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TOMORROW THE STARS

Italian Space Policy between the US and Europe

1954 - 1988

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“The Space adventure is no more an episode of a single nation. Supranational collaboration and multidisciplinary research are increasingly necessary”

Luigi Broglio

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INTRODUCTION

The peace conferences[1], that preceded and followed the end of the Second World War[2], pointed out the two nations that mostly contributed to the complete defeat to the Axis nations, with their power and determination. They had nothing in common, except the war against Nazi German, these were the United States (US) and the Union of Soviet Socialist Republics (USSR, hereinafter called the Soviet Union).

The Marshall Plan overcame the development of a multilateral approach to international relations, preferring a bilateral solution with every single country participating in the given program. In this way the United States became the country offering benefits, in response to the assistance deemed necessary, in specific fields, by the other nation. Binding agreements were signed with the aided state that, in many aspects, produced a bilateral collaboration that was not only political. In the field of science and technology, specifically, the continuous exchange of know-how and technology contributed to the control and limitation of a possible indiscriminate use of the new scientific discoveries, with the enhancement of national prestige.

The Soviet refusal of the Marshall Plan[3] and the consequent formation of COMINFORM[4] contributed to the division of the world into two different blocks, one under the influence of the United States and the other in close contact to the

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1 During and after the Second World War, many meetings were held during which the Allied members met to decide the fate of the defeated nations. The most important were the Teheran Conference on 1 December 1943, the Yalta Conference on 4 February 1945 and the Potsdam Conference on 18 July 1945.

2 The Second World War officially ended when the last member nation of the Axis, the Japanese Empire, surrendered on 2 September 1945.

3 The Marshall Plan was named after the American Secretary of State, under the Truman administration. It was the plan under which aid was provided to rebuild Europe, addressed to all nations fighting during the Second World War with the hidden intent of preventing communist build up in Europe.

4 The Communist Information Bureau (COMINFORM), was the Soviet response to the Marshall Plan. It met for the first time on 22 September 1947, to form an umbrella organization for all the Soviet Republics.

decisions coming out from Moscow. The London Conference in November and December 1947, called: "…the last possibility" saw the four Foreign Ministers of France, United States, United Kingdom and Soviet Union meet, but showed that it was impossible to reach any agreement with USSR, especially in the post war accommodation of Germany, especially in resolving the after-war German situation, thus ending up in a complete failure[5]. The Berlin Blockade from 24 June 1948 to May 1949, put the entire world into a long phase where the United States and the Soviet Union fought each other in every possible field and theatre, under the constant threat of using atomic weapons. This phase notoriously became known as the "Cold War".

During this phase of history, which was characterized by an atypical struggle, the two blocks never openly or directly fought each other, the rivalry between the United States and the Soviet Union was not only emerging in cases of conventional conflicts between nations aligned in the two blocks, often fought over territorial claims or political supremacy, but through disputes related to every aspect of technological and scientific discovery. A struggle for supremacy that touched every aspect and area putting the two major winners of the Second World War in open competition, even in a field never explored before: the Space.

The Soviet Union inaugurated the level of competition in this new field, starting the "Space Race" launching the first artificial satellite[6] into space on 4 October 1957 from the Baikonur Cosmodrome[7]. The struggle became a battle for superiority of one toward the other in one of the most scientifically and technologically challenging areas. The demonstration of how easy it was to access space portrayed the competitor as being less efficient and technologically

5 Duroselle Jean Baptiste. *Storia diplomatica dal 1919 ai nostri giorni* Edizioni Universitarie di Lettere Economia Diritto, Milano, 2010, p.429.

6 Officially Sputnik1 was launched on 4 October 1957.

7 Was originally built by the Soviet Union in 1950 as the base of operation for its space program near the northern border of the 'Bet-pak-dala', the huge steppe inhabited by the Khirziki nomads, more than 2 000km from Moscow. Even if today it is part of the territory of Kazakhstan, it is managed jointly by the Russian Federal Space Agency and Russian Aerospace Defense Forces under a bilateral agreement between the two nations. It is the first and largest space launch facility in the world.

inferior, and also defenseless against potential nuclear threats. The aim was also the possess of a more powerful rocket-vector to launch something into orbit to be used against the rival. In this way space became an area to demonstrate the technical, military and political superiority of the national power over the other[8]. The initial advantage taken by the Soviet Union over the United States arose not from a particular development of knowledge, but from necessity, simply because the weights of the Soviet atomic weapons were heavier than the American; therefore the develop of more powerful launchers as carrier was needed[9].

The development of space technologies is closely related to the increase in national ballistics power. The rocket became the line of contact between the civil sectors of discovery and studies of space and the military world, which has the purpose of developing a powerful rockets that, in addition to putting an object into orbit, can also be an ordnance launcher.

The United States did not expect such high technological knowledge by the Soviet Union and the reaction was a total review of the former defence and security planning. Even if Eisenhower labelled Sputnik as: "a little ball in the sky, something that does not bother me even a little[10]", it became a form of national obsession for the President of the United States to take his country into space[11]. His administration reorganized the defence system, prioritizing space projects. For this purpose the National Aeronautics and Space Administration (NASA) was founded, which is a civil government agency with the responsibility for developing US aerospace research. NASA replaced the National Advisory Committee for Aeronautics (NACA) and had a larger budget and had more power to act than the previous agency. In a certain way it could be said that the mother of the development of space research was the Cold War itself.

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8 Caprara Giovanni *Storia Italiana dello Spazio* Saggi Bompiani, Milan, 2012, p. 137.

9 Di Bernardo Nicolai Giorgio *Nella nebbia in attesa del sole*, Di Renzo editore, Rome, 2005, p.25.

10 Amatucci Bruno, Ragno Luciano. *L'Italia nello spazio prima e dopo Sirio*, Fratelli Palombi Editori, Rome, 1978, p.27.

11 As seen in (http://fas.org/spp/eprint/article03.html#3)

The defeat of the Axis nations, after the end of the Second World War, caused a massive brain drain. Scientists, professors, researchers, people in general, members of the scientific community who were economically and politically part of nations, that had been devastated by the horrors of the war, found it impossible to receive help from their respective governments to continue their activities, thus they decided to emigrate to the victorious nations. This escape contributed to the further enrichment of the scientific community of that nations. For the most part, the scientists split into the two nations that, at that time, lead the Western and Eastern block, the United States and the Soviet Union respectively. One of these migrants was the father of US space activities Wernher von Braun, a German scientist with US citizenship. He was the creator of the launcher that took the Americans to the Moon, Saturn V.

The European nations, battered by the ravages of war, found themselves also deprived of those men capable to lead a resurgence at least in the technical and scientific field. Among the defeated nations Italy definitely proved in the field of the space exploration, at least in the initial phase, all its worth reaching an initial advantage over the other European nations. Undisputed star of this rescue was the genius of someone who became the "father" of Italian astronautics: Luigi Broglio. He was a man who knew how to "ride" the surprise that amazed the world hearing the sound of the 'beep-beep' indicating the presence of the "traveling companion"[12], Sputnik, therefore showing the way ahead to the progress of science and technology. In a single vision, Broglio combined the Americans of the nascent NASA, the Italian university world and the military field with *Aeronautica Militare*[13]. He received support and financial aid from them to perform experiments that, in a few years, led Italy to be part of the exclusive "club of the space nations", until that moment attended only by the United States and Soviet Union. At the beginning of this space adventure, Italy showed to the other Western nations clear sighted ideas for the investment to be done in an entirely new field, still to be discovered.

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12 Literally *Sputnik* in Russian means "travelling companion".

13 The Italian Air force.

Thanks to its ability Broglio gave birth to a movement of opinion in favour of space research that had its lifeblood in the relations with the United States. A partnership propitiated by personal relationships that the engineer officer maintained with the upper echelons of NASA, that became the common denominator during all of the pioneering phase of the Italian space adventure.

Meanwhile, all European countries began to rediscover themselves as a single entity, able to gather the skill e strength of the devastated European economy, with the aim to emerge from an undeniable economic delay in comparison to the two super powers that were about divide the world. From the Manifesto of Ventotene to the Schuman's declaration, new forms of association began to take shape, devoted to push the European governments to collaborate first, in strictly defined matters as the European Community for Coal and Steel, and later to more binding agreements with the foundation of the EEC. It was decided to join forces also in the scientific research with the extraordinary success of the European Organization for Nuclear Research (CERN) in Geneva, that gathered, for the first time, the scientific research in the nuclear field, from the different European countries, with satisfactory results. Finally it was decided to bridge the gap in the field of the space exploration joining forces in the European Launcher Development Organization (ELDO), to make available to all European nations the instrument to gain access to space, and in the European Space Research Organization (ESRO) to build scientific satellites. The two organizations later joined to create the European Space Agency (ESA).

The Italian sector that mainly tried to benefit from union of intent conveyed in ESA was the industrial world. Italian industries, especially those involved in the aviation business, realized immediately how Europe could represent an opportunity to increase know-how and, of course, generate profits. Industries, in contrast to the Italian academic world, demonstrated to remain up to date trying to meet the challenges that space offered them.

Space turned out to be a very mutable field, where interests and objectives were changing faster and faster. This change of objectives was made evident after the moon landing, turning point sanctioning the end of the "Space Race". The period of the great expansion of the 1970s changed the perspective on space. After acquiring a good amount of knowledge, the cosmos was perceived as a field where to compete with other nations to seek gains. This source of income was to come from the large development in the field of media and telecommunications in general. The competition to place a satellite in orbit that could transmit data communication to the ground receivers halted the process of mutual support on both sides of the Atlantic Ocean. The United States had no more reason to offer its help for free, so every European country had to improve the necessary know-how to develop the sector by themselves.

The NASA administration decided, anyway, to implement cooperation policies with other nations, especially European, essentially to reduce public funding to the NASA. The Nixon administration, in fact, after the conquest of the moon, cancelled funding destined for the continuation of the Apollo project and started a new space policy, which had as its goal the creation of reusable vector; the Post-Apollo project. It was thanks to this American impulse to share knowledge that projects arose, relevant from either technical progress and international relations point of view.

The 1970s were in Italy the years of the SIRIO project, which had been approved by the ministerial Committee for Financial Planning (CIPE) after the axing of the European program ELDO/PAS, to build a telecommunications satellite. Italian industries looked at space with more interest than in the past because the field was growing, even in Europe. In those years, the potential advantages of a telecommunications satellite were little understood[14].

[14] Caprara Giovanni, *Storia italiana dello spazio*, Saggi Bompiani, Bergamo, 2012, p. 261.

If it is true that the relationship with the US was put aside in the telecommunications sector, we cannot say the same for the most significant collaboration with the States, represented undoubtedly by the Spacelab project, conducted together by European nations and NASA. This project although led by the American space agency, offered both a new reusable vector named the Space Shuttle as well as staff training. Italy contributed notably producing the housing units to put onboard the Shuttle.

Purpose of this work is then to analyze the effective role played by the American and European space organizations, since the end of the II World War up to the founding of the Italian Space Agency (ASI)in 1988. It is a significant step, in fact, to understand, if and how, those organizations contributed to make Italy a respectable space power, able to play a starring role in the major space programs worldwide.

Not to be limited to a mere chronicle of the significant events that have led to the partnership between Americans and Europeans, the work also analyzes one of the issues that still divides the actors of the Italian space policy: the sharp dualism between the academic world lead by Luigi Broglio and the industrial sector joined in the *Compagnia Industriale Aerospaziale*, (CIA). The first one focused entirely on the San Marco project, with few studies conducted in the atmosphere with scientific tasks and open to collaboration with the United States, while the second more oriented to perceived space from a commercial perspective, and more prone to collaboration within the European Space Agency. A fracture that caused delay in the formation of the Italian Space Agency (ASI), the only Italian agency assigned to coordinate space activities. Although it is now seen as a shadow in the past, it is still present in the actions of the men who lead today's space activities. This issue will be analyzed to illustrate the presence of this division trying to offer valuable key, the more objective as possible, to understand the reasons that led to this fracture. Although, even today, many assumptions and obscured shadows are still present and far to be clearly interpreted.

CHAPTER I

Space: The new front in the Cold War

1 . The United States toward the Moon Conquest

The Space Race between the United States (US) and the Soviet Union (USSR) can be considered as one of the competition raged by the two Cold War rivals in the second part of the 20th century. The prize was the supremacy in spaceflight capability. It had its bases in the attempt of both nations, at the end of the World War II, to gain technology and personnel from the defeated Germany, enabling its armed forces to develop projects necessary for the national security.

The technological superiority to be acquired became a symbol of ideological superiority. Out of the develop of ballistic missile, able to carry nuclear weapons, the rising space capability was seen as a valuable mean, not only in the military field, to enable the launch of artificial satellites, unmanned space probes and human spaceflight to start a space exploration in close competition with the opposite block.

An official date to be considered as the starter's firing of the race could be the 2 August 1955, after separate announcement done by the nations on the intention to send satellites in Earth orbit. The Soviet Union announcement came in that date, in response of the US announcement four days earlier regard the of intent to celebrate the International Geophysical Year by launching artificial satellites.
The Soviet Union won the first leg of the race on 4 October 1957 launching Sputnik 1 in Earth orbit, and later won another important leg on 12 April 1961 when the Soviet Yuri Gagarin[15], was the first cosmonaut to visit the space e safely recovery. But may the most important leg was won by the American on 20 July 1969, with the landing of the first humans on the Moon, after a decade of close competition for the conquest of that celestial body.

A symbolic date for the checkered flag of the race can be considered the 17 July 1975 when an Apollo capsule met a Soyuz, and US astronauts and Soviet

[15] Yuri Alekseyevich Gagarin (9 March 1934 – 27 March 1968) was born in the village of Klushino, (renamed Gagarin in 1968 after his death), from parents working in a collective farm. He was selected as cosmonaut from the very beginning of the Soviet Space Corp.

cosmonauts shook their hands in Earth orbit, following a three years of preparation program within the co-operative Apollo–Soyuz Test Project signed on 24 May 1972[16].

It is not possible to analyze the events of the Space Race without tracing its origins in Germany in the early 1930s and continuing during World War II, when Nazi Germany researched and built operational ballistic missiles. The leader of the Weimar Republic were trying to circumvent the Treaty of Versailles' ban on research and development of long-range cannons[17] by the acquisition of liquid-fueled rockets, able to reach high altitudes and traverse long distances.

The first military personnel involved in the studies were leaded by Lieutenant Colonel Karl Emil Becker, head of the German Army's Ballistics and Munitions Branc. In is small team he included two young and promising engineers: Walter Dornberger[18] and Leo Zanssen[19].

Wernher von Braun (1912–1977), was recruited at that time by Becker joining the secret army program at Kummersdorf-West in 1932. In the following years Dornberg, in the rank of General, became the military head of the army's rocket program, while von Braun became the technical director of the ballistic missile program in the Peenemünde army rocket centre.

Von Braun soon became head of important project, the most important related to the construction of the Aggregate-4 (A-4) rocket[20], first vehicle capable to reach

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16 See: (https://www.nasa.gov/mission_pages/apollo-soyuz/index.html)

17 The Treaty of Versailles is one of the peace treaty that officially ended the First World War. It was agreed under the Paris Peace Conference of 1919-1920 and signed by 44 States June 28 1919 in Versailles. It is divided into 16 parts and consists of 440 articles. The US never ratified the treaty and as a result, they never joined the League of Nations and later negotiated a separate peace with Germany: the Treaty of Berlin of 1921.

18 Walter Robert Dornberger (1895 – 1980) was a German Military Officer and Engineer who took part to both the Word Wars. He put his base and laboratories in Kummersdorf, close to Berlin where he starter his studies on rockets.

19 Leo Zanssen (1896 – 1973) was a German Military Officer expert in artillery and ballistic.

20 The A4 rocket was designed as a surface to surface missile with a gyroscope guidance system. It was 14mt long with a diameter of 1,65mt and a wingspan of 3,5mt. Its engine was powered with liquid fuel capable of a 25000kg of thrust. Total mass weight 12900kg, maximum speed

outer space, as seen in its test flight program in 1942 and 1943. By 1943, Germany was able to start the production of the Vergeltungswaffe 2 [21], out of the A-4 project. It was a ballistic missile able to reach a distance of more than 300km, carrying warheads with a weight of more than 1000kg, with a speed of about 4000km/hr. For this very high supersonic speed it was virtually impossible to intercept it, and for its smaller size it was almost invisible to radar detection, allowing only late warning.

While working hardly on the military projects Von Braun had a clear vision about the scientific conquering of the outer space with rockets. For this convinctions he can be considered the foundation on which, at the end of the War the US space program was built. This is due to the fact that the Americans were able to recruit von Braun together with his engineering team, as a result of the Operation Paperclip[22], along with a large number of German V2 rockets together with the complete collection of designs and drawing .

Immediately after the discovery of the crimes perpetrated by the Nazis against the forced laborers in factories associated with Peenemunde was not immediately clear whether treating Von Braun and other German prisoners as scientists to associate at the American space programs or simply consider them war criminals

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5580km/h. Though it was one of the first experiment was already able to reach a distance of 320km with a warhead of around 1000kg, being launched from mobile platform.

21 Vengeance Weapon 2, more commonly V2

22 Operation Paperclip was the codename under which the US intelligence and military services extricated scientists from Germany, during and after the final stages of World War II in 1945. The project was originally called Operation Overcast, and is sometimes also known as Project Paperclip. Of particular interest were scientists specialising in aerodynamics and rocketry, such as those involved in the V-1 and V-2 projects, chemical weapons, chemical reaction technology and medicine. These scientists and their families were secretly brought to the United States, without State Department review and approval. The only condition placed by President Truman was that scientists had not been part of, or supported, the Nazi Party. In many cases, indeed, US Intelligence modified their backgrounds, providing them new identities. Among them were: Wernher von Braun, Arthur Rudolph, Kurt Blome, Kurt Tank, Hans Hollmann.An aim of the operation was capturing equipment before the Soviets came in. The US Army destroyed some of the German equipment to prevent it from being captured by the advancing Soviet Army. See http://www.operationpaperclip.info/ . See also Jacobsen Annie. *Operazione Paperclip: The Secret Intelligence Program to Bring Nazi Scientists to America* Edizioni PIEMME, Milan, 2004, and the CIA web site at https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/csi-studies/studies/vol-58-no-3/operation-paperclip-the-secret-intelligence-program-to-bring-nazi-scientists-to-america.html

like the Soviets did: “Was the man a genius who should be brought to America, or a war criminal who had inflicted a life unutterable misery on his fellow men?”[23]. Finally Von Braun, became the United States' lead rocket engineer during the 1950s and 1960s .

About 500 scientists coming from Germany were gradually deployed at White Sands Proving Ground, New Mexico, Fort Bliss, Texas and Huntsville, Alabama with the task to put their knowledge in the development of guided and ballistic missile. This in turn led to the foundation of NASA and the US ICBM program.

