominent group of scientists and pioneers discuss with millions of Americans the space frontiers mankind faces to conquer in the next century.

Willy Ley was born on Oct. 2, 1906, in Berlin and in 1927 was one of the founding members of the German Society for Space Travel. Ley left his compatriots in the Society such as Wernher von Braun, after Hitler came to power, and sailed for America, arriving at the beginning of 1935. His friend and fellow writer Sam Moskowitz reported in 1966, "he started writing and publishing as soon as he got to the U.S."

Working closely with friends, such as G. Edward Pendray of the American Rocket Society, Willy Ley immediately started proselytizing. On March 8, 1935, after he had been in the United States for less than two months, he spoke at an American Rocket Society public meeting at the Museum of Natural History on "Rocketry in Europe." By 1937, Ley was billed in magazines as "the world's foremost rocket authority."

Throughout the 1930s, Ley wrote articles for aviation and flight magazines to explain the new science of rockets.

However, Ley concentrated on writing non-science-fiction articles for science fiction publications. His writing touched on every subject one can imagine that has fascinated scientists and young people alike. "Visitors from the Void," in *Astounding Stories,* was a report on a huge meteor that had struck Siberia. In it, he speculated that such a "visitor from outer space" could have transported life to Earth, in the spore state.

Ley published an article titled "Stations in Space" in the February 1940 edition of *Amazing Stories,* but this was not about Hermann Oberth's Earth-orbiting stations. "Space travel would already exist if we lived on Mars," Ley told his readers. Providing an explanation of the concepts of gravity and escape velocity, he wrote that there is so much less energy needed to go into the orbit of Mars, because of its lower gravity (to reach a velocity of only 3 miles per second) compared to reaching orbit around the Earth (a velocity of 7 miles per second) that surely if we lived on Mars, space travel would already have been accomplished.

Ley also pointed out that the Martian moons Phobos and Deimos are so small and so near the planet, they are almost irresistible. This "would increase the efforts of Martian rocket enthusiasts considerably and silence the critics at the same time," he proposed. Phobos and Deimos were perfect locations for spacecraft refueling stations, he said.

Ley made clear the moral of the story for Earthlings: Man should build a space station. "The existence of Phobos and Deimos is valuable to us even though we live on Earth," he wrote. "It constitutes an example of what space travel could gain by having near and comparatively small bodies around them." After all, transatlantic pioneers had considered building an artificial (floating) island midway between America and Europe, as "a fuel depot, repair shop, and temporary haven in bad weather."

Ley's article "Calling All Martians" appeared in November 1940. After reviewing the myriad theories about life on Mars and ideas of how to communicate with these intelligent beings, including a suggestion by Carl Gauss, Ley considers the development of language and how one would communicate through symbols with beings not familiar with any of our languages. A "letter of introduction" to the Martians should be prepared, he said, to show the expedition's planet of origin, and its relationship to Mars, and to demonstrate basic concepts of geometry and mathematics, which are universal. Some 30 years later, when scientists were planning the launch of the Pioneer 10 spacecraft to Saturn and Jupiter, they knew that after its planetary fly-bys, it would be the first man-made object to leave the Solar System. Reaching a similar conclusion, they placed aboard a plaque illustrating some of the concepts Ley had specified.

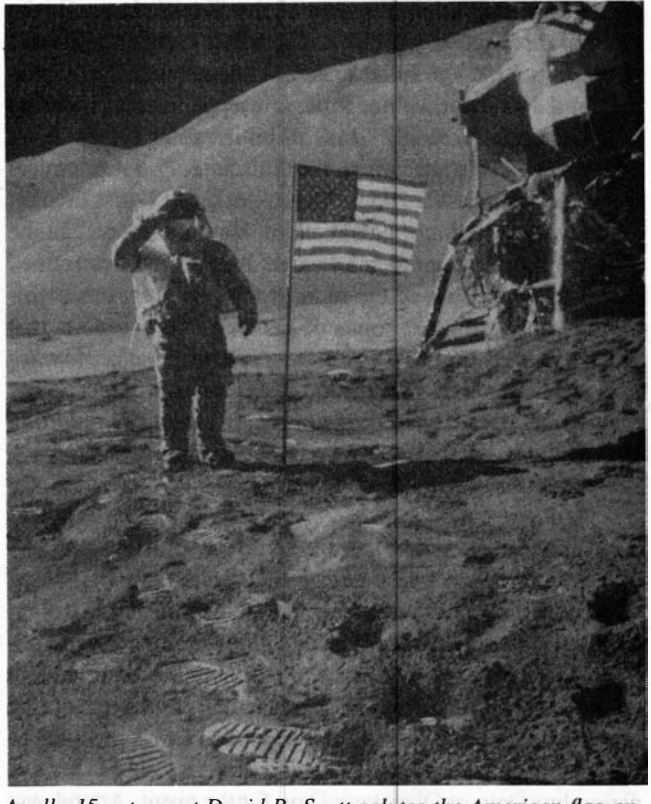
Willy Ley took as his model for communications with extraterrestrial life the "message to the future" contained in a time capsule buried at the site of the New York World's Fair in 1937, to be opened by archaeologists 5,000 years later. "The differences between a message to the future and a message to the Martians are mainly gradual," he wrote.

