Juno 1: The Rocket that Launched America's First Satellite

By Barry Davidoff

Photos of Models by Frank Glackin. Other photos courtesy of NASA.

The world was shocked by the launch of Sputnik I on October 4, 1957 by the Soviet Union. One month later, the Soviets launched Sputnik II into orbit carrying the dog, Laika, the first living being in space. Headlines proclaimed the start of the space race. People everywhere tried to find the fast moving satellites against the background of fixed stars of the "October Sky".

Although America would have liked to have been first in space, it would take nearly four months for the United States to launch a Juno 1 rocket carrying the Explorer 1 satellite. The launch of the first Soviet satellite was a profound achievement of Soviet technology and was a great surprise to the United States; or was it?

Development of the Redstone and R-7

The United States and the Soviet Union had been seriously developing rockets since the end of World War II. Germany had terrorized London, Amsterdam and Antwerp with the V-2 rocket. The principal developer of the V-2, Werner Von Braun had led his team to join the Americans in creating new missiles at White Sands and later the Redstone Arsenal in Huntsville, Alabama.

The Soviets seized the remainder of German missile technology and scientists and shipped them back to Russia. The Soviets re-built several V-2's with the aid of the former German scientists, but after the initial phase excluded them from all new developments. The Soviets relied on an indigenous team of rocket pioneers lead by Sergei Korolev, who had been imprisoned by the government during the Stalinist purges. Korolev's designs and Glushko's engines would result in the R-7 series of boosters, that would become the first Soviet ICBM's (Inter-Continental Ballistic Missiles) and launch the Sputniks.

Juno 1 prior to Launching America's First Satellite; Explorer 1 on January 31, 1958.

In 1951 Werner Von Braun and his team started development of the Redstone missile as the first Intermediate Range Ballistic Missile (IRBM). The Redstone had a range of about 200 miles (320 km) and used liquid oxygen and alcohol as fuel. The rocket was controlled by four vanes at the base rocket underneath the engine bell.

Technicians install Explorer 1.

Juno 1 is prepared for launch.

Comparison of the Juno I and R-7 launchers. The R-7 generated ten times more thrust. The models are in 1/144th scale. Models built by Barry Davidoff.

Project Orbiter

In June 1954 Von Braun proposed Project Orbiter in which the Redstone would be modified to launch a satellite. The proposal was rejected since it was premature. The following year the United States announced that it would orbit a satellite as part of the International Geophysical Year (IGY) which ran from July 1, 1957 to December 31, 1958.

The government, however, decided to develop the Vanguard which was being developed the Naval Research Laboratory, rather than the Army's Redstone. One of the reasons for choosing Vanguard was that it was a new rocket that had not been developed as a weapons system, as was the case with Redstone. The Vanguard satellite was the size of a softball with a diameter of only 6.4 inches (16 cm) and weighed only 3.5 pounds (1.5 kg). It was planned that Vanguard would be launched in late November or early December 1957.

Von Braun continued development of the Redstone as a launcher to test the re-entry of nosecones on high speed flights. The missile was lengthened by eight feet and used Hydyne as the propellant rather than alcohol. Hydyne consists of 60% unsymmetrical dimetylhydrazine (UDMH) and 40% diethyltriamine. This variant of the Redstone is known as the Jupiter C.

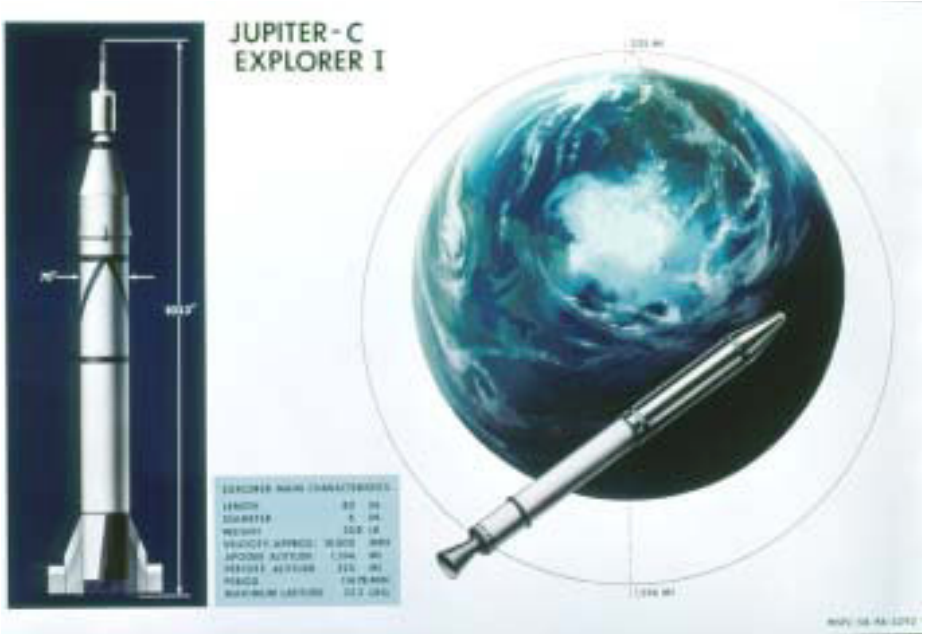
Korolev's group was working on the R-7 as an ICBM and which had more than ten times the thrust of Redstone. Huge rockets were needed by the Soviets since their atomic bombs were physically much larger due to the Soviet inability to miniaturize electronic systems. The first successful launch of the R-7 was in March 1957, followed by two successful long range flights. On August 26, 1957 the Soviets announced that they possessed a fully operational ICBM system.