But the American technology related to space dates back to the beginning of the World War I when, in 1914, The American Robert Goddard[24] developed studies on solid-fuel rockets, reaching a test phase for a light battlefield rocket to the US Army Signal Corps, just at the end of World War I. His studies were continued until 1921 whit the develop of a liquid-fueled rocket, but he was ignored by the public and unable to obtain commissions by the government even within the post-WW II rocket development effort.

Von Braun himself was inspired by Goddard's work. It is well known that during his first interrogations, after the recruitment in USA, he often referred to Dr. Goddard’ studies. At the end of 1945 Von Braun’s team started working in the United States Army's White Sands Proving Ground, New Mexico. Their first job was to enable American engineers to assemble and launch some captured V2s. In this trials the Americans obtained for the first time photos from outer space in 1949, through the combination of a vector, named WAC Corporal, with a V2, obtaining a two stage. The year after those first achievements The Von Braun’s team was transferred from Fort Bliss to the Army's new Redstone Arsenal[25], in

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23 Cadbury Deborah, *Space Race* Fourth Estate, London, 2005, p. 36

24 Robert Hutchings Goddard (1882 – 1945) was an American engineer, professor, physicist, and inventor who is credited with creating and building the world's first liquid-fueled rocket, which he successfully launched on 16 March 1926. Goddard and his team launched 34 rockets[] between 1926 and 1941, achieving altitudes as high as 2,6 km and speeds as high as 885 km/h.

25 The Redstone Arsenal is an Army Installation still in activity. In the official website it is mentioned with pride the period of the years 50s that saw the work of von Braun’s team.

Huntsville, Alabama. Their new task become the development of the first Army's medium-range ballistic missile, the Redstone rocket. After the completion of the studies the new rocket become, in modified versions, the first space launcher rocket, able to send in orbit the firs American satellite and the Mercury space capsule for the first piloted missions. Out from this program the Jupiter and Saturn family of rockets had their develop..

At the beginning the United States had several rocket programs each one for the different Armed Forces, aimed to developed different ICBM program. First to initiate a ICBM research was the Air Force with MX-774. After two years of testing with successful launches 1947 the program was cancelled due to lack of funding. The following attempt was made in 1951 with the MX-1593. This program, enhanced in 1955, evolved in the Atlas-A project destined to became the first American success, in the field of the ICBM, with the successful test launch on 11 June 1957. The further version D of the rocket became a valid operational nuclear ICBM and was also used as launcher in the Project Mercury and for the Agena Target Vehicle within Project Gemini.

By the year 1955 both the United States and the Soviet Union could rely on ballistic missiles also capable to reach the outer space. Following the spectacular announcements in 1957, shoving a rising vocation to compete, there was a greater commitment to be the first launch Earth circling satellites. In particular the White House made his announcement declaring the intention to launch a satellite between 1 July 1957, and 31 December 1958, as part of their contribution to the International Geophysical Year. The Soviets replayed immediately at the Sixth Congress of International Astronautical Federation[26] in Copenhagen, where the

See: http://www.garrison.redstone.army.mil/

[26] In the tense Cold War atmosphere, scientists found themselves in an increasingly polarised world, where most of the dialogue between the rival superpowers was closing down. In 1951scientists from the field of space research created the International Astronautical Federation (IAF) in an attempt to re-establish that dialogue. See:
(http://www.iafastro.org/about/history/)

notable scientist Leonid Sedov[27], in a interview with the international press, revealed the intention of his country to launch a satellite as well very soon.

At that time the international legislation related to space activities was very poor or non-existent. In particular it was still unclear if a satellite passing above a nation at over 100 kilometers could be considered as a violation of that nation's sovereign airspace.

President Eisenhower and his staff were concentrated to avoid any international incident related illegal overflights, He was deeply convinced that a nation's airspace sovereignty did not extend into outer space, then beyond the Kármán line[28]. He started a series of attempts to establish this principle, culminating with the proposal of an international law, presented during the International Geophysical Year in 1957-58.

The main concern for the President was also to avoid to de considered a warmonger, because the use of military missiles as launchers. For this reason he ordered to use, for the space objectives, the research booster Vanguard developed in the Naval Research Laboratory[29]. This caused a stop for von Braun's team, unable to employ the Jupiter-C rocket mainly devoted to future military employs. As result, the launches of Jupiter-C, starting on20 September 1956, were mainly used for suborbital test, while the rocket itself was already capable of putting a satellite into orbit. All these concerns led American to the first defeat in this stages of the Space Race[30].

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[27] Leonid Ivanovitch Sedov (1907 – 1999) was a leading physicist of the Soviet Union. During World War II, he devised the so-called *Sedov Similarity Solution* for a blast wave. He was the first chairman of the USSR Space Exploration program and broke first news of its existence in 1955. He was president of the International Astronautical Federation (IAF) from 1959 to 1961. Until recently, it had been thought that Sedov was the principal engineer behind the Soviet Sputnik project.

[28] The Karman Line ideally lies at an altitude of 100km above the Earth's sea level, and commonly represents the boundary between the Earth's atmosphere and outer space. Thes definition is accepted by the Fédération Aéronautique Internationale (FAI).

[29] The Naval Research Laboratory (NRL) is a corporate institution for the Navy and Marine Corps which has been conducting a broad program of scientific research, technology and advanced development since for almost one century. (http://www.nrl.navy.mil/)

[30] President Eisenhower was strongly recommended by an high-level Technologies Capability Panel to develop a reconnaissance satellite to spy URSS, but with the caution to launch a

Actually bilateral discussions between the US and USSR began only in 1958 with satellites of both nations already in orbit. An issue for debate the peaceful uses of space was presented to the United Nations, which created a Committee on the Peaceful Uses of Outer Space late in the following year.

Finally the negotiations led to the "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies"[31] signed by the majority of the world nations on 27 January 1967[32].

From the test of the Treaty is possible to draw the main principles:

- ban from placing weapons of mass destruction in Earth orbit, on the Moon, or any other celestial body, with the exclusive use of the Moon and other celestial bodies to peaceful purposes,
- prohibition to use celestial bodies for testing weapons of any kind, conducting military maneuvers, or establishing military bases, installations, and fortifications,
- declarations regarding the free exploration by all the States of outer space, but in total benefit for all countries, explicitly prohibiting any government from claiming a celestial resource such as the Moon or a planet as common heritage of mankind, "not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means". However, the State that launches a space object retains jurisdiction and control over that object;
- the necessity for any non-governmental entities to obtain an authorization to operate in outer space, including the Moon and other celestial bodies by the appropriate State Party to the Treaty;
- The possibility for State Party to the Treaty to request consultation concerning the activity or experiment when a potential harmful interference with activities in the peaceful exploration and use of outer space is detected;

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civilian satellite first to establish the "freedom of space" precedent. Cadbury Deborah, *Space Race* Fourth Estate, London, 2005, p. 144

31 Full test of the Treaty can be found in Annex 1 (http://www.state.gov/t/isn/5181.htm#treaty).

32 Italy signed the Treaty together with the first Nations on 27 January 1967. The Treaty was finally ratified by the Italian Parliament on 4 May 1972

The treaty was signed by 102 member states and is still in force as of 2015.

The Soviet success, in sending into space the first human-made object, caused public concern in the United States, and Eisenhower tried to speed up the Vanguard project forcing its timetable and anticipating the launch. The 6 December 1957, broadcasted live to a large US television audience, the Vanguard rocket dramatically failed to lift from Cape Canaveral Air Force Station in Florida[33]. It was one of the first sensational failure seen live in television and soon became an international joke[34]. But the worst setback was the offer made by the Soviet delegate, in the United Nations, to assist the US in their projects within the international Soviet program of technical assistance to foreign nations. The only positive feedback from the failure was the green light given to von Braun's Redstone team to complete their work to launch Jupiter-C rocket, with an American satellite onboard, as soon as they could.

The positive conclusion of von Braun's team work finally came on 31 January 1958, with the launch of a satellite put in orbit by a four-stage Juno I rocket, derived from the US Army's Redstone missile. The satellite Explorer 1 was definitely more valid and useful in confrontation with the Sputnik 1, in its 14kg in mass was included an important scientific tool, like a micrometeorite gauge and a Geiger-Müller tube. With the completion of 360 orbit the satellite could obtain important data related to the Van Allen Belt, capable to confirm the principles theorized by Dr. James Van Allen, a space scientist at the University of Iowa[35]. Not by chance Van Allen was among the scientists charged to design the testing kit and built the satellite instrumentation of Explorer 1.

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[33] The installation was chosen by the Pentagon as the best site for developing a new missile launch facility in the early 50s. In August 1953 Von Braun tested in this location the first Redstone missile. Cadbury D. "*Space Race"* Fourth Estate, London, 2005, p. 141

[34] The satellite appeared in newspapers under the names *Dudnik Flopnik, Stallnik, Kaputnik..*, Cadbury Deborah, id. p. 173

[35] The radiation belt, today known as Val Allen Belt, had already been theorized by the Italian scientist Enrico Medi whose studies on the radar and the ionizing bands in the atmosphere were boycotted by the fascist regime in the 1930'

The followers of the Explorer 1, starting with a second satellite in March 1958, were generously provided with more instrumentation capable of new experiment and data collection to measure phenomena like cosmic ray, radiation levels, temperature in the spacecraft and frequency of collisions with micrometeorites. Since there was no storage capabilities the data were entrusted to a continuous transmission. Related with the simple “beep - beep” emitted by Sputnik the American satellites capabilities were a great demonstration of the intention do not fall behind in the space race.

Following the first American success in the space President Eisenhower, on 2 April 1958, proposed to the US Congress the foundation of a civilian agency completely devoted to the space activities. As consequence the US Congress formalized the National Aeronautics and Space Act, with the Majority Leader, Lyndon B. Johnson, as first proponent. The Act was signed into law by the President on 29 July 1958.
It was the birthday of the National Aeronautic and Space Administration (NASA) that became operative in the following October. NASA absorbed the structures and competences of the National Advisory Committee for Aeronautics (NACA) incorporating 8000 employees, together with the budget of one hundred million dollars and all the facilities, including Langley Aeronautical Laboratory, l'Ames Aeronautical Laboratory e the Lewis Flight Propulsion Laboratory. In the following process NASA took control of the Army Ballistic Missile Agency (ABMA) renamed Marshall Space Flight Center and the Jet Propulsion Laboratory. First NASA Director was T. Keith Glennan that remained in the office until 20 January 1961. This law also created a Civilian-Military Liaison Committee, chaired by the President, responsible for coordinating the nation's civilian and military space programs.

On 21 October 1959, by Eisenhower’s order, all remaining space activities and project of the Army's converged to NASA and on 1 July 1960, the Redstone Arsenal was renamed in NASA's George C. Marshall Space Flight Center, under the direction of von Braun. A more decisive commitment could be finally put in

the development of the Saturn rockets, which allowed to regain the lost terrain in the race dramatically increasing the American lift capabilities.

The National Advisory Committee for Aeronautics, which gave its resources to NASA, was a federal agency of the United States of America, founded on 3 March 1915 to undertake, promote and institutionalize aeronautical research. Then Founded as an emergency measure during World War I to promote research in the field of military aviation, the NACA was structured on the basis of other institutions European counterparts. In particular, special attention is paid to the structure of the French Institute The *Central Établissement Aérostation Militaire de Meudon*, Aerodynamics Laboratory of the University of Göttingen and the Institute of Aerodynamics Kučino, near Moscow, which influenced so decisive development and the formation of the NACA.

In December 1912, President William Howard Taft had approved the creation of a research institute led by Robert S. Woodward, then president of the Carnegie Institution of Washington. Although the bill providing for the establishment of such an institute was already prepared, the proposal was rejected in January 1913 by the Congress. NACA could be finally founded thanks to the Secretary of the Smithsonian Institution, Charles D. Walcott, who exerted strong pressure for the creation of a so fundamental institution[36]. Finally, on 3 March 1915, President Woodrow Wilson approved the formation of NACA allocating an annual budget of $ 5,000.

By 1959, American observers believed that the Soviet Union would be the first to get a human into space, because of the time needed to prepare for Mercury's first launch. In fact on 12 April 1961, the USSR surprised the world again by launching Yuri Gagarin into a single orbit around the Earth in a craft they called

[36] On the advice of Walcott, Senators Benjamin R. Tillman and Ernest W. Roberts replayed in January 1915 back to both chambers the creation of that research institute, pointing out what would be its tasks. The main task of the institute would be to oversee and direct the studies in the fields of aeronautics research related to the flight, concentrating the majority of resources in the development of technologies that could solve the problems that plagued the first aircrafts at the time.

Vostok 1. The American lost another stage of the Space Race. They boosted the program simply named “Man in Space Soonest” by the US Air Force, initially committed to the program, with a selection of nine candidate pilots already done.

After NASA's creation, the program was transferred over to the civilian agency and renamed Project Mercury on 26 November 1958, with a new selection of candidate pilots from Navy, Air Force and Marine test pilots and narrowed this down to a group of seven for the program. They were soon well known with the neologism of astronauts, from the ancient Greek word for "star sailor.

Different types of one-man space vehicles were studied, settling on a ballistic re-entry capsule launched on a derivative Atlas missile. Capsule design and astronaut training began immediately, working toward preliminary suborbital flights on the Redstone missile, followed by orbital flights on the Atlas. Each flight series would first start unmanned, then carry a primate, then finally men. But the American were no able to beat the Soviets and Alan Shepard, the first American in space, followed Yuri Gagarin just three weeks later, on 5 May 1961. He was launched in a ballistic trajectory on Mercury-Redstone 3, in a spacecraft he named Freedom 7. Though he did not achieve orbit like Gagarin, he was the first person to exercise manual control over his spacecraft's attitude and retro-rocket firing. After his successful return, Shepard was celebrated as a national hero, honored with parades in Washington, New York and Los Angeles, and received the NASA Distinguished Service Medal from President John F. Kennedy.

It was the President Kennedy who directed the next stages of the Space Race, in particular the race toward the Moon. Before Gagarin's flight, US President John F. Kennedy's support for America's manned space program was lukewarm. Jerome Wiesner of MIT, who served as a science advisor to presidents Eisenhower and Kennedy, and himself an opponent of manned space exploration, remarked, "If Kennedy could have opted out of a big space program without hurting the country in his judgment, he would have".

As late as March 1961, when NASA administrator James E. Webb submitted a budget request to fund a Moon landing before 1970, Kennedy rejected it because it was simply too expensive. Some were surprised by Kennedy's eventual support of NASA and the space program because of how often he had attacked the Eisenhower administration's inefficiency during the election. Gagarin's flight changed this causing in Kennedy a sense of humiliation and fear, the same one that could have hit the American people after the Soviet achievements. He sent a memo dated 20 April 1961, to Vice President Lyndon B. Johnson, asking him to look into the state of America's space program, and into programs that could offer NASA the opportunity to regain the lost positions. The two major options at the time seemed to be, either establishment of an Earth orbital space station, or a manned landing on the Moon. After a deep examination, with the help of von Braun, mainly based on the estimates of US and Soviet rocket lifting capability, Johnson responded to Kennedy, concluding that much more was needed to reach a position of leadership, and recommending that the manned Moon landing was far enough in the future that the US had a fighting chance to achieve it first.

Kennedy ultimately decided to pursue a new program named “Apollo” with the intent to land a man on the moon before 1970. On 25 May he took the opportunity to ask for Congressional support in a Cold War speech titled "Special Message on Urgent National Needs"[37]. He justified the program in terms of its importance to national security, and its focus of the nation's energies on other scientific and social fields. He rallied popular support for the program in his "We choose to go to the Moon"[38] speech, on 12 September 1962, before a large crowd at Rice University Stadium, in Houston, Texas, near the construction site of the new Manned Spacecraft Center facility. At that time Kennedy expressly declared: “I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish”.

[37] Full test can be found on https://research.archives.gov/id/193915
[38] Full test can be found on http://er.jsc.nasa.gov/seh/ricetalk.htm

It was necessary to wait almost one year after the Gagarin flight to have the first American astronaut to perform an orbital flight. Few months after Shepard Virgil "Gus" Grissom repeated Shepard's suborbital flight in Liberty Bell 7 on 21 July 1961, while John Glenn became the first American to orbit the Earth, on 20 February 1962. His Mercury-Atlas 6 mission completed three orbits in the Friendship 7 spacecraft, and splashed down safely in the Atlantic Ocean, after a tense reentry, due to what falsely appeared from the telemetry data to be a loose heat-shield. As the first American in orbit, Glenn became a national hero, and received a ticker-tape parade in New York City, reminiscent of that given for Charles Lindbergh. On 23 February 1962, President Kennedy escorted him in a parade at Cape Canaveral Air Force Station, where he awarded Glenn with the NASA service medal.

The United States launched three more Mercury flights after Glenn's: Aurora 7 on 24 May 24 1962 duplicated Glenn's three orbits; Sigma 7 on 3 October 1962, six orbits; and Faith 7 on 15 May 1963, 22 orbits in about 32 hours, the maximum capability of the spacecraft. NASA at first intended to launch one more mission, extending the spacecraft's endurance to three days, but since this would not beat the Soviet record, it was decided instead to concentrate on developing Project Gemini.

On 10 May 1962, Vice President Johnson addressed the Second National Conference on the Peaceful Uses of Space revealing that the United States and the USSR both supported a resolution passed by the Political Committee of the UN General Assembly on December 1962, which not only urged member nations to "extend the rules of international law to outer space," but to also cooperate in its exploration. But it was necessary to wait until on 27 January 1967 to have a Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, which was signed

by the United States, USSR, and the United Kingdom and went into force the following October 10[39].

Following the passing of the 1962 resolution, Kennedy started to promote a cooperation program to be indorsed by the two superpowers. On 20 September 1963, in a speech before the United Nations General Assembly, he proposed that the United States and the Soviet Union join forces in their efforts to reach the Moon. Soviet Premier Nikita Khrushchev initially rejected Kennedy's proposal. According to a report by Khrushchev's son Sergei in 1997, the Soviet leader was poised to accept Kennedy's proposal at the time of Kennedy's assassination on 22 November 1963, sharing the idea that both nations might realize cost benefits and technological gains from a joint venture, but changed his mind and dropped the idea since he did not have the same trust for Kennedy's successor, Lyndon Johnson.

As President, Johnson steadfastly pursued the Gemini and Apollo programs, promoting them as Kennedy's legacy to the American public. One week after Kennedy's death, he issued an executive order renaming the Cape Canaveral and Apollo launch facilities after Kennedy.