In 1940, Ley became science editor of the tabloid *PM,* and the next year published his book *The Lungfish and the Unicorn,* dealing with a subject which was his first love—zoology. During World War II, to explain basic principles of current interest, Ley published titles such as *Bombs and Bombing* and *Shells and Shooting*.

With all of his writings on a wide variety of subjects, it was space that would "catapult [Willy Ley] into the limelight during 1944 and 1945," Sam Moskowitz wrote.

An article in 1945 titled "Rocket to the Moon," published in *Mechanix Illustrated,* was the start of a very fruitful collaboration between Ley and artist Chesley Bonestell. Ley wrote the text for Bonestell's astronomical illustrations. Bonestell was born in 1888, and was drawing before he was 5 years of age. Until the age of 50, his art work centered on architectural drawings and renderings, but in 1938 he went to Hollywood as a special effects artist for the motion picture industry. At that time, Bonestell's interest in astronomical subjects flowered, and a series of his illustrations appeared in the May 29, 1944, edition of *Life* magazine, depicting Saturn as seen from five of its moons. His astronomical paintings also appeared in *Look* magazine, *Astounding Science Fiction,* and many other magazines.

Bonestell's collaboration with Ley after the war produced



Apollo 15 astronaut David R. Scott salutes the American flag on the Moon in 1971.

spectacular (and realistic) views of the surface and craters of the Moon, Earth-orbiting manned space stations, interplanetary spaceships, and missions to Mars. In 1949, the team produced its first book, *The Conquest of Space,* which included Bonestell's pictorial representation of the spaceship designed by Ley, that would become the model for most popular renderings of the subject.

In his introduction to *The Conquest of Space,* Ley writes that by 1949, Bonestell had already painted "half a hundred astronomical pictures." Color reproductions by Bonestell show aerial views of the Earth from space, reminiscent of today's images from remote sensing satellites. A view of the Earth from 2,000 miles is described as "a sight which people will see during the first trip around the Moon."

The Moon ship, designed by Ley and painted by Bonestell in *The Conquest of Space,* assumes the use of atomic power as fuel, and the renderings of craters, mountains, and lunar mare were surprisingly accurate. In fact, better images of these scenes were not available until years later, when the Apollo astronauts took photographs from a few miles above the lunar surface. The book describes the development of a lunar base requiring weekly transport missions that would be traveling from the Earth to the Moon. For the first time scientifically sensible renderings of what astronauts will do on the Moon appeared in print, accompanied by Ley's discussion of the basics of astronomy, and how the outer planets were discovered.

In a chapter titled "Vermin of the Skies," Ley tells the story of the discovery of the asteroid belt between Mars and Jupiter. In 1801, he relates, the mathematician Carl Gauss performed calculations for Prof. Giuseppe Piazza, who had been observing a small "star" in its irregular orbit. Gauss calculated its distance from the Sun as 2.77 astronomical units (an AU measures 93 million miles), and Gauss thought "there was something special about this very figure." In the 17th century, astronomer Johannes Kepler had determined that the relationship of the radii of the planetary orbits followed the five regular solids of geometry. Ley reports that Kepler wrote simply: *"Inter Jovem et Martem planetam interposui*—Between Jupiter and Mars I put a planet." Ley then traces the discovery of the major asteroids, reporting that between 1850 and 1870, there were an average of five new discoveries each year.

