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Fifty Years Of Man´s Arrival On The Moon

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***Abstract*— On July 20, 2019, will be celebrated the fiftieth anniversary of the great feat of the American astronaut Neil Armstrong, when he became the first man to touch the lunar surface. Neil Armstrong, one of the crew of the Apollo 11 spacecraft, also became famous in uttering the following phrase: "A small step for man, but a great leap for mankind." This great feat not only marked the end of the space race between the United States and Russia (former Soviet Union), but also reflected in the technological and scientific advancement in different areas such as in physics, chemistry, biology and for the society that began to become globalized. This article intends to present a chronological sequence of the main events that led the man to the most distant place ever visited, and the benefits that mankind has gained over decades of studies for the given mission.**

Keywords— Moon; explore space; space race; technologies

I. INTRODUCTION

From the earliest civilizations, the sky awakens fascination in the human imagination (1), since, with the exception of Uranus and Neptune, the other planets of the Solar System were known and observed without the aid of optical instruments. By not understanding the natural phenomena, the man sought explanations in the stars, mainly in the Moon and in the Sun. At this moment, several ancient civilizations credited to the Sun and the Moon, the status of gods and myths. In the description of Aristotle's universe (2) (384-322 BC), the Moon marks the boundary between the spheres of changeable elements (earth, water, air and fire) and the perishable stars of the ether, an influential philosophy that would dominate thought for centuries. In 1609, Galileo was one of the first to map the Moon through a telescope in his work called Sidereus Nuncius (3), noting that it was not flat and that it had mountains and craters. In 1865, the writer Frances Jules Verne published the science fiction (4) From Earth to the Moon, whose history is about the construction a huge cannon to throw in a projectile, a group of five astronomers that travel to the Moon in a capsule, where they are captured by the Selenites, as in HG Wells's The First Men on the Moon(5), written in 1901 However, they manage to escape and return safely to Earth. The trip to the moon of 1902, by Georges Méliès, was considered the first film of scientific fiction and was based on the works of Julio Verne and H. Wells. However, this desire for man to tread on the surface of the moon and return alive to Earth ceased to be fiction and began to become a reality at the end of Second World War, with the onset of the Cold War. One of the symbols of this war was the space race, whose winner would be the one who would reach the moon first.

II. WHERE IT ALL STARTED

During the Second World War, Germany invested heavily in the development of rockets (6) of liquid propellants to carry "flying bombs". Led by the German engineer Wernher Von Braun, the Nazis developed the missile capable of generating the desired propulsion, controlling its trajectory and traveling for thousands of miles to the target. Known as A4 and later called the V-2, it was one of the main weapons of Germany at that time. The V-2 was already ready to fulfill its function, a military action. It was the first projectile to reach a height greater than 100 km, since it exceeds the Kàrmán's line, considered the limit between the atmosphere and the outer space. With the end of the second war in September 1945, the world was divided between two political divisions: the capitalist, led by the US and the socialist, led by the former USSR, now known as Russia. With this division, another war, known as the Cold War (7) began. Although not considered an arms war, one of the main points of this war was the space race. The first to explore space would demonstrate that his ideology was superior. It was not long before they realized that the first man to take the man to the moon would be the winner of this race. When Germany lost the war, there was a row between allied countries to see who would capture the technology and the German scientists. It was at this moment that Wernher Von Braun became one of the most valuable people in the war. With the arrival of the allies, he orchestrated his surrender to the US, as he

observed better working conditions for him and his team. The plan was to dismantle the rockets, take as many pieces as possible, and send everyone involved in the direction of the US Army. The USSR also captured some German engineers, but its great advantage was that the rocket research center was in Soviet-occupied eastern Germany. Soviet engineer Sergei Korolev was the big name behind the space programs, began to work on the construction of the R-7 missile, beginning the space exploration by the side of the Soviets. With both sides studying the Nazi rockets, important events soon began to emerge for this race. In 1946, the United States obtained the first photos taken from space (8) , through the V-2 that rose 105 km in the sky of the new Mexico and became a global phenomenon.