The Gemini program, launched in January 1962, is to be considered as a support to the project Apollo designed to land the first man on the moon. Its task was concentrated to develop the key spaceflight technologies of space rendezvous and docking of two craft, flight durations of sufficient length to simulate going to the Moon and back, and extra-vehicular activity to accomplish useful work outside the spacecraft, all relevant capacities to be acquired by the two-man spacecrafts before the first launch of the later three-man Apollo spacecrafts.

Gemini took a year longer than planned to accomplish its first flight, allowing the Soviets to beat other records keeping the head of the competition. First flight with a three-man Voskhod spacecraft, first ultravehicular activity (UVA), long stay of

[39] Topic already detailed on page 21

cosmonauts in space. But in 1965 the Gemini program started to collects records overtaking the opponent in the Space Race, achieving several significant firsts during the course of ten piloted missions:

- On Gemini 3 (March 1965), astronauts Virgil "Gus" Grissom and John W. Young became the first to demonstrate their ability to change their craft's orbit.
- On Gemini 5 (August 1965), astronauts L. Gordon Cooper and Charles "Pete" Conrad set a record of almost eight days in space, long enough for a piloted lunar mission
- On Gemini 6 (December 1965), Command Pilot Wally Schirra achieved the first space rendezvous with Gemini 7, accurately matching his orbit to that of the other craft, station-keeping for three consecutive orbits at distances as close as 1 foot (0.30 m). Gemini 7 also set a human spaceflight endurance record of fourteen days for Frank Borman and James A. Lovell, which stood until both nations started launching space laboratories in the early 1970s
- On Gemini 8 (March 1966), Command Pilot Neil Armstrong achieved the first docking between two spacecraft, his Gemini craft and an Agena target vehicle.
- On Gemini 11 (September 1966), commanded by Conrad, achieved the first direct-ascent rendezvous with its Agena target on the first orbit, and used the Agena's rocket to achieve an apogee of 1,374km, the manned Earth orbit record still current.
- On Gemini 12 (November 1966), Edwin E. "Buzz" Aldrin spent over five hours working comfortably during three (EVA) sessions, finally proving that humans could perform productive tasks outside their spacecraft. This proved to be the most difficult goal to achieve.

Most of the novice pilots on the early missions would command the later missions. In this way, Project Gemini built up spaceflight experience for the pool of astronauts who would be chosen to fly the Apollo lunar missions.

On 27 January 1967, the same day the US and USSR signed the Outer Space Treaty, the crew of the first manned Apollo mission, Command Pilot Virgil "Gus" Grissom, Senior Pilot Edward H. White, and Pilot Roger Chaffee, were killed in a fire that swept through their spacecraft cabin during a ground test, less than a month before the planned 21 February launch. An investigative board determined the fire was probably caused by an electrical spark, and quickly grew out of control, fed by the spacecraft's pure oxygen atmosphere. Crew escape was made impossible by inability to open the plug door hatch cover against the greater-than-atmospheric internal pressure. The board also found design and construction flaws in the spacecraft, and procedural failings, including failure to appreciate the hazard of the pure-oxygen atmosphere, as well as inadequate safety procedures. All these flaws had to be corrected over the next twenty-two months until the first piloted flight could be made. Mercury and Gemini veteran Grissom had been a favored choice of Deke Slayton, NASA's Director of Flight Crew Operations, to make the first piloted landing.

The United States recovered from the Apollo 1 fire, fixing the fatal flaws in an improved version of the Block II command module. The US proceeded with unpiloted test launches of the Saturn V launch vehicle (Apollo 4 and Apollo 6) and the Lunar Module (Apollo 5) during the latter half of 1967 and early 1968. Apollo 1 mission to check out the Apollo Command/Service Module in Earth orbit was accomplished by Grissom's backup crew commanded by Walter Schirra on Apollo 7, launched on 11 October 1968. The eleven-day mission was a total success, as the spacecraft performed a virtually flawless mission, paving the way for the United States to continue with its lunar mission schedule.

Unfortunately the develop of the Lunar Module (LM) was not in line with the schedule and it was not ready for orbital tests in time for the Apollo 8 mission in December 1968. NASA planners overcame this challenge by changing the mission flight order, delaying the first LM flight until March 1969, and sending Apollo 8 into lunar orbit without the LM in December. This mission was in part motivated by intelligence rumors the Soviet Union might be ready for a piloted

Zond flight during late 1968. Actually, in September 1968, Zond 5 made a circumlunar flight with tortoises on board and returned to Earth, accomplishing the first successful water landing of the Soviet space program in the Indian Ocean. It also scared NASA planners, as it took them several days to figure out that it was only an automated flight, not piloted, because voice recordings were transmitted from the craft enroute to the Moon.

On 21 December 1968, Frank Borman, James Lovell, and William Anders became the first humans to ride the Saturn V rocket into space on Apollo 8. They also became the first to leave low-Earth orbit and go to another celestial body, and entered lunar orbit on 24 December. They made ten orbits in twenty hours, and transmitted one of the most watched TV broadcasts in history, with their Christmas Eve program from lunar orbit, that concluded with a reading from the biblical Book of Genesis. Two and a half hours after the broadcast, they fired their engine to perform the first trans-Earth injection to leave lunar orbit and return to the Earth. Apollo 8 safely landed in the Pacific ocean on 27 December, in NASA's first dawn splashdown and recovery.

The American Lunar Module was finally ready for a successful piloted test flight in low Earth orbit on Apollo 9 in March 1969. The next mission, Apollo 10, conducted a "dress rehearsal" for the first landing in May 1969, flying the LM in lunar orbit as close as 47,400 feet above the surface, the point where the powered descent to the surface would begin. With the LM proven to work well, the next step was to attempt the actual landing.

Unknown to the Americans, the Soviet Moon program was in deep trouble mainly related to the failures of the N1 rocket and the extensive damages suffered by launch pad explosion after an engine failure of the rocket Without the N-1 rocket, the USSR could not send a large enough payload to the Moon to land a human and return him safely.

Apollo 11 was prepared with the goal of a July landing in the Sea of Tranquility. The crew, selected in January 1969, consisted of commander (CDR) Neil Armstrong, Command Module Pilot (CMP) Michael Collins, and Lunar Module Pilot (LMP) Edwin "Buzz" Aldrin. They trained for the mission until just before the actual launch day on 16 July 1969, from Kennedy Space Center Launch Complex 39 in Florida. The trip to the Moon took just over three days After achieving orbit, Armstrong and Aldrin transferred into the Lunar Module, named Eagle, and after a landing gear inspection by Collins remaining in the Command/Service Module Columbia, began their descent. After overcoming several computer overload alarms caused by an antenna switch left in the wrong position, and a slight downrange error, Armstrong took over manual flight control at about 180 meters and guided the Lunar Module to a safe landing spot at 20:18:04 UTC, 20 July 1969. The first humans on the Moon would wait another six hours before they ventured out of their craft and Armstrong became the first human to set foot on the Moon.

"That's one small step for a man, one giant leap for mankind."[40]

The first step was witnessed by at least one-fifth of the population of Earth, or about 723 million people. Aldrin joined him on the surface almost 20 minutes later. Altogether, they spent just under two and one-quarter hours outside their craft. The next day, they performed the first launch from another celestial body, and rendezvoused back with Columbia. Apollo 11 left lunar orbit and returned to Earth, landing safely in the Pacific Ocean on 24 July 1969. When the spacecraft splashed down, 2982 days had passed since Kennedy's commitment to landing a man on the Moon and returning him safely to the Earth before the end of the decade.

NASA had ambitious follow-on human spaceflight plans as it reached its lunar goal, but soon discovered it had expended most of its political capital to do so. The first landing was followed by another, precision landing on Apollo 12 in

[40] The first human words coming from the lunar soil were listened by million of people on the Earth thanks to a large television broadcasting

November 1969. NASA had achieved its first landing goal with enough Apollo spacecraft and Saturn V launchers left for eight follow-on lunar landings through Apollo 20, conducting extended-endurance missions and transporting the landing crews in Lunar Roving Vehicles on the last five. They also planned an Apollo Applications Program to develop a longer-duration Earth orbital workshop (later named Skylab) to be constructed in orbit from a spent S-IVB upper stage, using several launches of the smaller Saturn IB launch vehicle. But planners soon decided this could be done more efficiently by using the two live stages of a Saturn V to launch the workshop pre-fabricated from an S-IVB (which was also the Saturn V third stage), which immediately removed Apollo 20. Belt-tightening budget cuts soon led NASA to cut Apollo 18 and 19 as well, but keep three extended/Lunar Rover missions. Apollo 13 encountered an in-flight spacecraft failure and had to abort its lunar landing in April 1970, returning its crew safely but temporarily grounding the program again. It resumed with four successful landings on Apollo 14 (February 1971), Apollo 15 (July 1971), Apollo 16 (April 1972), and Apollo 17 (December 1972).

But the after-Apollo era was already started. Starting in the beginning of 1969, still months before the historical lunar landing, President Richard M. Nixon convened a Space Task Group to set recommendations for the future US civilian space program, headed by his Vice President Spiro T. Agnew. Agnew was an enthusiastic proponent of NASA's follow-on plans, and the STG recommended plans to develop a reusable Space Transportation System including a Space Shuttle, which would facilitate development of permanent space stations in Earth and lunar orbit, perhaps a base on the lunar surface, and the first human flight to Mars as early as 1986 or as late as 2000. However, Nixon had a better sense of the declining political support in Congress for a new Apollo-style program, which had disappeared with the achievement of the landing, and he intended to pursue detente with the USSR and China, which he hoped might ease Cold War tensions. He cut the spending proposal he sent to Congress to include funding for only the Space Shuttle, with perhaps an option to pursue the Earth orbital space station for the foreseeable future.

In the 1970s, the United States began developing and launched a range of unmanned probes, they gave also impetus to second class of programs identified by the then Vice President Lyndon B. Johnson, in the Memo for Kennedy dated April 20, 1961, and related to the develop of orbital workstation. The United States launched the Skylab 1 on May 14, 1973. It weighed 77,090kg, was 58 feet (18 m) long by 21.7 feet (6.6 m) in diameter, with a habitable volume of 10,000 cubic feet (280 m3). Skylab was damaged during the ascent to orbit, losing one of its solar panels and a meteoroid thermal shield. Subsequent manned missions repaired the station, and the final mission's crew, Skylab 4, set the Space Race endurance record with 84 days in orbit when the mission ended on February 8, 1974. Skylab stayed in orbit another five years before reentering the Earth's atmosphere over the Indian Ocean and Western Australia on 11 July 1979.

Starting in 1972, President Richard M. Nixon and Soviet Premier Leonid Brezhnev negotiated an easing of relations known as detente, creating a temporary "thaw" in the Cold War. In the spirit of good sportsmanship, the time seemed right for cooperation rather than competition, and the notion of a continuing Space Race began to subside. The two nations planned a joint mission to dock the last US Apollo craft with a Soyuz, known as the Apollo-Soyuz Test Project (ASTP). To prepare, the US designed a docking module for the Apollo that was compatible with the Soviet docking system, which allowed any of their craft to dock with any other. The module was also necessary as an airlock to allow the men to visit each other's craft, which had incompatible cabin atmospheres. The joint mission began when Soyuz 19 was first launched on 15 July 1975 and the Apollo craft was launched with the docking module just six and a half hours later. The two craft rendezvoused and docked two days later and the three astronauts Donald "Deke" Slayton, Thomas Patten Stafford and Vance Brand could shake their hands with the two cosmonauts Alexey Leonov and Valeri Kubasov, exchanging gifts and visiting each other's craft.

This mission ended the Space Race and new developments occurred afterward, with the develop of the space stations, the use of a new generation of reusable orbital spacecraft known as the Space Shuttle and the entry of new nations active in space like Europe and China with more and more developments of international programs.

It is however absolutely correct to say that without the Space Race, in the Cold War era, space programs would have a slower progress. American concerns that they had fallen behind the Soviet Union in the race to space in the late 1950s led quickly to a push by legislators and educators for greater emphasis on mathematics and the physical sciences in American schools. The United States' National Defense Education Act of 1958 increased funding for these goals from childhood education through the post-graduate level. The scientists educated through these efforts helped develop technologies that have been adapted for use in the kitchen, in transportation systems, in athletics, and in many other areas of modern life. Dried fruits and ready-to-eat foods, food sterilization, package sealing techniques, stay-dry clothing, and even no-fog ski goggles have their roots in space science.

Today over a thousand artificial satellites orbit Earth, relaying communications data around the planet and facilitating remote sensing of data on weather, vegetation, and human movements for the nations who employ them. In addition, much of the micro-technology that fuels everyday activities, from time-keeping to enjoying music, derives from research initially driven by the Space Race.

2. Eastern Block Strategy in the "Space Race"

With the Cold War as an engine for change in the ideological competition between the United States and the Soviet Union, a coherent space policy began to take shape in the URSS during the late 1950s, but the first soviet activities in the space studies, as well as other field of technology, can be found once again in the years following the II World War.

On Stalin's orders, the Soviet Union sent its best rocket engineers to this region to see what they could salvage for future weapons systems. The Soviet rocket engineers were led by Sergei Korolev. He had been involved in space clubs and early Soviet rocket design in the 1930s, but was arrested in 1938 during Joseph Stalin's Great Purge and imprisoned for six years in Siberia. After the war, he became the USSR's chief rocket and spacecraft engineer, essentially the Soviet counterpart to von Braun.

Korolev would take much inspiration from the competition as well, achieving many firsts to counter the possibility that the United States might prevail. On 30 August 1955, Korolev managed to get the Soviet Academy of Sciences to create a commission whose purpose was to beat the Americans into Earth orbit: this was an important step in the soviet preparation for the Space Race. The Korolev' team became soon the OKB – 1, where OKB is a transliteration of the Russian initials of "Опытное конструкторское бюро" *Opytnoye Konstruktorskoye Buro*, meaning Experimental Design Bureau. During the Soviet era OKBs were closed institutions working on design and prototyping of advanced technology, usually for military applications, while the Americans created NASA as focal point for the space activities, Soviets created a numbers of OKB for the different activities, mainly linked to the leader scientist[41].

[41] Korolev was the scientist reference for the *OKB -1 Space Research*, but other OKB were activated with similar tasks, sometime in competition

The Council of Ministers of the Soviet Union began a policy of treating development of its space program as a classified state secret. For this reason his identity was kept a state secret throughout the Cold War, and he was identified publicly only as "the Chief Designer.". In the West, his name was only officially revealed when he died in 1966 [42].

The German WW2 rocket center in Peenemünde was located in the eastern part of Germany which became the Soviet zone of occupation. Simultaneously with the American Operation Paperclip the Soviets tried to collect as much material and designs, together with scientists, as they could[43]. After almost a year in the area around Peenemünde, Soviet officials moved most of the captured German rocket specialists to Gorodomlya Island[44] on Lake Seliger, about 240 kilometers northwest of Moscow. They were not allowed to participate in Soviet missile design, but were used as problem-solving consultants to the Soviet engineers. They helped in many areas and studies as the creation of a Soviet version of the A-4, the schemes organization, the research in improving the A-4 main engine, the development of a 100-ton engine, the assistance in the layout of plant production rooms and in the preparation of rocket assembly using German components. With their help, particularly Helmut Groettrup's group[45], Korolev used the A-4 technology to build his own version of the rocket, the R-1, in 1948.

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42 A detailed look at Korolev's scientific activities in the 1930s can be found in Vetrov Gregor Sergey, *S. P. Korolev i kosmonavtika: pervye shagi* (S. P. Korolev and Astronautics: first steps) Moscow Nauka, 1994.

43 According to Deborah Cadbury in Peenemunde, at the time of German retreat, there was a treasure of documents unique in the world, about 65000 technical drawings and blueprints, reports of trial and error testing, including the drawings of A-4 and its descendant A-9 and A-10. Cadbury Deborah, *Space Race* Fourth Estate, London, 2005, page 7

44 On 31 August 1946, the Minister of Armaments of USSR issued a secret order No. 258, which created a "Branch No. 1" of the NII-88 rocket development institute based in Podlipki. The purpose of the Branch No. 1 was to employ German rocket engineers, while keeping them isolated from overall rocket-development activities of NII-88 in Podlipki. First 73 German specialists with their families landed on Gorodomlya at the end of 1946. The island was surrounded by a barbwire fence along its entire perimeter and armed guards were posted for 24 hours at two piers on the northern and southern edges of the island.
(http://www.russianspaceweb.com/gorodomlya.html)

45 Helmut Groettrup (1916-81) was a German rocket engineer, who as a POW was taken to Russia and headed German design group at Kapustin Yar Cosmodrome. He was a rocket guidance expert in Peenemunde, after the war he headed the German rocket team in Russia from 1945 since 1953. Basically as a POW, Groettrup headed a group of also capture German rocket engineers.
(http://profpaulcutter.com/PDF/Hi-tech%20Studies/Helmut_Groettrup.pdf

From 1949 he developed his own distinct designs, though many of these designs were influenced by the Groettrup Group's, presenting the G4-R10 design. The Germans were eventually repatriated at the beginning of the 1950s[46].

Main task for the soviets scientist was to achieve an high military power to counter the American supremacy, For its part, the Soviet Union harbored fears of invasion having suffered at least 27 million casualties during World War II after being invaded by Nazi Germany in 1941. The Soviet Union was really worried its former ally, the United States, which until late 1949 was the sole possessor of atomic weapons. The United States had used these weapons operationally during World War II, and it could use them again against the Soviet Union. Since the Americans had a much larger air force than the Soviet Union, and the United States maintained advance air bases near Soviet territory, in 1947 Stalin ordered the development of intercontinental ballistic missiles (ICBMs) in order to counter the perceived American threat.

In 1953, Korolev was given the go-ahead to develop the R-7 Semyorka rocket, which represented a major advance from the German design. Although some of its components, as the boosters, still resembled the German G-4, the new rocket incorporated staged design, a completely new control system, and a new fuel. It was successfully tested on 21 August 1957 and became the world's first fully operational ICBM the following month. It would later be used to launch the first satellite into space, and derivatives would launch all piloted Soviet spacecraft.

Korolev received word about von Braun's 1956 Jupiter-C test, but thinking it was a satellite mission that failed, he expedited plans to get his own satellite in orbit. Since his R-7 was substantially more powerful than any of the American boosters, he made sure to take full advantage of this capability by designing Object D as his primary satellite. It was given the designation “D” to distinguish it from other R-7

[46] According to Debora Cadbury the number of scientists, helpers and staff collected by the Soviets reached the numbers of 7000 in 1946 and they were mainly employed to restore the missing drawings of the German weapons. Cadbury Deborah, *Space Race* Fourth Estate, London, 2005, page 96

payload designations A, B, V, and G which were nuclear weapon payloads. Object D would dwarf the proposed American satellites, by having a weight of 1400 kilograms of which 300 kilograms would be composed of scientific instruments that would photograph the Earth, take readings on radiation levels, and check on the planet's magnetic field.