The Collier's space series

In 1951, when astronautical congresses were beginning to take place in Europe, Ley had a meeting with Robert Coles, the chairman of the Hayden Planetarium in New York City. Ley was concerned that few Americans could attend the meetings in Europe, and urged that similar events be held in the United States. Coles approved Ley's proposal to organize a symposium at the planetarium. Ley chose Oct. 12, Columbus Day, or Discovery Day, for the event. Attendance was by invitation, and scientific and government institutions, the press, and Armed Forces stationed in New York were invited.

The symposium was a great success. According to Ley, after it was over, "I was stopped by two gentlemen who identified themselves as being representatives of *Collier's* magazine. Our two-minute discussion led to another luncheon, which was the germ of the first *Collier's* symposium on space travel." One of the gentlemen was Cornelius Ryan. The presentations at the *Collier's* symposia were based on the speeches delivered at the planetarium by Willy Ley, Wernher von Braun, and Heinz Haber, in particular. Out of the symposia, eight articles about space appeared in a series printed in *Collier's* magazine, with the first appearing on March 22, 1952.

The release of the first article was preceded by an elaborate publicity campaign, including window displays of the *Collier's* art work in the American Express offices in Manhattan and downtown Philadelphia, press releases, kits for use by local radio and newspaper staffs and high schools and colleges, and news photos. This media offensive was certainly reminiscent of that waged by Fritz Lang before the release of the film *Frau im Mond* [The Woman in the Moon] in Germany in 1929.

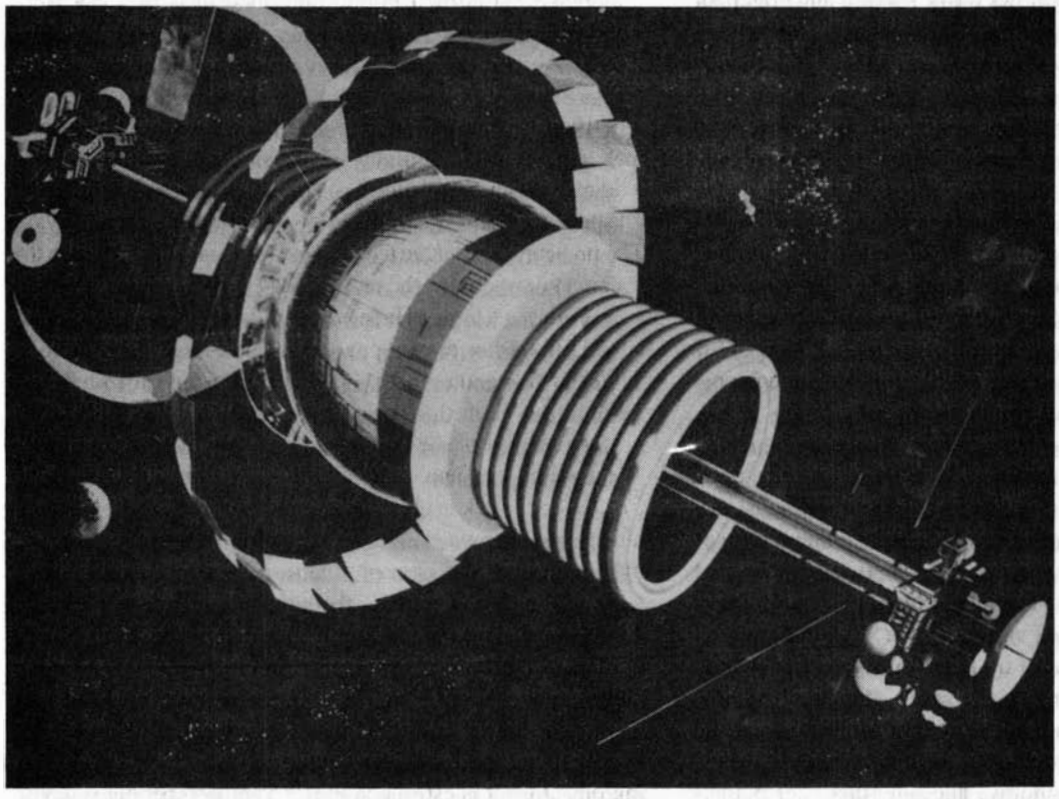
As part of the publicity, Wernher von Braun and Cornelius Ryan had speaking engagements in New York and Washington, D.C. It is estimated that 5.5 million people saw von Braun interviewed on television by John Cameron Swayze.