Korolev then took the next R-7 booster, which would be the only fourth successfully flown, and used it for the launch of Sputnik I in October. Soviet Premier Nikita Kruschev took this bold step in diverting a vital ICBM to launching a satellite to proclaim the triumphs of communism and that the Soviet Union had the ability to strike any target on the face of the earth.

American Options

The United States took a more cautious approach. In addition to Von Braun's Redstone series of launchers, the Atlas was being developed by Convair as the major ICBM. The Atlas had a thrust more than twice as great as Redstone and could easily launch a satellite. By the time that the Soviets launched their first satellite there were at least three options by which America could have launched the world's first satellite; Jupiter C, Vanguard and Atlas. If the United States would have accelerated any of the programs, Sputnik 1 would not have been the first satellite.

Research by Professor James Hereford has shed light on why the United States waited. First, President Dwight Eisenhower deeply wanted the first satellite to be peaceful in nature and chose Vanguard since it had not been developed from an existing military weapon system. The second reason is founded on the principles of international law.



Orbit of Explorer 1.

Reconnaissance and International Law

During the Cold War there had been countless protests by the Soviet Union about over flights of its territory. An U-2 had photographed one of the earliest R-7's on its launch pad at Baikonour.

The Soviets also used aerial reconnaissance to assess the strength of NATO forces in Western Europe. There even were several reconnaissance incidents involving neutral Sweden and the Soviet Union.
A major issue was how high did a country's airspace extend, and could it limit satellites from flying over its territory. Under international law the prevailing concept was that a sovereign nation owned its territory *usque ad coleum* and that its rights literally extended to the stars. Nations, pursuant to this concept, would have the right to protest and limit the passage of satellites over their territory.

In the event that the United States launched the first satellite as a symbol of its technology and power, the Soviets and other nations certainly would have protested. World opinion may have sided against the United States for the intrusion of the airspace space of other nations by its satellites. Rather, President Eisenhower took a realistic and cautious approach. He let the Soviets be first with Sputnik. While the Soviets were proclaiming their triumph as Sputnik circled the globe passing over most nations, Sputnik also was creating a precedent where there was a right of free passage in space. Satellites had the right to transit high above any nation without any diplomatic protests.

Although the United States had chosen to let the Soviets be first, the launch of Sputnik 1 caused a furor around the globe. Sputnik 1 was the first of a series of space spectaculars in which the Soviet Union would use as propaganda to proclaim the success of the Soviet state. Many feared that the Soviet Union now possessed the ability to send an ICBM carrying an atomic weapon anywhere. The political climate in America was to seize the lead and for America to become first in space.