However, things were not going along well with the design and manufacturing of the satellite, so in February 1957, Korolev sought and received permission from the Council of Ministers to create a rudimentary and simple satellite, the Sputnik (PS-1). The Council also decreed that Object D be postponed until April 1958. The new sputnik was a shiny sphere that would be a much lighter craft, weighing 83.8 kilograms and having a 58cm diameter. The satellite would not contain the complex instrumentation that Object D had, but it did have two radio transmitters operating on different short wave radio frequencies, the ability to detect if a meteoroid were to penetrate its pressure hull, and the ability to detect the density of the Earth's thermosphere.

Korolev was buoyed by the first successful launches of his R-7 rocket in August and September, which paved the way for him to launch his sputnik. Word came that the Americans were planning to announce a major breakthrough at an International Geophysical Year conference at the National Academy of Sciences in Washington D.C., with a paper entitled "Satellite Over the Planet", on 6 October 1957. Korolev anticipated that von Braun might launch a Jupiter-C with a satellite payload on or around the fourth or fifth of October, in conjunction with the paper. He hastened the soviet launch, moving it to the fourth of October. The launch vehicle for PS-1, was a modified R-7 vehicle 8K71PS number M1-PS without much of the test equipment and radio gear that was present in the previous launches. It arrived at the Soviet missile base close to the village of Tyuratam in the Kazakh Steppe, later known in the western countries as Baikonur Cosmodrome, in September and was prepared for its mission at launch site number one.

On Friday, 4 October 1957, at exactly 10:28:34 pm Moscow time, the R-7, with the now named Sputnik 1 satellite, lifted off the launch pad, and placed this artificial "moon" into an orbit a few minutes later. But the celebrations were muted at the launch control centre until the down-range far east tracking station at Kamchatka received the first distinctive signal from Sputnik 1's radio transmitters, indicating that it was on its way to completing its first orbit. About 95 minutes after launch, the satellite flew over its launch site, and its radio signals were picked up by the engineers and military personnel at Baikonur, though it was just a single repeated note Korolev yelled “listen to the music! This is music non one has heard before”, his team could start to celebrate the import achievement[47]. The Sputnik 1 “beep beep” signal continued for 22 days bearing witness to the rest of the world that the man had launched into a stabilized orbit its first solid object.

After only few weeks the Soviets were able to send in the space the first living creature. On November 3 the a new satellite, six time heavier than the first, was launched from Baikonur with the dog Laika onboard. A TV system carried together was able to transmit pictures of a calm a normally breathing dog floating in the space. But the survival equipment of the satellite was really rudimentary, unable to keep a stady temperature, so Laika died for overheating after just six hours “American humiliation was complete. Twice in a matter of weeks the Soviets had beaten the United States”[48].

The next step to achieve first was the sending human been to space. In 1959 NASA started to train his astronauts pirouetting them onto the word stage, pushing Korolev to ask for a selection of candidates. The Korolev idea of a cosmonaut was submitted to Academy of Sciences and Institute of Aviation Medicine representatives: “I think the candidate’s age should be about 30, height below 67 inches and weight below 150 pounds. Above all he should be a man with a smile. He must be brave!”[49].

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47 Cadbury Deborah, *Space Race* Fourth Estate, London, 2005, p. 164
48 Cadbury Deborah, id. p. 170
49 Cadbury Deborah, id. p. 199

In the meantime Soviets were able to score new first with the launch of unmanned probes called Luna, in 1959, able to leave the Earth orbit and travel toward the moon sending back photos of the of the hidden face[50]. In 1960 all the effort were put to prepare a spaceship able to perform orbits and safely recovery allowing a human travel onto space. Pressure were made on Aleksey Isayev[51], responsible for creating the rockets, to obtain immediate achievement .

The first unmanned Vostok was launched in May 1960 but after a successful entrance in orbit it failed to recovery toward the Earth surface skimming off the upper layers of the atmosphere with no more fuel left to avoid the Earth's gravitational pull. Just two month later one more failure occurred with the explosion of a capsule carrying two dogs onboard. Finally a successful mission was flown in August with a safe reentry of two "cosmonaut dogs" parachuted just ten kilometers away from the designated point of landing. After the news was released by the TASS agency[52], before the Western press, John F. Kennedy, at that time aspiring presidential candidate, chided that "the first canine passengers in space who safely returned were called Strelka and Belka[53]… not Rover and Fido"[54].

But the failures of that period were to continue with the falling back to the Earth of Mars 1, intended to start the exploration of the red Planet. Failure was kept in secret to prevent a poor showing to President Khrushchev who had just boasted of the incoming Soviet space conquest during a conference at the UN, "we are turning out rockets like sausages"[55]. At the end of 1960 it was clear that all the

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50 Luna 1 was launched on 2 January, being the first human object to leave the Earth orbit, it was to fast to establish a lunar orbit and after missing the Moon for abot 6000km stabilized in a solar orbit. Luna 2 reached the Moon surface in the Mare Imbrium on September 15, being the first human craft to visit another celestial body. Luna 3 was launched on October 4 orbiting the Moon and mapping about 70% of the hidden face.

51 Aleksey Mihajlovic Isayev was the tem leader of the OKB – 2 responsible for the implementation of aeronautical engines and rockets.

52 TASS is the major news agency in Russia, it was founded in 1902 and it is still in activity (Russian: Информационное агентство России ТАСС, Informatsionnoye agentstvo Rossii TASS)

53 Names of the two dogs sent onto space by the Soviets and safely recovered. The meaning is "Squirrel" and "Arrow".

54 Cadbury Deborah. "Space Race" Fourth Estate, London, 2005, p. 211

55 Cadbury Deborah, id. p. 212.

snags were not cleared enough to risk a human mission. In November a new couple of dogs were sacrificed in a controlled explosion again for problems in the reentry phase. In December a new mission with dogs onboard risked to be lost after the landing because a calculation error that brought the spaceship far in remote Siberian lands.

According to a Korolev's biography[56] there was a meeting with the candidate cosmonauts were Yuri Gagarin[57] affirmed that most of the encountered problems could have solved with a man onboard taking manual control. Korolev was heartened but still convinced that more automatic test were needed. After two more automatic mission with more animal and a dummy called Ivan Ivanovic onboard the Soviets were ready to start the human missions.

On 12 April 1961, the USSR surprised the world again by launching Yuri Gagarin into a single orbit around the Earth in a craft they called Vostok 1. They dubbed Gagarin the first cosmonaut, roughly translated from Russian and Greek as "sailor of the universe". Although he had the ability to take over manual control of his spacecraft in an emergency by opening an envelope he had in the cabin that contained a code that could be typed into the computer, it was flown in an automatic mode as a precaution; medical science at that time did not know what would happen to a human in the weightlessness of space. Vostok 1 orbited the Earth for 108 minutes and made its reentry over the Soviet Union, with Gagarin ejecting from the spacecraft at 7000 meters and landing by parachute.

The Federation Aeronautique Internationale[58] (International Federation of Aeronautics) credited Gagarin with the world's first human space flight, although

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[56] Korolev's biographer was Yaroslav Kirillovich Golovanov (1932 – 2003) he was a Russian journalist and writer. He covered space exploration by the Soviet Union from its beginnings.

[57] Yuri Gagarin was the favourite candidate for Korolev, at that time he was close to be designated for the first human mission by the General Nicolai Kamanin, an Aviator awarded with the title of Hero of the Soviet Union, responsible of the cosmonauts selection. At the meeting were also present Gherman Titov soon designated to be the second.

[58] The Fédération Aéronautique Internationale was founded on 14 October 1905 at the conclusion of an international aeronautical conference convened in Paris. After two days of debate, the representatives of Belgium, France, Germany, Great Britain, Italy, Spain, Switzerland and the USA adopted a package of proposed Statutes. From its inception, the FAI

their qualifying rules for aeronautical records at the time required pilots to take off and land with their craft. For this reason, the Soviet Union omitted from their FAI submission the fact that Gagarin did not land with his capsule. When the FAI filing for Gherman Titov's second Vostok flight in August 1961 disclosed the ejection landing technique, the FAI committee decided to investigate, and concluded that the technological accomplishment of human spaceflight lay in the safe launch, orbiting, and return, rather than the manner of landing, and so revised their rules accordingly, keeping Gagarin's and Titov's records intact.

Gagarin became a national hero of the Soviet Union and the Eastern Bloc, and a worldwide celebrity. Moscow and other cities in the USSR held mass demonstrations, the scale of which was second only to the World War II Victory Parade of 1945.

The 12 April was declared Cosmonautics Day in the USSR, and is celebrated today in Russia as one of the official commemorative dates of Russia. In 2011, it was declared the International Day of Human Space Flight by the United Nations. It was another Korolev's success, he was in the control room at launch talking with Gagarin during the preparation phase, trying to maintain a lighthearted tone. He was also directly calling the various stages of the launch: "Ignition is being given…Preliminary phase... Interim phase... complete take off!" Gagarin answered with an informal "Поехали!" (Poyekhali - Let's go) that became a historical phrase in the Eastern Block, used to refer to the beginning of the human space flight era[59]. Once again the reentry phase was very difficult, but finally Gagarin was able to land with his parachute in a rural area soon surrounded by local peasants aware of his travel having just listened news of the historic mission from the radio.

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defined its principal aims as being to*"methodically catalogue the best performances achieved, so that they be known to everybody; to identify their distinguishing features so as to permit comparisons to be made; and to verify evidence and thus ensure that record-holders have undisputed claims to their titles."* (http://www.fai.org/about-fai/history)

[59] Cadbury Deborah, *Space Race* Fourth Estate, London, 2005, p. 237

Gherman Titov became the first Soviet cosmonaut to exercise manual control of his Vostok 2 craft on 6 August 1961, in that date also the American had already been in the space, but only in suborbital flight. Korolev was particularly pleased with his success but not at all satisfied. He was already committed to new tasks to obtain new successes. He was convinced that the URSS were perfectly capable to reach new targets in the just began space era. "Soviet science, technology, and industry have achieved significant succeses in the past year, culminating in the first space flight of Yuri Gagarin… The vast importance of these flight cannot be overemphasized, for they herald a new era of space flight for mankind"[60]

In the following years the Soviet Union demonstrated 24-hour launch pad turnaround and the capability to launch two piloted spacecraft, the Vostok 3 and the Vostok 4, in essentially identical orbits, with launches on 11 and 12 August 1962. The two spacecraft came within approximately 6.5 kilometers of one another, close enough for radio communication. Vostok 4 also set a record of nearly four days in space. Though the two craft's orbits were as nearly identical as possible given the accuracy of the launch rocket's guidance system, slight variations still existed which drew the two craft at first as close to each other as 6.5 kilometers, then as far apart as 2,850 kilometers. There were no maneuvering rockets on the Vostok to permit space rendezvous, required to keep two spacecraft a controlled distance apart.

The Soviet Union duplicated its dual launch feat with Vostok 5 and Vostok 6 (June 16, 1963). This time they launched the first woman and also the first civilian, Valentina Tereshkova, into space on Vostok 6. Launching a woman was reportedly Korolev's idea, and it was accomplished purely for propaganda value. Tereshkova was one of a small corps of female cosmonauts who were amateur parachutists, but Tereshkova was the only one to fly. The USSR didn't again open its cosmonaut corps to women until 1980, two years after the United States opened its astronaut corps to women.

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[60] From the article *The Soviet land has become the gateway to the universe* published on the Pravda on 31 December 1961, by Sergei Korolev under the pseudonym of Professor K. Sergeev

The Soviets kept the details and true appearance of the Vostok capsule secret until the April 1965 Moscow Economic Exhibition, where it was first displayed without its aerodynamic nose cone concealing the spherical capsule. The Vostok spaceship had been first displayed at the July 1961 Tushino air show, mounted on its launch vehicle's third stage, with the nose cone in place. A tail section with eight fins was also added, in an apparent attempt to confuse western observers. This spurious tail section also appeared on official commemorative stamps and a documentary. In the following years it was clear to the Soviets the Americans were eager to catch up winning the race towards the conquest of the moon. The new programs Gemini and Apollo were launched and it was declared by President Kennedy the intent to land a man on the moon before 1970. Khrushchev responded to Kennedy's implicit challenge with silence, refusing to publicly confirm or deny the Soviets were pursuing a moon race. However, as would later be disclosed, they pursued such a program in secret over the next nine years.

Meanwhile, Korolev had planned further long term missions for the Vostok spacecraft, and had four Vostoks in various stages of fabrication in late 1963 at his OKB-1 facilities. At that time of the American announcement for their ambitious Project Gemini Korolev had already plans including major advancements in spacecraft capabilities, with a two-person spacecraft, the ability to change orbits, the capacity to perform an extravehicular activity (EVA) and the goal of docking with another spacecraft. These represented major advances over the previous Mercury or Vostok capsules, and Korolev felt the need to try to beat the Americans to many of these innovations. Korolev already had begun designing the Vostok's replacement, the next-generation Soyuz spacecraft, a multi-cosmonaut spacecraft that had at least the same capabilities as the Gemini spacecraft.

However, Soyuz would not be available for at least three years, and it could not be called upon to deal with this new American challenge in 1964 or 1965. Political pressure in early 1964 pushed him to modify his four remaining Vostoks to beat

the Americans to new space firsts in the size of flight crews, and the duration of missions. Different sources claim the pressures coming Khrushchev while other sources claim they were from other Communist Party officials[61]. The new hasty program was named Voskhod.

Gemini took a year longer than planned to accomplish its first flight, allowing the Soviets to achieve another first, launching Voskhod 1 on October 12, 1964, the first spacecraft with a three-cosmonaut crew.
The USSR touted another technological achievement during this mission since the cosmonauts were able to perform in a “shirt-sleeve” environment for the first time in a space flight. However, flying without spacesuits was not due to safety improvements in the Soviet spacecraft's environmental systems, rather this innovation was accomplished because the craft's limited cabin space did not allow for spacesuits. Flying without spacesuits exposed the cosmonauts to significant risk in the event of potentially fatal cabin depressurization. This feat would not be repeated until the US Apollo Command Module flew in 1968; this later mission was designed from the outset to safely transport three astronauts in a shirt-sleeve environment while in space.

Between 14 and 16 October, 1964, Leonid Brezhnev and a small cadre of high-ranking Communist Party officials, deposed Khrushchev as Soviet government leader a day after Voskhod 1 landed, in what was called the "Wednesday conspiracy".

On 8 March 1965, about a week before the first American piloted Project Gemini space flight, the USSR accelerated the competition, by launching the Voskhod 2 mission with the cosmonauts Pavel Belyayev and Alexey Leonov. Voskhod 2's design modifications included the addition of an inflatable airlock to allow for extravehicular activity (EVA), also known as a spacewalk, while keeping the

[61] According to Korolev’s deputy, Vasili Mishin, Korolev received a direct telephone call from President Khrushchev in early February ordering to upstage the two-men Gemini program “launching three cosmonauts right away”. Cadbury Deborah, *Space Race* Fourth Estate, London, 2005, p. 275

cabin pressurized so that the capsule's electronics wouldn't overheat. Leonov performed the first-ever EVA as part of the mission. A fatality was narrowly avoided when Leonov's spacesuit expanded in the vacuum of space, preventing him from re-entering the airlock. In order to overcome this, he had to partially depressurize his spacesuit to a potentially dangerous level. He succeeded in safely re-entering the ship, but he and Belyayev faced further challenges when the spacecraft's atmospheric controls flooded the cabin with 45% pure oxygen, which had to be lowered to acceptable levels before re-entry. The reentry involved two more challenges as an improperly timed retrorocket firing caused the Voskhod 2 to land 386 kilometers off its designated target area, the town of Perm, and the instrument compartment's failure to detach from the descent apparatus caused the spacecraft to become unstable during reentry.

The new political leaders, along with Korolev, ended the technologically troublesome Voskhod program, cancelling Voskhod 3 and 4, which were in the planning stages, and started concentrating on the race to the Moon. Voskhod 2 would end up being Korolev's final achievement before his death on 14 January 1966, as it would become the last of the many space firsts that demonstrated the USSR's domination in spacecraft technology during the early 1960s. According to historian Asif Siddiqi[62], Korolev's accomplishments marked "the absolute zenith of the Soviet space program, one never, ever attained since."

There would be a two-year pause in Soviet piloted space flights while Voskhod's replacement, the Soyuz spacecraft, was designed and developed, but once again it was clear to the new Soviet leaderships that the most important target to achieve

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[62] Asif Azam Siddiqi is a Bangladeshi American space historian and a Guggenheim Fellowship winner. He is a professor of history at Fordham University specialized in the history of science and technology and modern Russian history. He has written several books on the history of space exploration. His first book *Challenge to Apollo: The Soviet Union and the Space Race, 1945-1974* is widely considered to be the best English-language history of the Soviet space program in print and was identified by the *Wall Street Journal* as "one of the five best books" on space exploration. He is a currently serving on the National Research Council's Committee on Human Spaceflight and he also collaborate with the NASA History Division.

in the next future was the conquering of the Moon. Korolev's design bureau had already produced two prospectuses for circumlunar spaceflight (March 1962 and May 1963), the main spacecraft for which were early versions of his Soyuz design. Soviet Communist Party Central Committee Command 655-268 officially established two secret, competing manned programs for circumlunar flights and lunar landings, on 3 August 1964. The circumlunar flights were planned to occur in 1967, and the landings to start in 1968.

The circumlunar program Zond, created by Vladimir Chelomey's design bureau OKB-52, was to fly two cosmonauts in a stripped-down Soyuz 7K-L1, launched by Chelomey's Proton UR-500 rocket. The Zond sacrificed habitable cabin volume for equipment, by omitting the Soyuz orbital module. Chelomey gained favor with Khruschev by employing members of his family.

Korolev's lunar landing program was designated N1/L3, for its N1 superbooster and a more advanced Soyuz 7K-L3 spacecraft, also known as the lunar orbital module ("Lunniy Orbitalny Korabl", LOK), with a crew of two. A separate lunar lander ("Lunniy Korabl", LK), would carry a single cosmonaut to the lunar surface. The N1/L3 launch vehicle had three stages to Earth orbit, a fourth stage for Earth departure, and a fifth stage for lunar landing assist. The combined space vehicle was roughly the same height and takeoff mass as the three-stage US Apollo/ Saturn V and exceeded its takeoff thrust by 28%, but had only roughly half the translunar injection payload capability.

Unfortunately Korolev could not survive long enough for a malignant tumor to see the progress of the program. In January 1966 he died during a surgery, in a time when the Soviet race to the moon had needed him most[63]. Following Khruschev's ouster from power, Chelomey's Zond program was merged into the N1/L3 program.