The *Collier's* articles produced a flood of inquiries to the publisher on how to become an astronaut, which led to articles in 1953 on the human aspects of space travel. The seventh article in the *Collier's* series, published on June 27, 1953, described a "baby space station" with a Rhesus monkey on board and included a proposal to study the medical effects of spaceflight while in orbit for 60 days. Such a station could be ready in five to seven years, von Braun said, as a precursor to a manned station.

Collier's decided to end the eight-part series in the summer of 1953 with an article about a manned expedition to Mars. But this article had to be delayed because of the large number of requests for information on how to train to be an astronaut. It finally appeared on April 30, 1954, incorporating von Braun's 1948 idea to build a flotilla of 10 Mars spaceships, to be assembled in Earth orbit. Mars would be home to 70 explorers who would stay for 15 months, having undertaken the most fantastic voyage man could then imagine. Many men who went on to work in the U.S. space program "attribute their initial spark of interest to the pages of *Collier's,*" according to Randy Liebermann.

From space stations to the Moon

The response to the *Collier's* series led to a project to make the material available in a more permanent form. In 1952, Cornelius Ryan edited *Across the Space Frontier,* with illustrations by Chesley Bonestell and others. The book was



A 1977 artist's rendering of a space station for 10,000 explorers similar to designs by Wernher von Braun.

an expansion of the scientific symposia that appeared in the pages of *Collier's* magazine, as Ryan explained in the introduction:

> This book is a fascinating preview of how man can reach space and establish, 1,075 miles above the Earth, a huge wheel-shaped space station. What you will read here is not a science-fictionist's dream. These chapters embody the latest available scientific data on the many problems which man must face when he travels beyond areas of space. Here is a blueprint of a programme for the conquest of space, prepared by some of the world's best scientific minds on space research. . . .
>
> The claim that huge rocket ships of the type here described can be built, and a space station created, is no longer challenged by any serious scientist. . . . All they need now is time—about 10 years—plus money and authority. . . . And when one considers the billions of dollars spent during World War II and on rearmament since the Korean war, such an expenditure would be small compared to the returns.

In a warning unheeded by the Eisenhower administration, Ryan continued:

> This book is also an urgent warning that the United States should immediately embark on a long-range development programme to secure for the West "space superiority," since a ruthless power established on a space station could actually subjugate the peoples of the world. Sweeping around the Earth in a fixed orbit like a second Moon, this man-made island in the heavens could be used as a platform from which to launch guided missiles. . . . We know that the Soviet Union, like the United States, has an extensive guided-missile and rocket programme under way. . . .
>
> We have the scientists and engineers. We have the inventive genius. We have vast industrial superiority. We should begin a space programme immediately, for in the hands of peace-loving nations the space station could be man's guardian in the skies. . . . It would be the end of Iron Curtains wherever they might be.

Across the Space Frontier was lavishly illustrated. Wernher von Braun supplied the first chapter, headlined "Prelude to Space Travel," which would make excellent reading for today's congressmen and all policymakers, who urgently need a new sense of what man can accomplish if his sights are set on the stars.

Von Braun described the space station, "which [would] be man's first foothold in space." The huge, new "moon" was to be carried into Earth orbit in pieces, assembled there, and placed in a 1,075-mile polar orbit around the Earth. From that vantage point, the space station was to circle the globe

once every two hours, with the Earth turning West-to-East underneath it. In addition to making spectacular observations of the Earth, "from this platform, a trip to the Moon itself will be just a step, as scientists reckon distance in space. The $4 billion cost, von Braun wrote, was only "about twice the cost of developing the atomic bomb, but less than one-quarter of the price of military materials ordered by the Defense Department during the last half of 1951."

Rockets would be built, according to von Braun, able to carry a crew and 30 or 40 tons of cargo to the space station. Such a rocket would stand 265 feet tall, measure 65 feet in diameter, and be equipped with 51 rocket motors capable of delivering 28 million pounds of thrust. By comparison, the Saturn V rocket that took Apollo astronauts to the Moon stood 365 feet tall, measured 30 feet in diameter and its engines produced 7.5 million pounds of thrust.

