= Project A119 =

Project A119 , also known as " A Study of Lunar Research Flights " , was a top @-@ secret plan developed in 1958 by the United States Air Force . The aim of the project was to detonate a nuclear bomb on the Moon which would help in answering some of the mysteries in planetary astronomy and astrogeology . Had the explosive device not entered into a lunar crater , the flash of explosive light would have been faintly visible to people on earth with their naked eye , a show of force resulting in a possible boosting of domestic morale in the capabilities of the United States , a boost that was needed after the Soviet Union took an early lead in the Space Race and was also working on a similar project .

The project was never carried out , being cancelled primarily out of a fear of a negative public reaction , with the potential militarization of space that it would also have signified , and because a moon landing would undoubtedly be a more popular achievement in the eyes of the American and international public alike . A similar project by the Soviet Union also never came to fruition .

The existence of the US project was revealed in 2000 by a former executive at the National Aeronautics and Space Administration (NASA) , Leonard Reiffel , who led the project in 1958 . A young Carl Sagan was part of the team responsible for predicting the effects of a nuclear explosion in vacuum and low gravity and in evaluating the scientific value of the project . The project documents remained secret for nearly 45 years , and despite Reiffel 's revelations , the United States government has never officially recognized its involvement in the study .

= = Background = =

During the Cold War , the Soviet Union took the lead in the Space Race with the launch of Sputnik 1 on October 4 , 1957 . Sputnik was the first artificial satellite in orbit around the Earth , and the surprise of its successful launch , compounded by the resounding failure of Project Vanguard to launch an American satellite after two attempts , has been dubbed the " Sputnik crisis " and was the impetus for the beginning of the Space Race . Trying to reclaim lost ground , the United States embarked on a series of new projects and studies , which eventually included the launch of Explorer 1 and the creation of the Defense Advanced Research Projects Agency (DARPA) and NASA .

= = Project = =

In 1949 , the Armour Research Foundation (ARF) , based at the Illinois Institute of Technology , began studying the effects of nuclear explosions on the environment . These studies would continue until 1962 . In May 1958 , ARF began covertly researching the potential consequences of an atomic explosion on the Moon . The main objective of the program , which ran under the auspices of the United States Air Force , which had initially proposed it , was to cause a nuclear explosion that would be visible from Earth . It was hoped that such a display would boost the morale of the American people .

At the time of the project 's conception , newspapers were reporting a rumor that the Soviet Union was planning to detonate a hydrogen bomb on the Moon . According to press reports in late 1957 , an anonymous source had divulged to a United States Secret Service agent that the Soviets planned to commemorate the anniversary of the October Revolution by causing a nuclear explosion on the Moon to coincide with a lunar eclipse on November 7 . News reports of the rumored launch included mention of targeting the dark side of the terminator ? Project A119 would also consider this boundary as the target for an explosion . It was also reported that a failure to hit the Moon would likely result in the missile returning to Earth .

A similar idea had been put forward by Edward Teller , the " father of the H @-@ bomb " , who , in February 1957 , proposed the detonation of atomic devices both on and some distance from the lunar surface to analyze the effects of the explosion .

= = = Research = = =

A ten @-@ member team led by Leonard Reiffel was assembled at the Illinois Institute of Technology in Chicago to study the potential visibility of the explosion , benefits to science , and implications for the lunar surface . Among the members of the research team were astronomer Gerard Kuiper and his doctoral student Carl Sagan , who was responsible for the mathematical projection of the expansion of a dust cloud in space around the Moon , an essential element in determining its visibility from Earth .

Scientists initially considered using a hydrogen bomb for the project , but the United States Air Force vetoed this idea due to the weight of such a device , as it would be too heavy to be propelled by the missile which would have been used . It was then decided to use a W25 warhead , a small , lightweight warhead with a relatively low 1 @.@ 7 kiloton yield . By contrast , the Little Boy bomb dropped on the Japanese city of Hiroshima in 1945 had a yield of some 13 ? 18 kilotons . The W25 would be carried by a rocket toward the unlit side of the Moon , near the terminator , where it would detonate on impact . The dust cloud resulting from the explosion would be lit by the Sun and therefore visible from Earth . According to Reiffel , the Air Force 's progress in the development of intercontinental ballistic missiles would have made such a launch feasible by 1959 .

= = = Cancellation = = =

The project was eventually canceled by the Air Force in January 1959 , seemingly out of fear of a negative public reaction and the risk to the population should anything have gone wrong with the launch . Another factor , cited by project leader Leonard Reiffel , was the possible implications of the nuclear fallout for future lunar research projects and colonization .