[63] General Kamanin wrote in his diary “He left us when is talent was in bloom” Cadbury Deborah, *Space Race* Fourth Estate, London, 2005, p. 295

Meanwhile, the Soviet Union was having its own problems with Soyuz development. Engineers reported about 200 design faults to party leaders, but their concerns their concern was to accelerate launches for new successes. On 24 April 1967, the single pilot of Soyuz 1, Vladimir Komarov, became the first in-flight spaceflight fatality. The mission was planned to be a three-day test, to include the first Soviet docking with an unpiloted Soyuz 2, but the mission was plagued with problems. Early on, Komarov's craft lacked sufficient electrical power because only one of two solar panels had deployed. Then the automatic attitude control system began malfunctioning and eventually failed completely, resulting in the craft spinning wildly. Komarov was able to stop the spin with the manual system, which was only partially effective. The flight controllers aborted his mission after only one day. During the emergency re-entry, a fault in the landing parachute system caused the primary chute to fail, and the reserve chute became tangled with the drogue chute; Komarov was killed on impact. Actually Komarov was the reserve pilot for the mission although the first designated pilot was Yuru Gagarin. Looks like the decision to reverse the positions was taken to preserve the life of the first cosmonaut for a mission that was known to have many risks[64].

The spacecraft faults caused an eighteen-month delay before piloted Soyuz flights could resume, for the necessity to fix the parachute and control problems. The next piloted mission Soyuz 3 was launched on 26 October 1968. The goal was to complete Komarov's rendezvous and docking mission with the un-piloted Soyuz 2. Ground controllers brought the two craft to within 200 meters (660 ft) of each other, then cosmonaut Georgy Beregovoy took control getting a 40 meters close to his target, but was unable to dock before expending 90 percent of his maneuvering fuel, due to a piloting error that put his spacecraft into the wrong orientation and forced Soyuz 2 to automatically turn away from his approaching craft. The first docking of Soviet spacecraft was finally realized in January 1969

[64] After the Komarov disaster General Kamanin informed Gagarin there would never be another space flight for him to protect him for dangerous situation. But on 27 March 1968 Gagarin died in a plane crash during a training mission. Cadbury Deborah, *Space Race* Fourth Estate, London, 2005, p. 313

by the Soyuz 4 and Soyuz 5 missions. It was the first-ever docking of two manned spacecraft, and the first transfer of crew from one space vehicle to another.

The Soviet Zond spacecraft was not yet ready for piloted circumlunar missions in 1968, after four unsuccessful automated test launches: Cosmos 146 on 10 March 1967, Cosmos 154 on 8 April 1967, Zond 1967A on 27 September 1967, Zond 1967B on 22 November 1967.
There was a partially successful mission with the Zond 4, launched on 2 March 2 1968, that successfully made a circumlunar flight. But after its successful around the Moon Zond 4 encountered problems with its Earth reentry on 9 March 9, and was ordered destroyed by an explosive charge 15,000 meters over the Gulf of Guinea. Soviet official announcement said that Zond 4 was an automated test flight which ended with its intentional destruction, due to its recovery trajectory positioning it over the Atlantic Ocean instead of over the USSR.

In September 1968, Zond 5 made a circumlunar flight with tortoises on board and returned to Earth, accomplishing the first successful water landing of the Soviet space program in the Indian Ocean. It also scared NASA planners, as it took them several days to figure out that it was only an automated flight, not piloted, because voice recordings were transmitted from the craft en route to the Moon. On 10 November 1968 another automated test flight, Zond 6 was launched, but this time encountered difficulties in its Earth reentry, and depressurized and deployed its parachute too early, causing it to crash-land only 16 kilometers from where it had been launched six days earlier.

Unknown to the Americans, the Soviet Moon program was in deep trouble. After two successive launch failures of the N1 rocket in 1969, Soviet plans for a piloted landing suffered delay. The launch pad explosion of the N-1 on 3 July 1969 was a significant setback. The rocket hit the pad after an engine shutdown, destroying itself and the launch facility. Without the N-1 rocket, the USSR could not send a large enough payload to the Moon to land a human and return him safely. It turned out there was no chance of a piloted Soviet circumlunar flight during 1968,

due to the unreliability of the Zonds and his vector. Meanwhile, the USSR continued briefly trying to perfect their N1 rocket, finally canceling it in 1976, after two more launch failures in 1971 and 1972.

Having lost the race to the Moon, the USSR decided to concentrate on orbital space stations. During 1969 and 1970, they launched six more Soyuz flights after Soyuz 3, then launched the first space station, the Salyut 1 laboratory designed by Kerim Kerimov[65] on 19 April 1971. Three days later, the Soyuz 10 crew attempted to dock with it, but failed to achieve a secure enough connection to safely enter the station. The Soyuz 11 crew of Vladislav Volkov, Georgi Dobrovolski and Viktor Patsayev successfully docked on June 7, and completed a record 22-day stay. The crew became the second in-flight space fatality during their reentry on June 30. They were asphyxiated when their spacecraft's cabin lost all pressure, shortly after undocking. The disaster was blamed on a faulty cabin pressure valve, that allowed all the air to vent into space. The crew was not wearing pressure suits and had no chance of survival once the leak occurred.

The toll of losses for the conquest of space thus continued to grow. The astronauts of Apollo 15, launched from Cape Canaveral (at that time still Cape Kennedy) in July 1971, brought with them a commemorative plaque and the "Fallen Astronaut" sculpture that were left on the Moon in 1971 in memory of 14 deceased NASA astronauts and USSR cosmonauts.

Salyut 1's orbit was increased to prevent premature reentry, but further piloted flights were delayed while the Soyuz was redesigned to fix the new safety problem. The station re-entered the Earth's atmosphere on 11 October, after 175 days in orbit. The USSR attempted to launch a second Salyut station designated Durable Orbital Station 2 (DOS-2) on July 29, 1972, but a rocket failure caused it

[65] Kerim Kerimov (1917–2003) was born in Baku, Azerbaijan (then part of the Russian Empire) in a family of an engineer-technologist. He was an aerospace engineer and a rocket scientist, one of the founders of the Soviet space industry, and for many years a central figure in the Soviet space program. Despite his prominent role, his identity was kept a secret from the public for most of his career.He was one of the lead architects behind the string of Soviet successes that stunned the world from the late 1950s ranging fron the launch of the Sputnik to the orbital station MIR in 1991.

to fail to achieve orbit. After the DOS-2 failure, the USSR attempted to launch four more Salyut-class stations through 1975, with another failure due to an explosion of the final rocket stage, which punctured the station with shrapnel so that it wouldn't hold pressure. While all of the Salyuts were presented to the public as non-military scientific laboratories, some of them were actually covers for the military Almaz[66] reconnaissance stations.

In the 1970s, in parallel with the United States, the USSR continued to develop space station technology with the Salyut program and Mir space station, supported by Soyuz spacecraft. They developed their own large space shuttle under the Buran program. However, the USSR dissolved in 1991 and the remains of its space program were distributed to various Eastern European countries. The United States and Russia would work together in space with the Shuttle–Mir Program, and again with the International Space Station. The Russian R-7 rocket family, which launched the first Sputnik at the beginning of the space race, is still in use today. It services the International Space Station (ISS) as the launcher for both the Soyuz and Progress spacecraft. It also ferries both Russian and American crews to and from the station.

Finally came the moment of the joint mission with the US. The USSR used the Soyuz 16 mission in December 1974 to prepare for ASTP. On the 15 July, 1975 the Sojuz 19 was launched from Baikonur cosmodrome. It was the first launch of a Soviet rocket broadcast live by international televisions, representing a beginning of political transparency which was institutionalized by Gorbachev with his “Glasnost” in 1986.

Once again the Space Race has left a legacy of Earth communications and weather satellites, while the start of the co-operation between the two rivals, with the

[66] The ascent of man into space at the height of the Cold War raised the question of the military role for piloted spacecraft. On 12 October 1964, during a meeting of leading specialists of the OKB-52 design bureau, based in Reutov, on the eastern edge of Moscow, its chief-designer Vladimir Chelomei officially announced the beginning the Orbital Piloted Station, OPS, project code-named *Almaz* or "Diamond." The Soviet government saw the Almaz project as a response to the development of the Manned Orbiting Laboratory, MOL, by the US Air Force.

growth of the European presence, allowed the continuation of the expensive programs with human space presence. The “Space Race” also sparked an important increase in spending on education, research and development, which led to beneficial spin-off technologies.

CHAPTER II

The Beginning of the Italian Space Policy: “The Broglio Era”

1 . Relations between the US and Italy in the San Marco Project

The consequences of the Second World War in Italy were catastrophic, as they were for the other defeated nations. The partisan domestic struggle against the German occupying forces and militias, who were still loyal to Mussolini, made the Treaty of Paris[67] particularly difficult, not only because of the massive costs of repairing damage caused by the war, but also because of the heavy restrictions in the fields of science and technology[68]. Italy began rebuilding the State and joined the Marshall Plan. After the election in 1948 won by the Christian Democrats, headed at that time by Alcide De Gasperi, Italy's relations with the United States improved. De Gasperi signed, a series of bilateral agreements with the national leaders of the Western block, with the intent of reviving a devastated economy and improving scientific and technological development. A series of these bilateral agreements initiated a new area that merged the sciences and technology including a subject that was, at that time, pure fiction: Space.

Analyzing the first appearances in the Italian space sector, a man must be mentioned who, despite having made questionable choices and somewhat slowed the Italian race as forerunner in space, produced the impetus that led to the birth of the Italian space sector. This was Luigi Broglio, an officer and aeronautical engineer, originally from Mestre. After the successful launch of Sputnik into orbit and thanks to his abilities, Broglio was able to bring together the wonder and the desire to rise both in the field of civil academics and in the military. Exploiting this desire to avenge Italy of that prestige that had been devoured by the defeat in the Second World War, Broglio's vision began to take shape around a project.

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[67] Paris Peace Treaties were a series of peace conferences after the end of the Second World War held from 29 July to 15 October 1946. During which the victorious Allied powers negotiated the details of peace treaties with the defeated nations of Germany's allies: Italy, Romenia, Bulgaria, Hungary and Finland. The Paris Peace Treaty was officially signed on 10 February 1947.

[68] In a speech the Minister of Foreign Affairs, at that time, Alcide De Gasperi, tried to defend Italy against the most demanding conditions of the Paris Peace Treaty by declaring that the partisan fight was necessary to finally defeat Mussolini's regime; the conferences prohibited Italy from developing knowledge in the nuclear field and in any aspect that could bring about an upgrade in the field of weaponry and war in general.

This plan, which in a few years caused the whole world to turn their eyes upwards to observe a metal body, bearing the name of a saint and the symbols of Italy.

Luigi Broglio was born in Mestre near Venice, on 11 November 1911. He graduated in civil engineering at the School of Engineering in Rome in 1934. After the graduation he left the army in 1936, at the end of the war in Africa[69] and then he won concourse joining Italian royal air force in 1937. He became Lieutenant and his first tour was at *Centro Studi ed Esperienze* in Guidonia near Rome. His curiosity was not contained within military sector, and he also graduated in math in June 1940[70]. A man of science, who combined within his culture both the civil and military worlds.

The initiation of the San Marco project was caused by an explosion. In the morning of May 1954, Broglio conducted an experiment, for the first time in Italy, using a supersonic tunnel at Mach[71] 4 to study the effects of air friction on objects in the upper atmosphere. This experiment was being conducted within the establishment of the school of Aeronautical Engineering, of which Broglio had become Dean in 1952, succeeding Gaetano Arturo Crocco[72]. The experiment was being conducted at San Pietro in Vincoli in Rome. The experiment failed and a hole was blasted in the wall. The explosion caused many people to rush to the scene, including the police[73]. Despite the great collective fear concerning the explosion, Broglio realized he had observed something important and great things need large spaces.

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69 The African war, also known as the Ethiopian War, started on 3 October 1935 and ended on 9 May 1936 with the proclamation of the Italian Empire and colonization of the formerly independent African state.

70 Di Bernardo Nicolai Giorgio, *Nella nebbia in attesa del sole* Di Renzo Editore, Rome, 2005, p. 17

71 A unit of measure that indicates the speed of a body in a fluid compared to the speed of sound in the fluid where it travels in the body. Mach corresponds to the speed 345 m/s.

72 Crocco was one of the first people in Italy to deal with rockets. He was born in Naples on 26 October 1877. Distinguished scientist and a military engineer and aeronautical officer, he began study rocketry from 1927 conducting experiments on rocket liquid propellant. In the same year for 'exceptional merit' was appointed professor at the faculty of Engineering at the University of Rome. He projected and experimented with the first combustion chamber for liquid propellant in the 1930s thanks to the help of his son Luigi. He died in Rome in 1968.

73 Amatucci Bruno, Ragno Luciano, *L'Italia nello spazio prima e dopo Sirio* Fratelli Palombi Editori, Rome, 1978, p. 27

Broglio decided to move to a location that would be more suitable to his experiments. He found the ideal location at the Rome airport Urbe, in Via Salaria and, thanks to funding from *Consiglio Nazionale delle Ricerche* (CNR)[74], the Italian Air Force and Theodore von Kármán[75], an Hungarian scientists who had emigrated to America, and was at the time President of a NATO organization named the Advisory Group for Aerospace Research and Development (AGARD)[76].

Thanks to this funding, Broglio founded the San Marco Project Study Center. He built a Mach 6 tunnel, which is unique to Europe[77]. Broglio and his team, which were composed of the best minds selected from within the School of the Engineering in Rome, began experiments to study the resistance of objects in the upper atmosphere.

Broglio also had a brilliant career in the Air Force and in 1956, he was responsible for the branch of studies on weapons and ammunition. He then began to analyze and study rockets, conducting studies on behalf of various agencies and organizations. This appointment made him responsible of the launch site at Salto di Quirra[78] in Sardinia. In addition to Broglio's genius and knowledge, he also

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74 *Consiglio Nazionale di Ricerca* (CNR), is a public entity for Italian research under the auspices of the Minister of Instruction, University and Research with the mandate to develop, promote and spread scientific and technological research.
(http://www.cnr.it/sitocnr/IlCNR/Chisiamo/Chisiamo.html)

75 Considered by many to be one of the highest world authorities in the field of aeronautical research, Theodore von Kármán devoted himself to this sector, especially the branch of aerodynamics, where he studied supersonic and hypersonic flows. Of Hungarian-Jewish descent, after completing his studies in philosophy and graduating in Germany in 1930, he went to the United States after accepting the directorship of the Guggenheim Aeronautical Laboratory at the California Institute of Technology. He was a firm believer in the potential for rocket propulsion and its application in aeronautics. He died in 1963.

76 The Advisory Group for Aerospace Research and Development (AGARD) was a NATO Military Committee agency, whose activities dealt with the information exchange in aerospace research. AGARD was founded in May 1952 and existed until 1998, when it merged with the Defense Research Group creating the Research & Technology Organizations.

77 Caprara Giovanni, *Storia italiana dello spazio,* Saggi Bompiani, Bergamo, 2012, p. 115.

78 The *Poligono sperimentale e di addestramento interforze Salto di Quirra* (PISQ) was built in 1956 near Cagliari. The installation is used by the Army, the Navy and, mostly, by the Air Force, for the development of aircraft, rockets and missiles. It is also used in the field of civil engineering by *Consiglio Nazionale di Ricerca* (CNR), the University of Rome and the European Space Agency (ESA), he contributed greatly to the birth and development of Italian

gained the tools to study the effects that would be undergone at point of launch and during an eventual satellite launch into orbit at high altitudes.

Although everything seemed to be going right, and the Italian conquest of space seemed to be close, soon problems began to arise. The first was that it proved impossible to use the polygon at Salto di Quirra, because it became evident that in order to launch a satellite it needed to point west for take off and, if there was a problem it would fall onto inhabited regions, especially in Libya[79], so the option was rejected. Despite the impossibility of using the site to launch a satellite, the Sardinian base, however, contributed to the development of the pioneering phase of Italian astronautics.

Since 1959, the CNR and the Italian Air Force had been working on a program to study the distribution of winds at an altitude of 120 km, by releasing clouds of colourful sodium gases that were visible from the ground[80]. The experiment, in addition to having undisputed scientific value, opened the door to bilateral relations with the United States, a winning partnership that later proved essential to ensuring Italy's inclusion in the club of Space Nations[81]. The agreement provided a platform on which to share findings on experiments with NASA, in exchange for the use of the Nike-Apache[82] rockets provided to Italy by the American Space agency to launch payloads.

This agreement was the first of a long series of memorandums of understanding that led to Italian universities and industry playing a role in becoming protagonists in this new field.

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aerospace. See artiche by Alegy Gregory, *50 anni Salto di Quirra,* in *Rivista Aeronautica, 5/6,* 2006.

79 Caprara Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Bergamo, 2012, p. 150

80 Ferrone Enrico. *Carlo Buongiorno lo spazio di una vita.* LoGisma Editore, Florence, 2011, p. 59.

81 The event had great resonance in Italy and both the press and television presented that moment as the "Space baptism" of Italy.

82 The Nike-Apache rocket was used until 2006 by the US Air Force to defend national air space. It was a two-stage missile, first at solid propellant, second liquid. The Nike rocket was built by Douglas for Western Electronics, through Bell Telephone.

Relations with NASA were facilitated by the Luigi Broglio' experience in America. The aeronautical engineer went to the United States on several occasions. The first was in 1950 as visiting professor at La Fayette, where he taught two courses, on aviation and math, which earned him the respect of many important people in American aviation and astronautics, to the point that they proposed he take up American citizenship and remain working in the United States, a proposal that Professor Broglio declined[83]. On that occasion Broglio met various personalities from NASA, including Hugh Dryden[84], an aerodynamic engineer like Broglio, who later became the head of NASA.

The first agreement between Italy and the United States for experiments in the upper atmosphere were to be conducted jointly on Wallops Island, Virginia and in Salto di Quirra, Sardinia, was signed in 1959. Dryden facilitated the agreement and, of course, so did Broglio, who as chairman of the Committee on Space Research had the power to negotiate and conclude agreements with NASA. At the time, the study on the dynamics of the upper atmosphere and movements of air at that altitude greatly interested NASA, because the relative data available at that time was poor and satellites orbited in those altitudes[85].

The next step that brought Italy closer to becoming a space nation took place during the meeting of the Committee on Space Research (COSPAR)[86] in Florence. During the meeting, which was convened by the mayor of Florence,

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83 Di Bernardo Nicolai Giorgio. *Nella nebbia in attesa del sole.* Di Renzo Editore, Rome, 2005, p. 31.

84 Hugh Latimer Dryden was a man of extraordinary intellectual faculties. He graduated at the age of 14 and when he was 20 he had already begun to study for his doctorate on physics and math. He became director of the National Advisory Committee for Aeronautics in 1958 when it was replaced by NASA following the reform desired by the Eisenhower administration. Dryden held this position until his death on 2 December 1965 in Washington. See also: *Hugh L. Dryden's Career in Aviation and Space,* by Gorn Michael.