Von Braun estimated that about a dozen flights would be needed to construct the station, including the construction of a space observatory some distance away from the station and telescopes for mapping the Earth and heavens. The illustrations for von Braun's design, executed by Chesley Bonestell, remained a popular image of a space station until the 1984 initiation of President Reagan's Space Station program, when more modern planning and design work replaced it. Von Braun estimated that America would establish a permanent manned space station during the year 1963.

Ley ended the book on the following optimistic note:

> The establishment and subsequent operation of the space station is undeniably a large-size project. But so was the liberation of atomic energy, so were Grand Coulee Dam and Boulder Dam. And so, at an earlier date, were the Panama Canal and the Suez Canal. . . . And there is one other thing that should never be forgotten even for a minute. The space station is, or will be, the first step toward the exploration of space. Any first step is said to be difficult. . . . But once it has been made the difficulties will diminish at a surprisingly rapid rate and the gate to the Solar System will have been opened.

Man on the Moon, which appeared in 1953, was the second installment of the *Collier's* symposium and magazine series in book form. It was also edited by Cornelius Ryan, who forecast in his introduction that after the establishment of a space station, within 10 or 15 years, mankind will have gone "another step forward—to the Moon":

> The ships the explorers will use for the long journey through space will bear little resemblance to those depicted by the science-fictionists. In fact, their appearance is even more fantastic. But there is this difference: They work.
>
> The reader may well ask if it isn't rash to attempt a detailed technical description of vehicles that are at least a quarter of a century away. He may also wonder whether, by the time such vehicles are constructed, there may not be better solutions to the technical problems than those presented here. The answer, of course, is yes. . . . The purpose of this book, however, is to show that a lunar voyage is possible even now, by applying the basic engineering knowledge and technical ability available to us today. . . .
>
> There have been many books written about journeys to the Moon, but few of the writers seem to know what to do with their explorers once they get them there. The authors of this book have tried to describe definitely both the types of scientists who will go on the expedition and the experiments and investigations they will perform.

"Here is how we shall go to the Moon," Chapter 3 opens. "The pioneer expedition of at least 50 scientists and technicians will begin its journey from the space station's orbit in three clumsy-looking but highly efficient rocket ships. . . ."

To build the Moon ships, 360 flights of three-stage supply rockets will be required to deliver construction material and fuel to the space station. They will "need about three times as much fuel as was consumed in the form of high-octane gasoline during the Berlin Airlift." This job will make use of a fleet of 15 ferrying ships, each making about 24 flights over a period of eight months.

Ryan and his collaborators understood the impact such an adventure would have on the public. The authors predicted that the takeoff from the space station to start the journey to the Moon would "be watched by millions. . . . Television cameras on the space station [would] transmit the scene to receivers all over the world."

During parts of 1952, 1953, and 1954, while the *Collier's* series and the books based on them were circulating, Willy Ley made an extensive lecture tour, which took him to 40 states and to Canada. In 1957, Ley described the atmosphere of public excitement about space exploration at that time, although he modestly does not say that he played a major role in creating it: "Scientific institutions, public lecture halls, the magazines, the newspapers, the radio waves, and the television channels were full of space-travel and satellite talk" (Ley 1957a, p. 330).

On tour, Ley explained the basics of rocketry and spaceflight: "To a mathematician or astronomer this explanation is 'obvious,' but I have found that it isn't quite that obvious to highway engineers, judges, medical doctors, and just plain interested laymen."

Walt Disney presents. . .

Public excitement about space travel was so great, in fact, that the architects of popular culture joined the bandwagon. After the appearance of the *Collier's* magazine series Willy

Ley received a phone call from Walt Disney who proposed that he make monthly trips to California, to be an adviser for a new Disney film, *Man in Space*. Ley agreed.

Ward Kimball, a collaborator of Disney beginning in the 1930s, related that Walt Disney had asked him for ideas for the theme of his planned Tomorrowland at the new Disneyland Park, then under construction in California. Kimball replied that he had read some very interesting articles about spaceflight in *Collier's* and said he found it "fascinating that such noted scientists believed that we would actually be moving into space.

Kimball studied the *Collier's* article, worked out some ideas with his layout people, and presented them to Disney on April 17, 1954. As reported in a 1992 biography of von Braun by Frederick Ordway and Ernst Stuhlinger:

> We wanted to be cautious, however, and to retain, beside the more fantastic aspects, the serious aspects as well. . . . Our reputation was based on fantasy," explained Kimball, "but here we were to offer only a presentation based on solid science. People with imagination would come together with men who dealt with facts, to combine their resources.