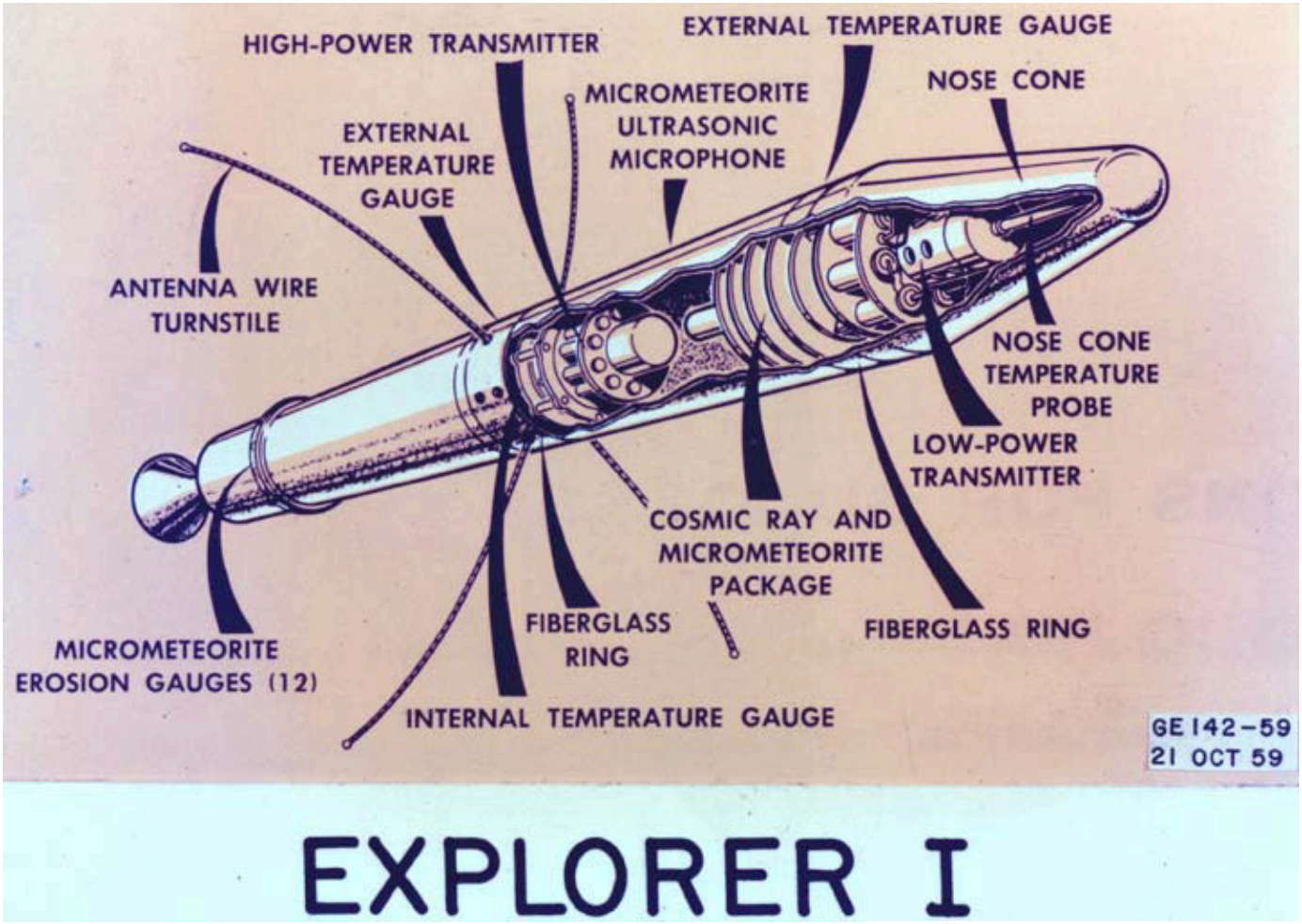
A month following Sputnik 1, the Soviets launched Laika in Sputnik II. The Soviet accomplishment was even greater since Sputnik II weighed almost half a ton. Preparations were continuing for the launch of Vanguard I as the primary American satellite. Five days after the launch of Sputnik II, the government instructed Von Braun to prepare one of the Jupiter C rockets to launch the Explorer I satellite within 90 days.

Unfortunately, on December 6, 1957 in full view of the world's cameras, Vanguard I exploded on the launch pad. Explorer I, therefore, would become the first American satellite.

Juno 1 Development

The Jupiter C was further modified. Three more stages were placed atop the Jupiter C in order to reach orbital velocity. The Juno I launcher was 71.25 feet tall (217.2 cm) with a diameter of 5.8 feet (1.77 m). The entire rocket weighed just 64,000 pounds (28500 kg). The single Rocketdyne A-7 engine in the first stage developed 83,000 pounds (369 kN) of thrust.

Explorer 1 perched atop the Juno 1 rocket.



Cut-away diagram of the Explorer 1 satellite.

Vanguard 1 was intended to be America's first satellite.

The second stage consisted of 11 Sergeant solid fuelled rockets in a circle. The second stage had a combined thrust of 16,500 pounds (74 kN). The third stage was three more Sergeants that were within the circle of Sergeants of the second stage. In the center was the fourth stage, a single Sergeant that was attached directly to the Explorer 1 satellite. These four Sergeants each provided thrust of 1800 pounds (8 kN), which was sufficient to propel Explorer I into orbit. The three top stages were spin stabilized. The configuration of the Jupiter C and the three upper stages of Sergeant rockets was named the Juno I launcher. The Juno I was launched six times of which four successfully orbited satellites.

Juno 1 was diminutive in comparison to the Soviet R-7 booster which launched Sputnik. The R-7 was originally developed as an ICBM and as the Sputnik launcher generated 876,000 pounds (3896 kN) of thrust. The R-7 became the mainstay of the Russian space program and is still used nearly fifty years later to launch most satellites, as well as the Progress and Soyuz spacecraft.