85 Di Bernardo Nicolai Giorgio. *Nella nebbia in attesa del sole*. Di Renzo Editore, Rome, 2005, pp. 57-59.

86 The "Committee on Space Research" was founded by the International Council for Science Unions in 1958, to follow the research programs on rockets and satellites after the International Geographical Year of 1957-1958. It is a multidisciplinary scientific organization devoted to international progress in all areas of scientific research carried out by space vehicles, rockets and satellites. Its primary task is to provide scientific worldwide community means for exploit the possibilities that satellites and space probes would provide for scientific purposes on a cooperative basis. It was one of the few organism that saw discuss at the same table delegates from Western block with those of Eastern block.

Giorgio La Pira[87], Broglio presented the San Marco project, which was addressed specifically to the Americans to encourage their cooperation. It was 12th April 1961, the same day that Yury Gagarin became the first man in space. It was the Russian representative at COSPAR that broke the news with tears in his eyes, to the applause of those present.

Even American representatives cheered, attempting to hide that they had been affected by yet another defeat in the space challenge. The COSPAR meeting served, however, to speak concretely about the San Marco Project. The United States promised to support Broglio and his team. The project was later presented to and examined by members of the Italian government who were interested in the project: the Prime Minister, Amintore Fanfani; the Minister of Foreign affairs, Antonio Segni; the Minister of Defense, Giulio Andreotti; the Minister of Industry, Emilio Colombo; the Minister of State Holdings, Giorgio Bo; the Minister of the Treasury, Paolo Taviani and the Minister of Budget, Giuseppe Pella.

According to Segni, who said it was preferable to use a pro-European view, and use the 'Blue Streak[88]' the launcher proposed by the United Kingdom to the nascent European space organizations. The position of cooperation with the Americans prevailed, however, supported by, among others, Andreotti[89]. In January 1961 the Commission approved the San Marco Project for an initial three-year funding 1961-1963.

Although the agreement was a step away from its conclusion, a problem arose that, cleverly, was overcome thanks to Broglio. It was decided that the nature of

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87 Defined as "The Space Major" Giorgio La Pira was a Democratic Christian (DC) politician, a leading member of the left wing of the DC party. He was Mayor of Florence with two terms: 1951-1958; 1961-65. He supported Broglio in all of his ideas and projects.

88 Before the Blue Streak became the first stage of the European launcher 'Europa 1' it was a medium-range ballistic defense missile (3 000 km) using liquid propellant for military use, which should have replaced the V bomber. In British service the missile was designed by de Havilland Aircraft Company and Rolls Royce provided the rocket engines. An advanced technology was required for its development that increased the cost dramatically, leading to the cancellation of the program.

89 Caprara Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Bergamo, 2012, pp 143-144

cooperation with NASA should be scientific and only for scientific research. In this case the Americans would make the launcher available that was required by Italy to complete the Project. Broglio did not initially count this option, because for him and his team the real purpose was to get something into space. Broglio was able to perfectly interpret the time and what they were looking for from the major competitors in the space race. The United States and the Soviet Union in fact had researched the composition and properties of the upper atmosphere. The Engineer-Professor launched the question, creating a tool of scientific detection that was able to register wind attrition suffered by bodies fired at those altitudes[90]. Broglio invented a tool to insert inside the satellite and he called it *Bilancia Broglio*[91]. Luckly the Americans were looking for a solution and Broglio, casually, suggested it to them[92].

The bilateral agreement with CNR and NASA was signed in Washington in April 1962, and those between the Governments of Italy and United States were signed in Rome the following September. The United States Government was represented by Vice President Lyndon B. Johnson in person who, on this occasion stopped in Italy as part of an official visit to the main Mediterranean countries. Lyndon Johnson, as well as the Vice President of John Fitzgerald Kennedy, was also chairman of the United States Space Council. The Minister of Foreign Affairs, Attilio Piccioni, signed the agreement as representative of the Italian Government. The memorandum of understanding[93] was signed in Rome on 5 September 1962 to establish a satellite launch to study the characteristics of the atmosphere and ionosphere in an equatorial orbit, an area hitherto unexplored. The agreement provided that the San Marco Project would be developed in three phases: in the first there would be testing of the satellite's scientific

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90 Di Bernardo Nicolai Giorgio. *Nella nebbia in attesa del sole*. Di Renzo Editore, Rome, 2005, p. 61.

91 The satellite was composed of a light, spherical outer shell. All the basic tools were mounted on a disk and the '*bilancia*' linked the internal disk with the outer shell. With the external aerodynamic force acting on satellite, tended towards restraint: the balance measured the value of the displacement of the internal disk thus giving precise and instantaneous information on the aerodynamic drag encountered.

92 Caprara Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Bergamo, 2012, p. 147

93 Full text of the Memorandum of Understanding on related to the San Marco project is available as Annex 2

instrumentation with a launch of a probe-rocket. A second phase when the satellite was placed in orbit around the Earth launched on a Scout rocket from the American base on Wallops Island in the east coast of the United States, and the third and last phase when the San Marco satellite was launched into equatorial orbit on a Scout Rocket from the mobile platform anchored off Kenya. NASA donated the rockets and trained Italian technicians for the launch in exchange for the scientific location[94].

The Broglio team began to work on the satellite, which was developed by all professors that taught at the Engineering School of Aerospace, directed by Luigi Broglio. They were: Michele Dicran Sirinian, a young man of Armenian origin, that worked on platform development; Carlo Arduini, the specialist for satellite dynamics and the one who was responsible for its management in orbit; Giorgio Ravelli, the telemetric and electronics expert; Ugo Ponzi the builder of the *Bilancia Broglio* and Carlo Buongiorno who acted as program coordinator and Broglio's right-hand man.

Despite the help of the Americans, Broglio's dream was to be able to give Italy a completely independent access to Space. To achieve this, having already begun the work on construction of a station for space launches, work was fully managed by CNR and the University of Rome. Another essential element was lacking, however, a launcher that would be able to carry payloads to space. Since 1957, Broglio, had attempted to convince the Italian industries to create at least a sounding rocket.

He turned first to the BPD for solid propellant rocket, but they declined the opportunity, he then turned to Italian Contraves[95] for a launcher using liquid propellant. The industry, founded in Rome, started to build a rocket that exceeded

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94 Caprara Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 157-159.

95 Contraves Italy, founded in Rome in 1952, produced low-range missiles for NATO countries and radar systems in the defense field. It was a branch of Contraves AG, a Swiss industry, founded in 1936 by Fritz Fisher and Max Lattmann, that built precision mechanics, optics, measuring instruments, satellites and the space shuttle. In 1993 Italy Contraves merged with Oerlikon Italy creating Oerlikon Contraves.

all the experiments, but was not the first to officially fly, as it exploded in the air over Guidonia, before the eyes of the Chief of Staff of the Italian Navy[96].

Another occasion to create an Italian launcher arose during the meeting when Luigi Broglio was invited by the American Ambassador in Italy, James David Zallerbach, to his residence at *Villa Taverna*. Present at the meeting was the United States Senator, Victor Anfuso, who was in Italy for a series of meetings with the Italian Prime Minister, Fanfani. The senator proposed that Broglio, Carlo Buongiorno and Giovanni Polvani, the president of CNR, who had all taken part in the special dinner and had been invited by Ambassador Zallerbach, should be invited to build a special three-stage rocket-launcher together with the United States, which would use liquid propellant and would be more advanced than 'Scout'. This launcher would be built within a commercial partnership between the American industry United Technologies Corporation (UTC) and FIAT.

The proposal was well received both at the institution and by Italian industries, but while it was formulating, so, overnight, it demised and all came to nothing[97]. So it was decided that the Scout-rocket launcher that was already on the market would be used to launch the San Marco. This was an American military rocket that was selected and to which was added another stage to increase the transportable weight and to increase the altitude to which it could go.

The technicians were selected to manage launch operations, and the choice fell on the group of experts from the 36° Strategic Interdiction Air Brigade[98], which had

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96 Di Bernardo Nicolai Giorgio. *Nella nebbia in attesa del sole*, Di Renzo editore, Rome, 2005, pp. 70-71.

97 Caprara Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, pp. 133-134.

98 The reaction of European States following the Soviet launch of Sputnik, was of great fear. The allied nations of the United States asked the Eisenhower administration for additional guarantees for European security. Americans reacted providing NATO with several medium-range nuclear missiles that, in case of threat, could strike Soviet bases only, however, if launched from polygons installed directly on site. When in Italy, following the elections of 1958, a government leaded by Fanfani was formed, Italy and Turkey strengthened, with an exchange of notes, the willingness manifested one year earlier during a meeting of the Atlantic Council to install some nuclear missiles. Americans placed Jupiter missiles, but nuclear warheads remained separated and under exclusively control by American military, as the McMahon Act did not provide for any exception in this regard. Jupiters were placed into the airport of Gioia del Colle, Puglia and their management was entrusted to the 36° Aerial

been founded in 1960 at the 'Antonio Ramirez' airport at Gioia Del Colle in Puglia. This Brigade had been trained by the Americans in the use of their Jupiter nuclear missiles, and had been dissolved in 1963 in accordance with the US-Soviet agreement to end the Cuban Missile Crisis. Eighty people were chosen, including those with technical and military expertise, to receive the necessary training at NASA facilities so as to ensure the smooth launch operations of the San Marco Project[99].

Meanwhile, at the aero-space research center on Via Salaria, Rome, in the first half of 1963, the construction of twelve specimens of the San Marco Project had been completed, two destined for experimentation on the ground where they were assembled. The ground trial, however, was insufficient for the *Bilancia Broglio* because, in order to be tested and proven, it needed to be launched into orbit.

The launch of the first San Marco prototype was carried out on 21 April 1964 from Wallops Island, using a powerful rocket named 'Shotput', but it failed because of an ignition problem during the second stage. The second launch went well and permitted the first experimentation with the *Bilancia Broglio*, which recorded data on the density of the lower atmosphere known as the 'Standard Atmosphere' between 100 and 300 km. Testing on Wallops Island was performed

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Brigade of strategy interdiction established by order number 1406/253 signed by the Deputy Chief of Staff of the Italian Air Force, General Pasti. The brigade was divide into four units and put under the command of Colonel Edoardo Medaglia. It received training in the US territory directly from the US Army. The Brigade remained operational until 1963, when its Jupiters were dismantled following the US-Soviets agreements following the Cuba Crisis. At the time of closure of the Brigade it had 1134 officers and NCOs and 1309 airmen. As there were nuclear missiles, which were potentially dangerous, the choice of hosting the Jupiter was dictated more by political then strategic-defensive reasons. The missiles installed at Gioia Del Colle were, in fact, a weapon that was certainly outdated in comparison to modern Polaris missiles. Unlike Jupiter, which had to be mounted in a vertical position and were, therefore, visible to surveys, the Polaris were positioned inside nuclear submarines. Owning the Jupiter still gave Italy a more important position inside NATO. To study the history and the role of Italy in Jupiter see: Mariani Antonio. *La 36^ Aerobrigata Interdizione Strategica 'Jupiter': Il contributo italiano alla Guerra Fredda.* Aeronautica Militare- Ufficio Storico, Rome, 2003.

[99] The members of the 36° Italian Air Brigade strategic interdiction were sent to the NASA Langley Research Center; Goddard Space Flight Center of Greenbelt near Washington; Wallops Island base on the east coast where they studied launch modalities and in Dallas, Texas in the headquarters of the industry that produced the Scout rocket, Chance Vought.

from the Santa Rita[100] platform, which ended the first phase cited as part of the Memorandum of Understanding with the United States.

Once the trials were successfully completed, tests proceeded to Phase 2, the most awaited moment, the launch of the San Marco 1 from the NASA base on the eastern cost of Virginia. Concern about the proper conduct of operations, bolstered by the fact that, despite the launch being carried out on American territory, the operations and tracking of the satellite would be performed by Italians, who although trained by NASA to perform these tasks, were to carry them out for the first time ever. The stress soon turned to joy and satisfaction when, in a strong freezing wind, on the 14 December 1964[101], under the supervision of the chief of NASA, Hugh Dryden and the Italian ambassador in Washington, Sergio Fenoalta, the Scout rocket carried a metallic sphere measuring 66 cm into space that bore the name of the Saint who was the protector of maritime missions, into an orbit of 846 km above sea level at the farthest point. Only a few minutes after launch, however, there was the impression that the San Marco had been lost when, for what turned out to be a mere miscalculation compared to the fixed time, the satellite disappeared from the control center at the receiving base set up in Capo Pachino, Sicily. All these concerns were forgotten when Woomera station in Australia confirmed that the San Marco had in fact reached orbit[102].

The President of the United States, Lyndon Johnson, complimented the Italian people and the San Marco team for the successful launch, and for being the first of a nationality other than the Americans or Soviets to put a satellite into orbit. Even Arnold Frutkin[103] who, during the launch phases led an American mission to supervise operations, complimented the Italian team asserting that to realize what

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100 The construction of the Santa Rita platform and the realization of the Italian test range are detailed in the Paragraph 2 of this Chapter, on page 68

101 The launch operation can be found in the "Press Kit" Annex 3

102 Caprara Giovanni, *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, pp. 168-170.

103 Born in New York on 30 November 1918, Arnold Frutkin was the Deputy Director of the NASA international programs office between 1957 and 1978. In that year he become associate administrator for external relations for NASA, a position that he held until his retirement in 1979.

had been accomplished by Italy in two years, NASA would have had to have worked for at least fifteen[104]. Italy thus became the fourth nation after the United States, the Soviet Union and Canada to launch an object into space.

This was a success for Broglio and his team that was not ignored by other states, but for the aeronautical engineer the launch from Wallops Island was only the first stage of a project having as its prestigious final objective to give Italy complete independence in space launches. To do this, starting with an already tested launch team, an Italian launch base was required that Broglio had already been assembling and, after a few years, was to see the launch of the second San Marco satellite.

The CNR, which financed the San Marco project from 1964 to June 1967 with 4.5 billion of Lira, managed the project on the basis of an ad hoc law promulgated by the former mayor of Florence, Giorgio la Pira. After 1967 the San Marco project was transferred to the control of the University of Rome.

Despite the fact it would be impossible to use *Salto di Quirra* to launch a satellite into orbit, Broglio did not admit defeat and he indicated a new revolutionary solution; an equatorial base on a platform at sea. At the time the idea was revolutionary, because no one possessed an installation to make space launches in the equatorial zone, and to have a launch base at grade zero offered several advantages.

The first of these is that it is not necessary to perform additional maneuvers to place the satellite perpendicular to the equator, because any satellite orbit must, necessarily, pass along the vertical[105], being able to launch in all directions. A second advantage is saving propellant, by using a higher terrestrial speed on the equator, another was that only one base would be required to follow the satellite

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[104] Di Bernardo Nicolai Giorgio, *Nella nebbia in attesa del sole*, Di Renzo editore, Rome, 2005, p. 74

[105] For example from Cape Canaveral, the place from which the United States launches its satellite, is located 28° on North, so orbits may be obtained by sloping from 28° to the perpendicular.

and to collect data and give orders[106]. Finally, climate conditions on the Equator are good every day and the equatorial orbit has some advantages over problems that may be caused by the Van Allen belts[107]. This, coupled with the location of the low equatorial orbit at 550 km, was one of the major advantages that a launch based in the equatorial region provides.

The idea of an equatorial launch base was already startling, but Broglio amazed everyone another time by accepting a proposal by the coordinator of the San Marco project; one of the most gifted men of his team, Carlo Buongiorno, who was an engineer. Buongiorno had studied in Italy and the United States and was responsible for the organization of the rocket-vector, platforms, satellite and the group management of the University of Rome; he was a military aviation engineer at the CNR microwave center, where a scientific detection instrument was being prepared for inclusion within the satellite. Buongiorno proposed placing the launch station, not on land, but on the water on a platform moored off the coast.

There were benefits to having a space launch station on the water that sealed the advantages of having an equatorial orbit. This was because the positioning of the base on water allowed money to be saved on the entire construction and commissioning of the plant road that would have been necessary for the transport of materials and would not be required. Good maintenance infrastructure is, in fact, absolutely necessary in the case of a land base, because it must minimize any shock that could damage delicate equipment such as satellites and all the necessary equipment for the launch and early orbit[108].

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106 Di Bernardo Nicolai Giorgio, *Nella nebbia in attesa del sole*, Di Renzo editore, Rome, 2005, p. 42.

107 Regions where protons and electrons are focused. They were discovered by the American physicist James van Allen, after analysis of the data transmitted by the satellites Explorer I and II.

108 In 1964, immediately after the construction of the *Centre Spatial Guyanais* by CNES, France had to rebuild all the infrastructure and road links near the space center.

2. San Marco 2 - The beginning of Italian Equatorial Space Launches

Once set, the secure advantages offered by a space station in the equatorial region, with the support of the military and the CNR, Broglio and his team began looking for the most suitable place to install the base. They were initially considering three equatorial states Somalia, Kenya and Brazil. The latter was soon discarded because of the excessive distance to Italy and the high costs that would have been incurred transporting the material across the ocean; moreover the climate in the rainforest region did not prove to be the most suitable for a satellite launch. The possibility of a launch base off the coast of Somalia was scrapped following opposition from the United Nations Security Council. The State of East Africa had achieved formal independence following expiry of Italian trusteeship of the country[109] and the United Nations Organization had opposed, for fear that installation of missiles and other potentially hazardous materials, could destabilize this delicate area[110].

In the end, Kenya was chosen for reasons of proximity and climate, unfortunately there were problems there also; one was linked to the political situation. The government of the former British colony was an expression of a national pact between the leaders of the two major tribes; the Government was lead by pro-Western Jomo Kenyatta[111] and the Vice President, a communist, who was pro-China[112]Odingo Ginga. To create further problems of geopolitical integrity in Kenya, formally independence was granted only 20 days before the close of

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[109] The Italian Trusteeship Administration on Somalia started on 21 December 1949 when the General Assembly of UN decided to give the Country under the Italian Trusteeship Administration. Formally Italy began to administrate Somalia from 1 April 1950 after the ratification by UN of the resolution number 442, until 1 July 1960.

[110] Caprara Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 150-151.