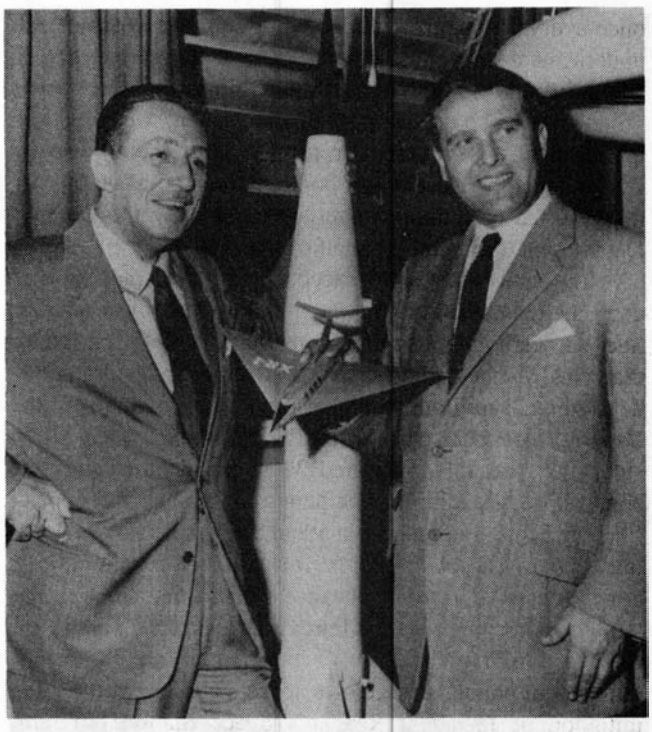
Disney was excited about the preparations made by his collaborators. "When we were finished," Bill Bosche, Disney's sketch-man reminiscences, "Walt was beside himself. He ran out of the story room, went up to a desk, and tore a blank piece of paper out of a notebook. He handed it to Kimball and said something that nobody had ever heard him say, 'Just tell me what you need!' "

With this support from his boss, Kimball set to work. He imagined a three-part show: "Man in Space" "Man and the Moon," and "Mars and Beyond." But first he needed some rocket and space experts. He remembered the *Collier's* series and got in touch with Willy Ley, who gladly agreed to cooperate. "Willy proved to be a virtual encyclopedia," Bosche recalls. "He could address almost every issue. . . . He was a very amusing guy and we all had great fun with him!"

Wernher von Braun and Dr. Heinz Haber also consulted on the television series. In the first show, all three consultants, plus Walt Disney and Ward Kimball, appeared on the program to explain to the audience what would follow. In all, Disney spent $1 million to produce the three shows.

"Man in Space" was planned for Disney's weekly television show, but was produced on film so it could also be released in movie houses. It was first shown on March 5, 1955, on ABC-TV. Willy Ley estimates that 42 million people saw the program, while Randy Liebermann quotes the figure of nearly 100 million.

The second show, "Man on the Moon," aired on Dec. 28, 1955. "The scene called for only a circumlunar reconnaissance flight without attempting a landing. The lack of any landing may have disappointed many viewers, but it



Walt Disney and Wernher von Braun in 1954 showing off some of the models of spacecraft used in Disney's television series promoting space exploration.

corresponded to one of Disney's ground rules for the series, that it be "based on solid science." The third show, "Mars and Beyond," was seen on television on Dec. 4, 1957, precisely two months after Sputnik.

The Disney series had a profound effect on many in the audience, including Dwight D. Eisenhower, the President of the United States. It thereby changed the course of the American space effort. Stuhlinger reported: "Shortly after the first Disney Space show had been presented to the television public, 'President Dwight D. Eisenhower borrowed the show and showed it to high-ranking officials at the Pentagon,' according to David R. Smith, the head of the archives at Walt Disney Productions. Six weeks later, he announced the intention of the United States to put a small unmanned satellite into orbit," during the International Geophysical Year.

During the 1950s, the German space pioneers were engaged in a quick-paced activity to build the popular support for space exploration they knew was necessary for a national program. Most ubiquitous was Willy Ley. As Sam Moskowitz describes it, "Everywhere one turned, Willy Ley's name was on a book, in a magazine, in the newspapers or in a catalogue endorsing a rocket toy. His face peered out from the television screen; his voice, instantly identifiable, seemed always on radio; and posters announced his lectures at major cities across the country."