Top Stages of Juno 1 model

Explorer 1

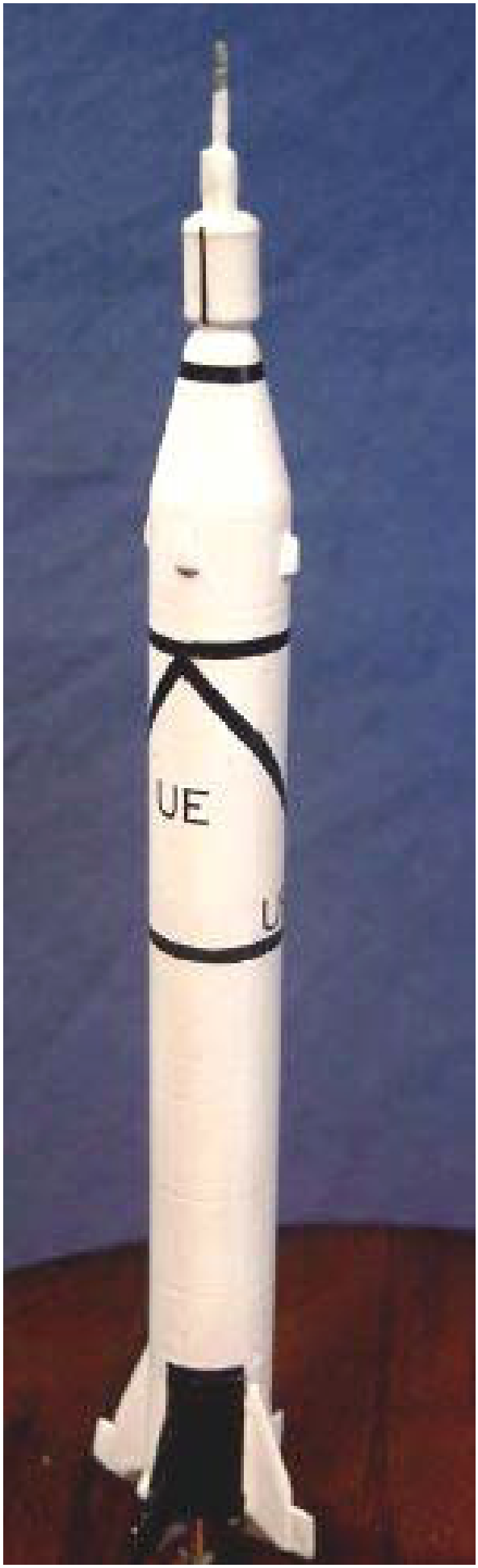
Just 84 days after being given the go-ahead, Juno I launched America's first satellite into orbit. Explorer 1 was small in comparison to the Russian satellites. It weighed only 30.8 pounds (13.4 kg) and had a length of 6.66 feet (2.03 m), including the Sergeant motor, with a diameter of only 6 inches (15.24 cm). The satellite was designed by the Jet Propulsion Laboratory under Dr. William Pickering. The instrumentation section included a cosmic ray detector, temperature gauges and a micrometer detector. Juno 1 launched the Explorer I satellite into a 224 to 1,573 mile (358 to 2517 km) high orbit and it did not re-enter for 12 years until 1970.

Almost immediately Explorer 1, made an outstanding scientific discovery. The satellite determined that the earth was surrounded by a series of radiation belts formed by the earth's magnetic field. They were named after Dr. James Van Allen, who was one of the principal investigators. The Sputniks also had detected higher radiation at different altitudes, but the Russians did not properly analyze the data until after Van Allen announced his discovery. Explorer 1 also determined that the threat from micro-meteors was less than some scientists anticipated and should not pose a threat to most satellites.

Explorer 1 was just the first in the longest series of American satellites, which included 55 Explorers. The first five Explorers were similar to Explorer 1. Explorers 3 and 4 were successfully orbited by Juno I launchers while Explorers 2 and 5 failed to achieve orbit. The Explorer series included over 20 major variants launched by an array of Junos, Jupiters, Thors, Scouts and Deltas. Explorer 55 was launched on Nov. 20, 1975, more than 17 years after Explorer 1. The Explorer series produced many important discoveries about the magnetosphere, meteorites, and atmospheric physics in addition to the detection of the Van Allen belts.

The Redstone family of missiles including the Juno and the Jupiter variants would form the backbone of the first American efforts in space. A Redstone was used to propel the first two Americans into space on sub-orbital missions in 1961.

The Huntsville group led by Werner Von Braun later would develop rockets that would dwarf Redstone. Within ten years from the launch of Juno 1, the Saturn V would generate 7.5 million pounds (33.36 MN) of thrust at launch, nearly 100 times greater than the rocket that launched America's first satellite. The Saturn V would carry Americans to land on the moon as the successful conclusion of the Space Race.



New Ware's well detailed model of Juno 1 and Explorer 1 in 1/144th scale. Model constructed by Barry Davidoff.
www.mek.kosmo.cz/newware