III. START OF SPACE RACE

For the first time in history, humans have seen the planet from this time. Von Braun's team was commissioned to build a second generation V-2, called Redstone, initially developed to carry military weapons. In 1947, the US wanted to study the effects of radiation on living things at high altitudes. They sent flies (8) to an altitude of 110 km and verified that they returned alive. They began to do the same with larger animals, such as monkeys, mice, but the result was not as expected. They all came back dead. It was at this moment that the USSR managed to send two dogs, Dezik and Tsygan and rescue them alive 15 minutes after the launch. Over time, American and Soviet scientists realized that these rockets could be used as launch vehicles to carry other objects into space, such as a satellite, and for that they needed increasingly powerful rockets. In 1957 the USSR built the first intercontinental missile (7), known as R-7. In the first test flew about 6000 km in height and thanks to this first rocket, the USSR conquered their first great victory in the space race. Launched that same year, Sputnik remained in Earth orbit for days in which it had two radio transmitters that operated in different frequencies and its purpose was only to transmit a signal of radio and could be listened by any amateur radio equipment worldwide. With Sputnik, the USSR proved to be the greatest power to date, generating the Sputnik crisis (9) in the USA. This Soviet technological breakthrough was obtained due to the high investment in education and research in previous years, making a larger number of scientists than the Americans. One month after the launch of Sputnik 1, the USSR sent the Laika bitch into space on Sputnik 2 (10), where she was the first living being to orbit the Earth. Laika died hours after the launch, caused by an overheating in the cabin, but all planned by the Soviet scientists.

In order to justify Soviet sovereignty, in the same year, the United States tried to launch its first satellite through the program Vanguard 1 in which the rocket didn't took off. At this time Americans began investing in scientific research and education program to create new scientists. In 1958, the Americans sent the first satellite (10), the Explorer 1, launched by the Juno1 rocket. In that same year, then-President Dwinght Eisenhower signed the bill that created a new agency that would coordinate all space exploration work known as the National Aeronautics and Space Administration (NASA). Meanwhile, on the Soviet side, it occurred to the creation of a program called Luna, whose purpose was to send probes on the surface of the moon. After several attempts, in September of 1959, the Soviets launched the moon-2, which arrived until the moon. This was another landmark in space history, for it was the first time that a man-made object reaches another celestial body. In less than two months after Luna-2, Luna-3 was launched, which flew around the moon and photographed its far side, the dark side of the moon. Another program created by the Soviets, known as Vostok (11), was intended to send the first men into space.

On April 12, 1961, the Vostok 1 took off with a space capsule (11) of approximately 2.3 m in diameter. On board the Soviet Yuri Gagarin, who before the takeoff shouted "poyekhalil", which in translation means "let's go". He remained in space for about 100 minutes and became the first man to enter Earth's orbit and return to the surface. It was Gagarin who uttered a phrase that became very famous "the Earth is blue". On his return, Gagarin became a national hero and later a crater on the moon and an asteroid were named in his honor. The Soviets would still send the first woman to the Earth's orbit, Valentina Tereshkova (12), on June 16, 1963. In turn, the American side created the Mercury space program, which sent the astronaut Alan Shepard at an altitude of 186 km and this fact was important because this astronaut became the first American in space. It was then that American President John F. Kennedy suggested in an address to the United Nations (an organization of the United Nations) an alliance with the Soviets to reach the moon, saving time and especially money, but was initially rejected by Soviet leader Nikita Khrushchev.

This alliance was eventually undone after the assassination of Kennedy. Without the agreement between countries, the next step was to take more than one astronaut into space at the same time. This dispute was again defeated by the Soviets through the Voskhod program.

The Voskhod 1 flight, held on October 12, 1964, was the first of a Soviet spacecraft to transport more than one cosmonaut into space, the first without the use of space suits by the crew and the first to carry an engineer and a doctor off the earth. The flight also set a record high for a manned flight, reaching 336 km. The mission was especially designed to surpass NASA's Gemini (14) program by placing a multiple crew into orbit. The Voskhod spacecraft had been planned to carry two crew members, but Soviet politicians had forced the designers to send three at the same time, which was done by removing the pressurized space suits of the cosmonauts used in the earlier missions of the previous program.