Although frequently on the road, Ley found time to do a review of science books for children in October 1953, using

Willy Ley, 1906-69, died less than a month before the launch of Apollo 11, which landed man on the Moon. One of the most remarkable men among the German space pioneers, he chose not to become an engineer or rocket scientist, but a writer and educator.

the works of Jules Verne as a model. "All of Jules Verne's books had the intent of instructing: as somebody once put it, 'all his heroes had swallowed the encyclopedia and disgorged sections of it with or without provocation,' " Ley wrote.

Ley described his standard for children's books: "A science fiction story, and especially one for young readers, has to pass its science test first. It is not a question of whether the reader is taught a little or a lot, the point is that whatever he is taught must be correct." Five years later, Ley himself wrote a series of books for young people.

Willy Ley's book *Rockets, Missiles, and Space Travel,* which should be read by every literate person, was first published in May 1944 under the title, *Rockets*. In 1947, an expanded version was titled, *Rockets and Space Travel,* and the final title first appeared in 1951. With almost every new printing, Ley expanded and updated the book. The 1957 version of *Rockets* was published only months before Sputnik. It is a comprehensive history of the concept of space travel from ancient times through modern science, and an on-the-spot account of rocket development from the 1920s on.

Although after Sputnik space exploration was the major subject of interest to Ley and his readers, a compilation in book form of the columns he published in *Galaxy Science Fiction Magazine* during the 1950s includes some of the most fascinating topics in the history of science: "Tribes of the Dinosaurs" (with illustrations by his wife, Olga); "Slow Lightning," about the ball lightning experiments of P.L. Kapitsa in the Soviet Union; "Strange Planet Next Door," which is not about Mars, but the world on the floor of the ocean; "The Early Days of the Metric System;" and "The Observatory on the Moon." Today, if one stayed home and spent time assimilating Willy Ley's articles and books, one would have a better education in science history than can be obtained at most high schools.

After the Sputnik shock, Ley was called upon to explain what the new "space race" was all about. In an article for the *New York Mirror* on Jan. 5, 1958, he responded to queries on the meaning of the phrase "space superiority," which had been used at Senate Preparedness subcommittee hearings:

"Bluntly speaking, it means that the Russians could prevent us from using space if they got there first. It is an equivalent of what has happened in the past—first with the sea and later in the air." Ley then guessed that "probably the most visible expression of space superiority will be the manned space station," and went on to describe some of the technical details of Wernher von Braun's enormous ring-shaped structure and its functions.

Two weeks later, Ley continued his explanation: "While in the long run, the purpose of the space station is peaceful and devoted to research and progress, the immediate and urgent purpose is to establish and maintain space superiority. This is accomplished by careful scrutiny of the ground. With the aid of optical equipment, it will be possible to see objects as small as single airplanes. . . . The fact that very little could be done without being observed is in itself a rather powerful deterrent."

Why put man into space?

In 1960, the only space program that had been approved by the Eisenhower administration was Project Mercury, for single-man orbital flights around the Earth. But as Willy Ley warned in a *Space World* magazine article titled "Getting Around—After We Get There," published that year, although the lunar landing might be 8-12 years away, "being ready ahead of time would do no harm but *not* being ready would be a catastrophe." "A few weeks ago, I was sitting on the front steps of my house, looking at the full Moon and thinking about how to get around the lunarscape" he continued. . . . "This is a situation wryly familiar to travelers of today: After the jet has whipped you across the continent in 4 hours and 40 minutes, you stand at the airport, screaming for a taxi. Only another 10 miles to go, but these 10 miles are almost harder to cover than the previous 2,500."

Ley then considered various proposals for traversing the lunar landscape, including the use of solar energy during the two-week lunar day; one by Wernher von Braun for powering

a vehicle with a turbine driven by the decomposition of hydrogen peroxide, which would have to be supplied from Earth; using energy stored mechanically in a flywheel; using atomic power; and Hermann Oberth's Moon Car. Vehicles were also considered for use on Mars, where the presence of an atmosphere, though very thin, allows the possible use of blimps and other aerodynamic vehicles, in addition to land rovers.