Later reports show that a corresponding Soviet project did indeed exist , but differed from the scenario reported in the press . Started in January 1958 , it was part of a series of proposals under the codename " E " . Project E @-@ 1 entailed plans to reach the Moon , while projects E @-@ 2 and E @-@ 3 involved sending a probe around the far side of the Moon to take a series of photographs of its surface . The final stage of the project , E @-@ 4 , was to be a nuclear strike on the Moon as a display of force . As with the American plan , the E series of projects was canceled while still in its planning stages due to concerns regarding the safety and reliability of the launch vehicle .

= = Consequences = =

The signing of the Partial Nuclear Test Ban Treaty in 1963 and the Outer Space Treaty in 1967 prevented future exploration of the concept of detonating a nuclear device on the Moon . However , by this time both the United States and the Soviet Union had performed several high @-@ altitude nuclear explosions , including those of Operation Hardtack I , Operation Argus , Operation Dominic I and II , and The K Project .

By 1969 , the United States had achieved a considerable victory in the Space Race after the success of the Apollo 11 mission . In December that year , Apollo scientist Gary Latham suggested detonating a " smallish " nuclear device on the Moon in order to facilitate research into its geologic make @-@ up . The idea was dismissed , however , as it would interfere with plans to measure the Moon 's natural background radiation .

The existence of Project A119 remained largely secret until the mid @-@ 1990s , when writer Keay Davidson discovered the story while researching the life of Carl Sagan for a biography . Sagan 's involvement with the project was apparent from his application for an academic scholarship at the University of California , Berkeley 's Miller Institute in 1959 . In the application , Sagan gave details of the project research , which Davidson felt constituted a violation of national security . The leak consisted of Sagan revealing the titles of two classified papers from the A119 project ? the 1958 paper Possible Contribution of Lunar Nuclear Weapons Detonations to the Solution of Some Problems in Planetary Astronomy , and the 1959 paper Radiological Contamination of the Moon by Nuclear Weapons Detonations . A 1958 paper titled Cosmic Radiation and Lunar Radioactivity ,

credited to I. Filosofo , was also named by Sagan in a 1961 paper written for the United States National Research Council . These were among the eight reports created by the project , all of which were destroyed in 1987 .

The resulting biography ? Carl Sagan : A Life ? was published in 1999 . Shortly after , a review published in Nature highlighted the discovery of the leaked information . This led Reiffel to break his anonymity and write a letter to the journal confirming that Sagan 's activity had at the time been considered a breach in the confidentiality of the project . Reiffel took the opportunity to reveal details of the studies , and his statements would later be widely reported in the media . Reiffel 's public admission of the project was accompanied by his denouncement of the work carried out , with the scientist noting that he was " horrified that such a gesture to sway public opinion was ever considered " .

As a result of the publicity the correspondence created , a freedom of information request was lodged concerning Project A119 . It was only then that A Study of Lunar Research Flights ? Volume I was made public , over forty years after its inception . A search for the other volumes of documentation , however , revealed that other reports were destroyed in the 1980s by the Illinois Institute of Technology .

Dr. David Lowry , a nuclear historian from the United Kingdom , has called the project 's proposals " obscene " , adding " had they gone ahead , we would never have had the romantic image of Neil Armstrong taking " one giant leap for mankind " . "

= = Explosions in lunar science = =

A vacuum stable chemical explosive filled the seismic source mortar ammunition canisters used as part of the Apollo Lunar Active Seismic Experiments . These explosive experiments investigated the composition of the Lunar mantle during the Apollo Program , analogous to the exploration geophysics practice of mineral prospecting with chemical explosives in " deep seismic sounding " reflection seismology .

The scientific objectives of Project A119 would have been the detonating of a " smallish " nuclear device (1700 + tons of TNT) on the Moon in order to facilitate research into its geologic make @-@ up " . This could have been attempted by non @-@ nuclear means , for example , using the much lower yield explosion created by the water prospecting Lunar Crater Observation and Sensing Satellite (LCROSS) mission , which was launched in 2009 and released the " Centaur " kinetic energy impactor , with a mass of 2 @,@ 305 kilograms (5 @,@ 082 lb) and an impact velocity of about 9 @,@ 000 km / h (5 @,@ 600 mph) .

The question of if LCROSS would find water had been stated to be influential in whether or not the United States government pursues creating a Moon base . On November 13 , 2009 , NASA confirmed that water was detected after the Centaur impacted the crater . The LCROSS " Centaur " kinetic energy impactor was however underpowered and therefore only partially successful , having not produced the expected earth visible flash , nor succeeding in excavating and vaporizing enough subsurface material for a complete lunar soil spectral analysis , that would identify the lunar soil composition to a high depth .