[111] Jomo Kenyatta, born Johnstone Kamau was the first President of Kenya, governing from 1963 until his death on 22 August 1978. He graduated in London with a thesis on the organization of his tribe the *Kikuyu*. He contributed actively to his country's struggle for independence from Britain, against which he struggled both in both word and deeds. His administration was constantly surrounded by excessive nepotism, awarding the most important administrative positions only to relatives and members of his tribe. Odingo Ginga, at the beginning his Vice Presidency, later said of him: 'He was an enemy much more ruthless and inhuman then colonialism against which we fought'

[112] Di Bernardo Nicolai Giorgio. *Nella nebbia in attesa del sole*, Di Renzo editore, Rome, 2005, p. 51

bilateral agreement with the Italian Government, which increased concerns over the massacres of Arabs on the Island of Zanzibar[113], off the Kenyan coast[114]. This background contributed to increasing tensions in Kenya, which is a state having a Catholic majority surrounded by Muslim countries.

To avoid further destabilizing the situation, and out of fear that the Soviet Union would oppose the transport of potentially dangerous rockets, it was decided to hold a press conference where the San Marco Project would be explained in detail, along with the tasks. This was to test the Soviet reaction, and to avoid triggering a possible negative reaction. Soviet newspapers and Russian public opinion did not manifest opposition to the Project, so the preliminary agreement was signed between the University of Kenya and Rome, followed by a partnership agreement between the two governments.

The final point to complete the revolutionary space travel of San Marco remained the procurement of the platform to moor off the Kenyan coast, from which to launch the scientific satellite. Once again the situation was unlocked by Carlo Buongiorno, who proposed that Broglio to launch the satellite from a marine platform. In this period there was the inauguration of the new oil platform 'Perro Negro[115]' and Carlo Buongiorno proposed that Broglio meet Enrico Mattei[116].

The head of ENI himself invited Broglio to the inauguration at Massa Marittima, Pisa. There Broglio explained his project to Mattei and after he refused to allow

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113 Former domain overseas and holiday residence of the Sultans of Oman from 1698 to 1861, Zanzibar was a British protectorate until 1960. The Island proclaimed formal independence in December 1963, but a month later, a black Kenyan sheikh, named Karume, leader of the main opposition party, backed by the Christian black population on the island. He overthrew the Sultan Jamshid bin Abdullah, resulting in the slaughter of Arabs.

114 Di Bernardo Nicolai Giorgio. Id. p.53.

115 Literally 'Black Dog'. The reference to the symbol of the six-legged dog, the ENI logo, is evident.

116 Enrico Mattei, parliament member from 1948 to 1953, was the architect of the reconstruction of the AGIP industry. Instructed by the government to dismantle the company created in 1926, he reorganized and founded ENI (*Ente Nazionale Idrocarburi)* in 1953. He died in a plane crash in 1962

free use of the Perro Negro platform, ENI's CEO presented the Scarabeo platform for use without cost, which at that time was anchored off Egypt[117].

The platform, renamed: 'Santa Rita[118]', departed for Kenya on 21 December 1962, towed by a tug-boat, it did not travel quietly. At a certain point while crossing the Suez Canal during a raging storm, fearing the worst, sailors cut the cables that held the platform to the ship. Fortunately, as soon as the storm had passed, the Santa Rita was reattached and, in February, reached its destination at the port of Mombasa. The platform was docked in the Formosa bay at 2.4° south of the equator in front of Ras Ngomeni and Malindi, three miles from the coast. Once moored, the ground support equipment was constructed, such as electrical and mechanical equipment required to for the launch, starting from drawings of the machinery used by NASA for maintenance of its launch bases[119].

A lump sum was provided at the last moment of a tender for staff accommodation, which had previously been rented, combined with the refusal of the Italian Navy to provide a new ship. It was decided that accommodation would be prepared on board the Santa Rita, which resulted in huge savings.

The first experimental launches from Santa Rita were made from 25 March 1964 with a Nike rocket, experiments were performed that were similar to those conducted in Sardinia and on Wallops Island[120], with a single difference that, as payload, there would be equipment that could be inserted inside the San Marco satellite. In particular, these instruments were designed to carry telemetric and temperature surveys. A launch test of the satellite with the probe rocket Shotput was expected to take place prior to the launches using Nike. It was cancelled,

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117 Caprara Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 158-159.

118 Luigi Broglio dedicated the launch platform to *Santa Rita*, the Holy Protector of the impossible missions.

119 Di Bernardo, Nicolai Giorgio. *Nella nebbia in attesa del sole*, Di Renzo editore, Rome, 2005, pp. 67-68.

120 The American base on Wallops Island was one of the first launch sites in the United States. It was built by Langley Aeronautical Laboratory in 1945 as an experimental center for test rockets. After the creation of NASA it was controlled by the Goddard Space Flight Center, which began various scientific programs for human flight.

however, because of political instability in some African countries, meant that moving a rocket into such a place could have been very dangerous.

Despite the smooth operation of all flight tests carried out from Santa Rita, problem solving was not over. Although the platform was fully operational to host Nike rocket launches, some concern was placed on the size of the triangular layout of Santa Rita, which was judged insufficient for boosting the larger and more powerful Scout rockets. The idea of launch again the San Marco 2 from Wallops Island was discarded. So Broglio and NASA decided to use mobile rectangular columns after discussion at the Langley Center. They decided to broaden the base of the platform where launching of the powerful American rocket would be initiated.

NASA had spotted the columns in a US Army base. The army had crammed them in while waiting to find a new use after they had been utilized during the Normandy invasion in 1945. The American space agency was able to obtain a 90 x 27 m platform that stood on 18 legs, and this was placed at the disposal of Broglio's team. The mobile platform was renamed 'San Marco' and after readjustment, it reached Santa Rita on 5 May 1966, and was docked 570 miles (917 km) from the launch platform[121].

The final step for completion of the construction of the Italian equatorial space station was achieved in 1966. The 'San Marco Equatorial Range', a base camp of more than 3 ha, with numerous facilities that had originally belonged to the 36° Air Brigade in Puglia. The base was connected by a road with Malindi and to Kenyan phone lines; infrastructure included a satellite receiving station, electric power generators and purifiers for drinking water.

The last of the three phases of the Memorandum of Understanding was about to be accomplished. In March 1967 a ship arrived from the United States that delivered the various stage of the Scout rockets and, in the same moment San

[121] Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 164-165.

Marco 2 arrived from Rome[122]. The preparatory work began in mid-April with the start of testing the launch systems. A few days before the launch it became clear that it would be impossible for the CNR to finance the final phase of the project because of a law that transferred project management to the University of Rome. This caused a problem in the financing of the last phase of the San Marco Project and the launch date had to be delayed. The stalemate was overcome by Agostino D'Avak[123], who was then rector of the University of Rome, who loaned the amount required.

On 26 April 1967 at 11.06 am, under the apprehensive eyes of Hugh Dryden and Arnold Frutkin, the Scout carried San Marco 2 into orbit. The equipment that had been delivered by the former 36° Brigade, appeared too old. Fortunately, this concern proved unfounded, and all worked well except the clock room, which failed and forced Broglio to complete the countdown using his wristwatch. The countdown began in the early morning, eight hours before the launch. Broglio and his team received many telegrams of congratulation from the President of the Italian Republic, Giuseppe Saragat, the Minister of Foreign Affairs Amintore Fanfani and the Prime Minister, Aldo Moro. The successful launch was given considerable media prominence in many countries, certainly more so than in Italy, where journalists were on strike. Time magazine also celebrated the event on its cover[124]. San Marco 2 remained in orbit for 171 days and ended its service on 14 October 1967 when it disintegrated in the atmosphere. Broglio shared the data collected by the scientific satellite, during the Committee on Space Research (COSPAR) meeting in Tokyo in May of the same year.

The future did not hold other glorious days such as those experienced during the launching of San Marco 2 from Wallops Island. A series of difficulties began to accumulate that accompanied the project until its final days. One problem was funding, in spite of a law of 1967 that had provided for a second financing of the

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122 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, p.175.

123 Pietro Agostino D'Avack (1905-1982) was a lawyer and a jurist in the *La Sapienza* University in Rome. He was rector of the University between 1967 and 1973.

124 Di Bernardo, Nicolai Giorgio. *Nella nebbia in attesa del sole,* Di Renzo editore, Rome, 2005.

project to strengthen the polygon. The most important reason for the ending of the Project was its isolation, in relation to the new realities that were arising for the space program. This new resolve was to take over the field once appropriated by the United States and the Soviet Union and to contest their rivalry. During each passing day, however Broglio's focused his view on the program, which was increasingly becoming 'his' creation.

Despite these limitations, for many years, Santa Rita remained a cutting-edge facility and was the envy of many nations. Activities at Santa Rita did not end with the launch of San Marco 2, but continued with the help of other nations, and the most valuable ally in the emergence of the Italian space era, the United States of America.

3. From San Marco 3 to the end of the Santa Rita Space Launches

To congratulate and celebrate the success of San Marco 2, James Webb invited Broglio and his right-hand man Carlo Buongiorno, to Washington in September 1967. The congratulations were not the only reason why the two engineers were invited. NASA seized on the opportunity of discussing what an installation such as Santa Rita could offer, and NASA requested permission to use the Italian equatorial base to send a scientific satellite into orbit. In exchange the American space agency offered Italy the supply of its Scout rockets and promised adequate reimbursement to the University of Rome, which managed the polygon. The meetings brought to close a memorandum signed in 1969 by Pietro Agostino D'Avack and NASA administrator, Thomas Paine[125]. NASA's request coincided perfectly with Broglio's vision to internationalize the Kenyan base, opening the way for all European and other countries to launch from Santa Rita. Unfortunately, despite the many projects programmed, only eight launches were allowed, three Italian (San Marco 3-5), four by NASA and one for the United Kingdom[126].

The winds of Space politics, at that time, were blowing in a different direction compared to that of launches with scientific tasks. The will of the new Space Research Commission was, in fact, to use its funding for the new project being presented by Professor Francesco Carassa[127], rector of the Milan Polytechnic, which was the Italian Satellite for Industrial and Operative Research (SIRIO). Broglio's refusal to support the new project led him to take refuge in 'his' San Marco. This decision led to his ouster from the presidency of the Italian Space Research Commission.

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125 Full text of the memorandum can be found in Annex 4

126 Di Bernardo, Nicolai Giorgio. *Nella nebbia in attesa del sole*, Di Renzo editore, Rome, 2005. p. 102.

127 Francesco Carassa graduated in industrial engineering at Polytechnic of Turin in 1949. He started his research on radio transmission, working in the Italian factory Magneti Marelli, Milan. He was appointed rector of Milan Polytechnic in 1969.

In contrast to the work conducted on the Santa Rita Platform there were international contingencies that made the Equatorial Italian launch station obsolete in relation to the standards required at that time. During these years, in fact, Europe was completing the construction of the common launcher named Ariane and all nation members of the new European Space entity were pushing to launch their satellites and payloads using the new European rocket. Ariane was too big to be launched from Santa Rita and, for this reason, international interest in launching from the Kenyan base very quickly waned[128].

Broglio continued to remain on the American side. The memorandum signed in 1969 guaranteed the San Marco base's life, at least until the middle of the 1970s. The agreement came into force when on 12 December 1970, for the first time, the Americans, using a foreign team, launched one of their satellites, the Small Astronomy Satellite. The Sas 1, was then renamed Uhuru[129], to celebrate the anniversary of Kenyan independence. Uhuru was built by Riccardo Giacconi[130], an American citizen with Italian origins.

Funding from the United States, together with the political support from Amintore Fanfani, who had been elected President of the Senate from 1968 to 1973, and Giulio Andreotti, leader of the Christian Democrat deputies to the Parliament , allowed Broglio to continue his research and activities. Support and financial aid permitted the construction of the San Marco 3, which was a heavier satellite than its predecessor because, in addition to the *Bilancia Broglio*, it contained two scientific tools built by the NASA Goddard Center and the University of

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128 Di Bernardo Nicolai Giorgio. *Nella nebbia in attesa del sole*, Di Renzo editore, Rome, 2005, p. 105

129 The Uhuru satellite, a small 64kg satellite, built in the Applied Physics Laboratory at John Hopkins University, was launched from Santa Rita and became the first satellite to draw the celestial map of X sources in the Universe. It measured intensity and variability, detecting a dimension of the cosmos hitherto unknown. At the end of its service, in March 1973, it allowed for the cataloguing of more than three 300 previously unknown star systems, including binary stars, the remains of supernova and Galaxy clusters.

130 Riccardo Giacconi, the 'father' of the Uhuru satellite, emigrated to the US in the 1950s after graduating from the University of Milan. In the US he took American citizenship, and became an astrophysicist. He was the first person to discover a black hole, a cosmic source of X-rays that he named SCO x-1, in 2002. He won the Nobel Prize for physics with Raymond Davids Junior, also thanks to discoveries made with Uhuru, and then became the director of the Hubble Space Telescope program.

Michigan, to measure the composition of the upper atmosphere and the distribution and temperature of nitrogen molecules. San Marco 3 was launched on 24 April 1971 and flown for 219 days and concluded its mission on 28 November 1971.

The Italian launch team had acquired experience in satellite launches that was envied the world over. This professionalism that had, within a very short time, been achieved during both the launch of San Marco 3 and the American satellite SSS1[131] to analyze the magnetic field in the Van Allen Belts, prompted NASA to present an award for the 'Best launching team of the year'[132]. The prestige of the Italian base was increased further by the visit of the 'father' of the first guided missiles, the creator of Saturn V, the powerful launcher that enabled the United States to land on the moon only two year before, Wernher von Braun.

Despite the additional prestige that the Italian launch team gained, the tensions within the Italian Space Research Commission and CNR increased, and came to a point of no return. With the new funding received, the Commission began, from the end of 1971 to 1972, to launch sounding rockets for several experiments into the upper atmosphere to detect the star sources of x-rays. After a first launch with a Nike Tomahawk rocket in November 1971, five more launches followed using Nike Apache rockets, all carrying equipment built in the laboratory of the Centro Ricerche Aerospaziali (CRA). The final conflict occurred when Edoardo Amaldi[133] proposed that Broglio follow a research plan to study cosmic physics more broadly. This was refused by Carlo Buongiorno and Giorgio Ravelli, who were already working to perform these tasks by the *Bilancia Broglio.* The unilateral vision of Broglio was past, even more so it became evident that there was a rift between those working on the San Marco project and the Italian

[131] "Small Scientific Satellite"

[132] Caprara, Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, p.187.

[133] Member of the *Ragazzi di Via Panisperna* a group of students including Oscar D'agostino, Emilio Segre, Franco Rasetti and Enrico Fermi, Edoardo Amaldi offered a considerable contribute to the study on subatomic elements of stuff realizing, in Frascati, near Rome, the first particle accelerator in Italy. Professor of experimental physics for over forty years, he contributed also to the creation of the National Institute of Physics (INFN), the European Center of Nuclear Research (CERN) and the European Space Agency (ESA)

scientific community. This further reduced the possibility of creating a national space agency such as NASA or the French CNES.

The clash with the opponents of San Marco became fiercer when, on the eve of the launch of SAS 2, which was a satellite built by NASA that was released into low orbit to map the cosmic sources of gamma radiation, there was an anonymous complaint that initiated an audit by the Italian General Prosecutor of the Court of Accounting in June 1972[134]. After two months, during which the Inspector analyzed all accounts related to the Aerospace Research Center, nothing was discovered and the investigation was archived.

Three years after the launch of the San Marco 3, Luigi Broglio's project continued with the launch of San Marco 4, which was an identical copy of its predecessor. The new satellite, in fact, carried the same tools built by the NASA Goddard Center as well as the inevitable *Bilancia Broglio.* San Marco 4 was launched in February 1974 and was operational until March 1976. The internationalization of the Kenyan base was completed with the launch of a British satellite UK-5, which had been made possible after the signing of an agreement with the British Research Council, on 15 November 1974. Six month later another American satellite was launched, SAS-3 and this ended, definitively, the launch activities of the Space agency. From that moment on, the base near Malindi, that five years before had been a miracle in terms of advanced technology, fell into an abyss from which it never again emerged.

In order to revive the San Marco Project, Luigi Broglio attempted to complete his ambitious original project intended to give Italy complete independence in space launches. To reach this objective, an efficient launch team was already in place, as well as the base from which to launch payloads into orbit, the launcher. Broglio considered the construction of an Italian version of the Scout rocket that would be more powerful than the American rocket, which had allowed San Marco satellites to reach orbit. The 'San Marco-Scout' as he called it, should have been an Italian

[134] Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 191-192.

launcher built under American license. It was to have had added auxiliary power units to fit into the rocket built in the United States.

The American company, LTV, which had constructed the rocket had declared itself in favour of the project, but, once again because misunderstandings this ambitious project failed. The motivating factor was Broglio's annoyed response to NASA's refusal to launch the pair of scientific satellites, one in low and the other in high atmosphere, to study the effects of the solar wind better between the various levels of the atmosphere using the San Marco-Scout launcher, as planned by the aeronautical engineer. Broglio's response concerning the 'San Marco D[135]', as the pair of satellites were named, led NASA to declare themselves uninterested in the San Marco-Scout project, and refused to issue the license required for construction of the rocket.

This is the official version why this Italian project, aimed to give independent access to Space, failed. Another reason has to be linked with the refusal of the Italian industries to realize the San Marco-Scout, following Broglio's requests. Even today shadows stir on this lost occasion. Rumors are related to a secret agreement between France and the Italian industries aimed to avoid the realization of a national launcher, competitor for the French one, developed jointly with other European countries. There are no evidences and documents able to attest this hypothesis, so remain a simple rumor[136].

Broglio's repeated detachment, his ignoring of the already accrued developments in European space activities and, more generally, the evolution the space sector was undergoing, brought his historic right-hand man, Carlo Buongiorno, to abandon the San Marco Project, and to begin more intensive activity as Director

[135] The San Marco D was proposed to Carlo Buongiorno by the NASA administrator Arnold Frutkin who, after the launch of the British satellite UK-5, was invited to the Goddard Space Center with Giorgio Ravelli to discuss the plan. The two went to Maryland in early 1975 and discussed a cooperation plan between the Italian and US Governments. A memorandum was prepared, but Broglio's backlash stopped everything and the project ended before it began.

[136] It seems that correspondence with Broglio and some exponets of European organizations of Space, still existed at Broglio's death, but was lost shortly after. Author's interview with Giorgio Di Bernardo, Rome, 25 September 2015.

of aerospace propulsion at *La Sapienza* University[137]. The San Marco-Scout project was definitively cancelled by Comitato Interministeriale per la Programmazione (CIPE) after a meeting on 29 January 1981.

San Marco 5 was launched in the night on 25 May 1988, watched by Broglio, who at that time was 77 years old. This launch permanently marked the end of a project that had led Italy to the stars. Until the final act of the San Marco project, Broglio remained isolated within the confines of the University, continually rejecting links with the industrial world, which had become a reality in the field of space. Broglio's, as 'head' of the Italian space program continued to refuse to 'wear legs' and the industrial sector continued to become stronger and lighter than those who remained attached to the Italian academic world linked to the Wallops Island launch.