A year later, aboard Voskhod 2, two crew in space suits, one of them Alexei Leonov, left the space

capsule and became the first human to take a space walk, being exposed for 12 minutes in the vacuum. The feat of Leonov marked the end of the golden age of the space program of the USSR, to which was added a series of tragedies. The exchange of the Soviet government, with Leonid Brezhhev taking command, would reflect in disorientation in the space program, which would be doomed to several failures.

On January 14, 1966, Korolev, the inspiring figure of the Soviet exploration of the cosmos, died after routine surgery from which he could not recover. His replacement was Vasily Mishin, who lacked the vision and management skills of the "chief strategist." On March 26, 1968, Yuri Gagarin died during a test flight. It was a great national tragedy. Less than a year later, the N1, the titanium rocket the USSR would use for its lunar adventure, exploded and left the launch base unusable (15). The Americans took advantage of the fragile moment of the Soviets and continued with the program Gemini. In approximately 1 year, 10 manned launches were made for the space. In 1967, the UN published a space treaty, which basically are the principles governing the activities of States and the use of Spaces, including the moon and other celestial bodies. In this treatise, the space is free for all countries and benefits all nations. Moreover, it could never have military purposes, such as installing weapons off the planet. This document is valid until the present day and was signed by the Americans and Soviets. Finally, the Americans launch the Apollo program (15), in which it was a set of space missions whose main objective is to put the man on the moon. However, on the day of the launch of Apollo 1, performed in the same day that the Americans and Soviets signed the space treaty, a tragedy occurred. A short circuit before the launch inside the cockpit caused a fire, which ended up killing the three astronauts who were on board. The investigations concluded that the program still had several flaws in the project. The Americans continued with this project, but no crew.

Apollo 5 gained prominence by doing the first tests with a lunar module. Only with Apollo 7 did the program once again have a manned mission. In late 1968 Apollo 8 became the first manned mission to go to the moon and returned to Earth safely. Despite Soviet disorganization, some space programs were still active, such as the Soyuz program. Like the Apollo program, its purpose was to send the man the moon. However, the Soyuz one stayed only 1 day in orbit and with several problems, in reentry with the Earth, the parachute used in the space capsule failed and ended up killing the astronaut Vladimir Komarov (8), making the first astronaut to die on a mission in the history of the space race. In January 1969, the Soviets successfully coupled two manned spacecraft, the Soyuz (8) 4 and 5 successfully, and it was the first time an astronaut was transferred from one vehicle to another in space. But with the advancement of the Apollo Project missions, the Americans got closer to reaching the moon first. Apollo 9 stayed only in Earth orbit, testing equipment for landing on the moon, such as the navigation system. Apollo 10 reached the orbit of the moon, made several tests including tests for landing on the moon, in preparation for the next Apollo flight.

In this way, they decided to design a spacecraft divided into three modules and only one would be specially prepared to land on the moon. The Apollo 11 mission (9) consisted of: Service Module: with propulsion, energy, oxygen and water, Command Module: called Columbia (homage to the rocket from the Earth book the moon of Jules Verne) in which it constituted a cabin for the three crew members (this part returned to Earth) and the Lunar Module: called "Eagle", symbol animal of the USA, to land on the satellite. Finally, on July 16, 1969, viewers around the world paid attention to the launch of Apollo 11. In order to put it into orbit, scientists created the most powerful rocket until then: Saturn V. The Apollo 11 crew was composed of three veteran astronauts in space travel: Commander Neil Armstrong, command module pilot Michael Collins, and lunar module pilot Edwin Buzz Aldrian. After three days of travel, Apollo 11 arrives at the moon orbit (7), and on July 20, aboard the lunar module, Armstrong and Aldrian begin the landing process.