In early 1961, before President Kennedy's announcement of the Apollo program, there was a very limited idea of what man could do in space. This was an interesting turn of events, because in the early prehistory of the space program it was assumed nearly everything would be done directly by men, including taking photographs and making observations, "largely because modern instrumentation didn't exist."

But, Ley wrote, "With the advent of guidance systems, telemetering, and television, the original idea of Man-in-Space was temporarily pushed into the background. . . . Carried away by their own accomplishments, some space planners even began to argue that there was no compelling need to put man into space." Ley argued to the contrary. "We now know that this reasoning was hasty at best and simply wrong in many cases," he wrote. "Certain unmanned satellite experiments which have failed miserably would not have gone wrong if a man had been aboard."

This is even more true today, when, on every Space Shuttle science mission, the astronauts have had to "troubleshoot" problems in experiments to save them from failure. "A manned satellite in orbit is not only a weather observing device, or a superlative astronomical observatory, or a monitor of possible enemy activities. It is also an inhabited 'house' in space. . . ." Ley continued. Ley discussed the Space Lab designed by the Martin company, which is similar in outline to the current space station designs, to make his point.

In March 1961, still before President Kennedy's Apollo announcement, Ley addressed the potential commercial applications of space technology in an article titled "Space Prospecting." "Almost exactly 30 years ago a German engineer and I were standing on the proving ground of the Verein für Raumschiffhart (Society for Space Travel) in Reinickendorf, Germany, watching the take-off of one of the early experimental liquid-fuel rockets," Ley began. The engineer asked Ley what would finally make money in rocketry. At that time, the answer he got back was "mail rockets, and Earth transportation." It is interesting looking back now, that neither of these two particular applications of rockets has proved to be commercially viable.

Ley then proposed that prospecting for space materials will be carried out from the lunar base. Asteroid mining will be of real value, he asserted, adding, "but don't try too hard to figure out what will be commercially viable in the future. . . . The commercial aspect of a certain voyage of 1492 was based on cheaper shipping of silks and spices from the Orient. Columbus could not foresee the immense flow of trade—including everything *but* silks and spices—that would come from the new world bonanza he had discovered."

Writing again in *Space World* in April 1961, Ley turned to answer questions posed to him during a lecture series the preceding winter, about the uses of nuclear energy in space. Project Rover, he explained, was a project of the Atomic Energy Commission in the 1956-1957 period. But before Sputnik: "Project Rover suffered from the disease common to all scientific projects at the time—it was artificially starved by a tight-fisted and thoroughly unimaginative bureau of the budget. Rover feasibility studies virtually died of monetary malnutrition."

After Sputnik, $15 million was allocated for the construction of test facilities, and nuclear energy was being developed for use in the upper propulsion stage of the Saturn rocket. Nuclear-powered propulsion systems should be ready by 1965-1966, Ley reported. Nuclear propulsion "will boost our space program out of the Chemical Stone Ages into the Astronomical Age, speeding up the conquest of space vastly." As it turned out, for trips to the Moon it was found that the Saturn V engines could be upgraded sufficiently with liquid hydrogen upper stage propulsion systems and the Apollo program did not require nuclear propulsion.

It was well recognized, however, that nuclear propulsion would greatly enhance, and perhaps even be required to enable, manned missions to Mars. But when the manned Mars program was cancelled after Apollo, so was the nuclear propulsion program. It has only recently been resurrected, on a small scale.

It was a sad moment for the Space Age when Willy Ley died on June 24, 1969, less than a month before the launch of Apollo 11. He had already purchased his plane ticket to fly down to Cape Canaveral. Lester del Ray wrote in an obituary:

> It was largely Willy's work that killed the public antipathy to rockets after their use as a terror weapon [during the war] and began to make people dream of space again. When Kennedy proposed the race to the Moon he mentioned large sums required to finance it. . . . Yet when public polls were taken . . . the people were willing to support our space venture. . . . Somehow, through all his articles, Willy and those who were converted by him had managed to convince half the nation [to spend the money needed to go to the Moon].

Willy Ley had the rare ability to make the most difficult, and to many, obscure, concepts in science accessible to the non-technical but interested public. He always looked at the present state of science from the shoulders of the giants of the past, which then informed his view of the future. In a December 1958 lecture at the Franklin Institute in Philadelphia, Ley remarked, "It is easy to prophesy the future because it is a future which began quite some time ago."