More than 700 million people have accompanied the entire mission from the Earth live. The lunar module landed on the surface in a region known as the "sea of tranquility." Armstrong opened the module hatch, descended the stairs, holding a sign with the following inscription: Here, men of planet Earth stepped on the moon for the first time in July 1969. We have come in peace in the name of all mankind. After that, Armstrong steps on the lunar surface, and says a phrase that would stand for one story "A small step for man, a giant leap for mankind." Shortly after Aldrian descends from the lunar module and they both put the American flag on lunar soil and talked to current President Richard Nixon, who was accompanying the mission. In addition to collecting several samples, they explored the site (about 250 m), took pictures, including the first man's footprint on the moon. Armstrong and Aldrian also placed a reflecting mirror on the lunar surface, allowing them to calculate the distance between the Earth and the Moon. After 21 hours on the surface of the Moon, they returned to the lunar module and returned to Columbia (which was not in orbit and where Collins had been waiting for their return) and on July 24 returned to Earth. They were quarantined and became American heroes.

IV. TECHNOLOGIES THAT HAVE EMERGED THROUGH RESEARCH GENERATED BY SPACE EXPLORATION

Not only does space search, but astronomy itself requires substantial values. The cost to reach the space is always high. Is it worth investing millions of dollars every year to maintain and send people to the International Space Station (16) (ISS)? Is it worth investing in a manned mission to the Red Planet? Is it worth investing billions of dollars to send a robot to Mars?

From the point of view of knowledge and new technologies, yes, it's worth a lot! A recently announced NASA mission (17) aims, for the first time in history, to "touch the sun." The space agency plans to get very close to our king star thanks to the help of a high-tech heat shield installed in an unmanned spacecraft. This innovation may be useful for other uses here on Earth, since the shield promises to block temperatures of 1371 °C making the thermal sensation for the spacecraft is only 29 °C. This technology can be very useful for the construction of Nuclear Fusion generators. Almost all space research has had great application in practical life, and the return it generates is not only scientific but also economic. According to estimates by the US space agency itself, each dollar invested in space technologies generates a return of US $ 14 for the economy of that country, that is, an investment with a return of around 1400%.

Each year, NASA and other space agencies make great scientific discoveries and develop innovative technologies that eventually end up in the hands of the general public (18). China and India have invested heavily in this area and Brazil, which owns the Alcântara Base, one of the most privileged places in the world to launch rockets, loses the chance of investments in this area, being hostage to technologies generated by other nations. Only NASA has more than 6,300 patents. In 2015, NASA's Technology Transfer Program (18) kicked off what they call the "Startup NASA Initiative," a project that frees up at least 1,200 initial patents filed by the US space agency.

The idea is to help new companies solve their two biggest problems: raising capital and guaranteeing intellectual property rights. On April 04, 2019, it has been published a photo by News agencies of the whole World - the first image of a black hole in the history of the humanity. This photo has shocked the scientific community (19) around the world for several reasons: it proves a theory drawn more than 100 years ago by the genius Albert Einstein, opens new lines of research on Space and Time and will change science textbooks throughout the world. The image does not exactly capture the black hole, but the light being sucked in by the hole just as water enters a drain, in its "event horizon." And what's so spectacular about it? It is the result of decades of work, a triumph of technology and human ingenuity, based on Albert Einstein's Theory of General Relativity.

This observation (19) will open the door to the observation of many other things seemingly impossible to be observed. Until that date, mankind had never actually seen a black hole. Its existence was predicted on the basis of General Theory of Relativity, elaborated by Einstein in the year of 1915, that provides a unified description of the gravity like a geometric property of the space and the time, or space-time, that is, Albert Einstein made a prediction theoretical of something that only came to be photographed more than a century later.

It is a photo of the past, which took 5 days to be taken and 2 years to be generated, which required a virtual telescope of the Earth's diameter and generated 5 petabytes of information (5000 Tb), equivalent to 5 millennia of MP3 songs playing or selfies taken by 40,000 people throughout their lives! This amount of data cannot be sent over the internet, so it had to be stored in many HDs and flown to a supercomputer. It is the photo of a black hole (1’9) that is 40 billion kilometers in diameter, about 3 million times the size of our planet. It is larger than our Solar System, but still, it would be like seeing a slice of pizza on the surface of the moon.

Telescopes from various Earth sites(19) had to point exactly at the same time to this exact location, synchronized by atomic clocks, taking only a few days of the year for conditions to be perfect. They set up an elaborate network of radio telescopes that transformed planet Earth into a large radio telescope of more than 10,000 kilometers in diameter.

It is the photo of an object that is 55 million light-years away from Earth, which lies in the nucleus of the M87 Galaxy ie the light we captured took 55 million years to get here - at that time man still did not inhabit the planet Earth. That's right, this is a photo from the past - we're seeing how the black hole was 55 million years ago! It is the photo of an object that has a mass 6.5 billion times greater than that of the Sun. Its density is extraordinarily high. It's as if we are compressing our entire planet to the size of a marble (small).

This is an extraordinary scientific achievement (19) carried out by a team of more than 200 researchers from 4 continents, using an elaborate algorithm, coordinated by a young scientist of 29 years. There is a lot of math, physics and computing involved. For some, the science causes many collateral damage - discovery of the radiation brought about the construction of an atomic bomb, but also brought the treatment that helps to cure cancer. The use of fire brought lighting, heat and better-quality food, and the possibility of premeditated arson and death by a fire. The choice between good and evil always depends on man. Without this science, we return to the middle Ages, where we have passed from producers of knowledge to mere users of knowledge, and this is devastating for any nation.

V. THE LOOK AT THE SKY INFLUENCES OUR LIFE

Several technologies developed by NASA (17) and other research agencies have resulted in innovations that have been incorporated into our daily lives. These include ear thermometers, baby food, grooving on airport runways, scratch-resistant sunglasses, transparent dental appliances, Easter eggs packaging, viscoelastic foam, GPS, fabric covered structures such as those covering large stadiums, portable and wireless vacuum cleaner, artificial limbs, cochlear implant, insulin pump, smoke detectors, solar panels, anti-icing system of airplanes, mine detectors, computed tomography, racing mats, sports shoes , water filters, water repellent wetsuit, thermal insulation systems, lyophilization processes. These are just a few, there are dozens and dozens of them, from plastic materials we use in our home to the technologies that are equipping our smartphones or tablets. There are also fabrics, school equipment, and

other tools that came from NASA's researches (17). These are just some of the main technologies developed during the space race, and the most common ones in everyday life. Several other discoveries are used today in medicine and industry, as are most of the firefighter equipment that comes from the space suit. Because Space is such an inhospitable place and travel is so long, agencies have to be very creative in how to keep their astronauts safe and healthy while away from Earth. In addition, major innovations come from the need to communicate more and more data at unimaginable distances - the most distant picture of planet Earth was taken from a satellite as it left the Solar System!

Today technology companies are collaborating with NASA to create three-dimensional maps of Mars, Moon and real-time meteorological tracking from the International Space Station, and to develop studies on the issue of data management, human-computer interaction, as well as performing various calculations. NASA and its partners have invested in studying virtual reality issues, improving existing space programs, training and simulation to improve the quality of photos taken from the air.

VI. FINAL CONSIDERATIONS

The journey from man to moon has generated several benefits (15), which are very present in today's world, such as: Automatic blood pressure devices, artificial heart valve (based on rocket fuel pumps), cardiac pacemakers, anti-flame overalls used by pilots, smoke and gas leak detectors, nitinol that represents a metallic alloy that is malleable and resistant, and is widely used in orthodontic appliances, GPS (Global Positioning System), microwave oven, microchip and computers, communication satellites for radio-TV broadcasts and expansion of telephone calls, meteorological satellites (important for agriculture), Teflon (used in frying pan), disposable diapers, Velcro, microwave, etc. After the lunar conquest by Apollo 11, there were six more missions to the Moon, all sent by the United States, adding 12 men on its surface from 1969 to 1972. The 37 years without new lunar landings are mainly explained by the high cost of the missions (the Apollo project consumed more than $ 20 billion). There is a great deal of interest today in studying our own planet, especially the challenges of climate change. This causes space agencies in developed countries to prioritize Earth observation missions. One must also consider difficulties related to the travel and the permanence of human beings in any planet or satellite for longer and with more security. On the other hand, there are two theories (20) on this subject: one rests on total fraud, that is, man has never been on the moon and we have been deceived on a scale never seen by mankind. The other theory, more believable, indicates that man was yes on the Moon, but several photos were taken in studios (21) on Earth. Another point in favor of this theory was the "quarantine" suffered by the astronauts.

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