The San Marco project finally ended, along with Broglio's space adventures. He was a man who certainly deserved the credit for taking Italy out of a state of backwardness, and who compensated for the tremendous delay in research, science and technology experienced by the defeated nations of the Second World War, Broglio carved out a role of primary importance in the field of aerospace.. Despite his initial undisputed foresight, Broglio was unable to get over his solitary vision and the purely personal concept that he had of space. Broglio remained anchored to the pioneering phase of the Italian space sector, he never realized how fast the sector was being changed by new challenges, or that space was increasingly being disengaged from the rivalry of the Cold War, and was taking a new direction that was increasingly independent.

To further aggravate the position of the 'Italian von Braun', there was also the continuing insistence of Broglio to request an increase in the funding that was being allocated to the San Marco project. In the end, CNR preferred to allocate funding to the technological development of Italian industry, which was

[137] Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 195-197.

struggling to find productive and competitive involvement at the European level[138].

Broglio's detachment, however, prevented what had already taken place in most European countries, the convergence of focus created a single vision that combined the spatial intent of academia with that of those operating in industry. In Italy two separate worlds existed that did not, except on rare occasions, join forces and ideas in shared space programs. While Broglio continued to conduct 'his' experiments, Italian industry, which had gained significant knowledge in the space field, began to run to catch up with the other nations, in an attempt to fit into the new sector that, in those years, engaged every effort of European and other industries around the world to gain access to space: Telecommunication.

[138] Caprara, Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, p. 175.

CHAPTER III

The difficult dialogue between Academics and Industries
The new European concepts of Space

1. The new European Element, Space: ESRO and ELDO

The 1970s were marked by events that proved to be a turnings point in the way space was conceived. If the pioneer phase of space had, as its main theme, discovery and research in a field that had hitherto been completely unknown, the United States' Moon landing, terminated the rivalry between that nation and the Soviet Union at least in the field of space. Among the infinite possibilities space could offer, the best way to exploit the scientific know-how obtained over the last decade, thanks to work on satellites such as San Marco, was to attempt to use space for business prosper.

The conditions were changing, and after the end of the 'Space Race' space became a business, and even if there were agreements having a scientific purpose, competition expanded to include all countries that wanted to gain access to space. Each State would have to earn its own know-how because the United States no longer had any reason to provide their expertise, especially to Europe that was increasingly becoming both a market to control and a formidable competitor[139].

Europe in those years was experiencing the effects of different forms of military[140], economic and political integration. A share of common objectives expressed by the *Manifesto di Ventotene*[141] and Schuman Declaration[142]. The

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139 Caprara, Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, p. 266.

140 Indeed the project to integrate the military forces and defence systems of European nations allowed for the rearmament of the Federal Republic of Germany, but was never entered into force. The proposal suggested in 1950 by the French Prime Minister, René Pleven, supported by Alcide De Gasperi, on the creation of the European Defence Community, failed because France itself did not ratify the Treaty of Establishment after opposition from French nationalists who opposed the rearmament of Germany. Duroselle Jean Baptiste. *Storia diplomatica dal 1919 ai nostri giorni* Edizioni Universitarie di Lettere Economia Diritto, Milano, 2010, pp. 502-504

141 *Manifesto of Ventotene*, was a document written by Altiero Spinelli, Ernesto Rossi and Ursula Hirschmann in 1941, that, for the first time, proposed a federation, an European institution with a democratically elected parliament and a democratic government with real powers in economic and foreign policies.

142 The Schuman Declaration was issued by the French Foreign Minister, Robert Schuman. He proposed the creation of the European Coal and Steel Community, whose members would find common policies for the production of coal and steel, in an attempt to prevent another

result of these declarations was established by the European Coal and Steel Community (ESCS)[143], which brought together the Benelux countries, Federal Germany, France and Italy to find common policies in coal and steel production, and then the EEC[144], which strengthened integration of the ESCS member nations, extending to all economic sectors the purpose of creating a common European market. The countries decided to strengthen integration to unite the scientific discoveries made by different European nations placing them within a common entity that would attempt to reduce delays that each nation registered in relation to the fact that the United States and the Soviet Union were the only two nations to have independent access to space.

Italy was the first European nation to launch a satellite into orbit, which gave an advantage over other countries. After the San Marco 1 launch from Wallops Island the Italian Prime Minister, Fanfani, made an official visit to meet French President, Charles De Gaulle, in January 1965. When he spoke about the Italian launch of San Marco 1, Fanfani, took the former French General completely by surprise. In fact, when the French President described to Fanfani the French project that aimed to put a scientific satellite into orbit, becoming the first European nation to do so, Fanfani told him, "It is a very interesting program Mr President, but we have already done it just a few weeks ago[145]". The news left De Gaulle in a state somewhere between dismay and disbelief. When, a few days later, the Minister of Research resigned, his reaction became clear to all. Unfortunately, Italy failed to exploit this considerable advantage that it had gained over other European nations and, in 1968, begun to direct their various realities toward common goals.

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bloody conflict over one of the subjects that had created divisions and rivalries between France and Germany.

143 The Treaty of Paris formally established the European Coal and Steel Community in 1951. It was the first international organization that joined French, Federal Republic of Germany, Italy, Luxembourg, the Netherlands and Belgium, on the production of steel and coal.

144 The European Economic Community was a regional organization created by the Treaty of Rome (1957), which aimed to bring about increased economic integration with Member Countries of the ECSC and of the European Atomic Energy Community within a common market that aimed for the free movement of goods, capital, services and people. In 1993, after ratification of the Treaty of Maastricht, it was renamed the European Community and, after the Treaty of Lisbon, it became the European Union.

145 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, p171.

The French began to overtake Italy, started precisely from this meeting. President De Gaulle, a few years later created *Centre National d'Études Spatiales* (National Space Study Center, CNES)[146], the first Space Agency in Europe. From 1961 the French parliament give its approval to the beginning of a project named *Pierres précieuses*, which had the objective of creating rockets for military applications. The most important were Emeraude, Topaze, Saphir and Diamant for civilian use, which were launched for the first time from the base at Hammaguir[147] in Algeria, thus bringing into orbit the first French satellite, Astérix-1.

The French started to research launcher development, one of the most important aspects required to gain independent access to space, the only one that Italy did not have. The project began with an advantage that Italy had not yet achieved, unity of purpose between the scientific world and industry that cooperated together to achieve common goals, a synergy that Italy was able to obtain 27 years later with the creation of the *Agenzia Spaziale Italiana* (Italian Space Agency, ASI)[148].

Unlike the situation in Italy, where all effort was concentrated in the realization of scientific satellites, neglecting launcher development, other European nations attempted to develop both, accepting the lack of know-how in comparison to the United States. In the United Kingdom, for example, space activities had begun in 1952, with a project carried out by the military, which researched both satellite development and the production of launchers able to take them into orbit. At first, a program was initiated that aimed to place a series of scientific satellites in orbit.

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146 The Centre National d'Études Spatial is the French agency with the responsibility for the management of space activities. Its headquarters is in Paris and launch operations are at the French Guyana Space Centre in Korou and the Toulouse Space Center. The current President is Mr Jean-Yves Le Gall, an astronomy engineering graduated from the *école supérieure d'optique.* From 2002 to April 2013 he was CEO of Arianespace.

147 The *Centre Interarmées d'essais d'engins spéciaux d'Hammaguir* (CIEES) was a missile launch polygon created in 1948 by the French Army and Air Force as a launch polygon for missiles and rocket-launchers. It was abandoned in 1967 and returned to the Algerian Government after the construction of the space launch base in Korou, French Guyana.

148 The reasons behind the delay were mentioned in Chapter II. The topic is also examined in Chapter IV, which is entirely dedicated to the origin of ASI.

The ‘Ariel’ program launched six satellites from 1962 to 1979; all except one were launched using NASA rockets. Launcher development began with two former military rockets Blue Streak and Black Knight. Thanks to the help of German scientists who had been captured at the end of the Second World War in 1957, the UK proposed the Black Prince, a large satellite launch vehicle. The project, however, was cancelled in 1960 because of lack of funding. A smaller rocket was produced from Black Knight: Black Arrow, which was launched in 1969 from the test range at Woomera, Australia[149]. Another important program that was undertaken by the United Kingdom was Skynet, which was an expansive space program that aimed to launch satellites for strategic communication services for branches of the British Armed Forces and NATO.

Even the Federal Republic of Germany, despite the brain drain, which had deprived the nation of its best scientists and researchers at the end of Second World War[150], began to invest, among many difficulties, in the space sector. The origin of the modern *Deutshce Zentrum für Luft-und Raumfahrt* (DLR)[151] were created in 1907 with the establishment of the Institute for Testing of Aerodynamic Models of the Powered Airship Society, founded in Gottingen in 1907 by Ludwig Prandtl, and after the end of the Second World War in 1947, with the foundation of the Society for Space Research.

The Treaty of Paris in 1955 ended the Allied occupation of German territory and returned full sovereignty for domestic and foreign affairs, granting freedom to begin research in the field of space. Unlike other nations, the Federal Republic of

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149 Prospero X-3 was launched using the British launcher Black Arrow in 1969, from the test range in Woomera, Australia, a site in use since the post World War II for the experiments of the Australian Army. A short documentary on the test range can be retrieved on: http://www.australiansatwork.com.au/rocket/rocket_sc7-8.php

150 See Chapter I page 17

151 DLR is the German Space Agency. Originally named *Forschungs- und Versuchsanstalt für Luft- und Raumfahrt* (German Institute for Development and Research of Avionics and Space Flight) it was founded in 1969, after merging three centers: The Laboratory of Aerodynamics, the German Laboratories for Aviation and the German Institute of Research for Aviation. The name was changed in 1997 after another merger with the German Research Institute for Aviation and Space Flight and the German Agency for Space Investment. For more information see http://www.dlr.de/dlr/en/Portaldata/1/Resources/documents/2012_1/The_DLR_GB.pdf

Germany did not initially develop its own independent space policy, but began research and projects in bilateral cooperation, especially with France and the United States, within broader European projects. Specifically, experience was placed in rocketry with the help of young scientists, and those who had returned to the motherland. The first official institution for rocket research was the Stuttgart Technical Academy[152], established in 1955.

Soon it became clear that, individually, every single European nation would not to be able to achieve the level of know-how retained by the United States and the Soviet Union. After the International Geophysics year, held at the end of 1958, European countries began to express their interests, pushing for the creation of a common organization in which to join forces so as to better keep up with the discoveries being made by the United States and the Soviet Union. The decisive impulse came from two people, who were already responsible for another great exploit, the creation of the European Center for Nuclear Research in Geneva (CERN). They were the physicists Edoardo Amaldi and Pierre Auger[153]. Amaldi wrote a document entitled: "Space Research in Europe"[154] addressed to European personalities[155] in which he explained the necessity of building a common platform from which to launch satellites[156] into orbit. The document specified that the common project should be created without military intent. Amaldi's hopes were partly neutralized after a meeting held in London when British delegates proposed the creation of a common launcher starting from the former military rocket named Blue Streak[157]. Amaldi refused the proposal as labeled as

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152 See *Luft-und Rahumfahrt* , autobiography of Koelle Heinz Hermann

153 Pierre Auger was a nuclear physics, who was born and died in Paris. Like Amaldi, during his career he studied cosmic rays, discovering their constancy over time. With Amaldi he collaborated at CERN and also contributed to the creation of ESRO.

154 Madders Kevin: *A New Force at a New Frontier Europe's development in the space field in the light of its main actors, policies, law and activities from its beginning up to the present*, Cambridge University press, Cambridge, 1997, p. 30

155 The personalities in question were: Cornelis Bakker, the General Director of CERN; Etienne Hirsch, the President of the Commission of EURATOM and Francesco Giordani, the president of the CNR.

156 Caprara, Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, p.207.

157 With the proposal, British delegates also presented the project to readapt the Blue Streak missile thanks to various agreements with the Britain companies of 'De Havilland', Rolls-Royce and the American 'Convair' for engine building.

'too British'. From that moment the Italian delegate for the following meetings become Luigi Broglio.

Amaldi's incentive was not unheard and, at end of November 1960, scientific and government delegates from many European countries met in Meyrin near Geneva, Switzerland to follow up. The meeting produced the start of the first of its kind European collaboration in space: the European Collaboration in the Field of Space (COPERS)[158]. The occasion was good for beginning to talk about the common European Space launcher. The majority of the delegates rejected the Britain proposal for the creation of an 'only English' launcher, so Britain accepted the French proposal to create a launcher with stages built by different nations. The launcher project provided the first stage composed of Blue Streak, and the second by the French rocket *Coralie*[159]. Subsequent discussions added a third stage to the launcher and Germany proposed building it. The initiative also had the aim of curbing the brain drain to the United States and to halt its flow[160].

The terms of the project were decided upon in Strasbourg. Carlo Buongiorno was the Italian representative at the meeting. On this occasion, it became clear that other countries would soon overtake Italy. Indeed, while French, Germany and the United Kingdom went to that meeting with strong support from their respective industries, Buongiorno went without the support of either industry or the political sphere. The clash with Broglio and Italian industry became, in fact, increasingly evident and continuous as Broglio refused to seek dialogue with industry. This left Italy, at that and subsequent meetings, in a position of inferiority. Carlo

158 An high level meeting with scientists and European government representatives was held in Meyrin, Geneve. A Commission was approved, aimed to study the possibility of cooperation in the space segment (European Collaboration in the Field of Space - COPERS) http://www.esa.int/ita/ESA_in_your_country/Italy/1964-2014_cinquant_anni_di_cooperazione_europea_nello_spazio

159 In reality, as well as to prevent the new European organization becoming too British, France proposed the use of its rocket Coralie to try to recoup the costs of another military launcher, the rocket Eméraude, which belonged to the same series of rockets named: 'precious stones'.

160 Amatucci Bruno, Luciano Ragno. *L'Italia nello spazio prima e dopo SIRIO*. Fratelli Palombi Editori, Rome, 1978. p. 35.

Buongiorno, in remembering that meeting said, "I felt like an ant among elephants[161]".

During the meeting, however, the scientific value of the project was not dealt with, as opposed to what had been desired by Amaldi, and it became clear that it would be impossible to create a single European entity that could manage all aspects, as each of the project members sought for complete independence in access to space, in addition to the scientific value of satellites launch. At the same meeting, it was decided to share new common agencies, including those within CERN in Geneva[162].

On 30 October 1961, at Lancaster House in London, a convention was formally drawn up and made law on the 29th February 1964, which created the European Launcher Development Organization (ELDO), accompanied by the foundation of 'Euro Space', a common association among the much important European industries. The Italians remained isolated and, in addition to misunderstanding the industrial world, they added the American position. It was no secret that the United States preferred to provide its own launcher, despite the fact that Europe would build one itself. This was both to prevent Europeans from competing with the American launcher, or to obtain the know-how to use one for the production of military missiles that could be potentially dangerous to the balance between the two blocks. Some time before during that same year, Italy had begun close collaboration with NASA and had tried to convince other European Countries to accept collaboration with NASA as opposed to developing a common launcher. It was the Italian Prime Minister, who called his delegate in person at the Lancaster House meeting, to tell him not to support any initiative that could indirectly damage the ongoing talks with NASA concerning the San Marco project[163].

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161 Ferrone Enrico. *Carlo Buongirono Lo Spazio di una vita.* LoGisma Editore, Florence, 2011. p.56-57.

162 The share was respectively France 20 %, Italy 19 % and FRG 10 %.

163 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, p. 216.

Indeed the reaction of Italy was also the result of a "burst of pride" to get out of the corner where it had been relegated by the other European nations. In order to try to soften the Italian position, the French proposed that Italy was important for putting the payload into orbit using the new European launcher, and relied on a topic that the French delegates knew to be very dear to Broglio. According to the agreement, Italian industry should have been committed to constructing a satellite text vehicle (STV), a satellite that would measure resistance encountered in orbit by the launcher. Italy accepted the proposal and, with some pressure from the French, German and British ambassadors, signed the ELDO convention with the other European nations on 30 April 1962[164].

The Italian Ambassador, Renzo Carrobio di Carrobio[165], was nominated as first General Secretary, he remained in that position for nearly eight years, ensuring its subsequent evolution into the ESA. The participation shares were discussed again with the United Kingdom, which had 39 %, followed by the French with 24 %, Germany with 19 % and Italy with 10 %. The choice of the location of the headquarters in Paris was the first evidence of which nation would guide the European organization: the French.

Initially the program developed a launch system that was able to put a payload weighing 1 ton into low orbit. The United Kingdom used its Blue Streak for the first stage, the French built the second stage using Coralie and Germany the third with a rocket named Astris. The Netherlands took part in the project, providing links to long distance telemetry and Belgium provided a guidance station[166].

[164] The Italian concerns about the ELDO project did not dissipate with the signing of the Convention. The ratification by the Italian Government for joining ELDO only came into action in March 1965, a year later than in other countries.

[165] Carobbio was born in Rome in 1905. He was a diplomat who served at the Consular Office in Bern, Moscow, and New Delhi and in San Salvador and South Africa as ambassador. After nomination as General Secretary of ELDO he concentrated all his energy on the creation of an integrated organization. He stayed at the head of ELDO and then ESA until 1975, contributing to its transformation into the new European Space Organization.

[166] Teofilatto Antonio. *Il Sirio e il dopo.* Rome, 2011, p. 2.

Europa 1 was completed in 1964, then began a series of test launches until 1967. All seven of the launches attempted failed. With the first three launches, only the British first stage worked, while the others failed because of the premature shutdown of the German third stage. It was understood that the know-how necessary for the completion of the European launcher was insufficient and so, while another project was being prepared for a new common rocket named Europa 2, the United Kingdom left ELDO in 1971. The reason that prompted the UK to withdraw from the ELDO Convention was because of two other reasons. One was the invitation that the US offered to the UK to leave the organization in exchange for a closer relationship on space matters. The other was dictated by political motives, in response to the continuous veto given by De Gaulle against entry of the UK into the European Common Market. Both these reasons had repercussions within the European Space Organization[167]. France, on the other hand, continued to take part in the trials[168]. Pursuant to the withdrawal of the United Kingdom, which had been the first contributor to the organization, the economic difficulties that ensued forced ELDO to resize the ELDO/PAS program under Italian management. After this decision, the Italian Government decided to stop funding the project and to upgrade the launcher, leaving France, Germany, Holland and Belgium to develop Europa 2 on their own.

The first European launcher, Europa 1, designed to send scientific satellites towards a low polar orbit (LEO) [169] needed to be upgraded to an higher level of characteristics, in order to be employed with the new telecommunication satellites and, in particular, for what Germany and France were building together: Symphonie[170].

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[167] For more information on the French veto against the entry of the UK into the European Common Market see: Peter, Mangold, *The almost impossible ally: Harold Macmillan and Charles de Gaulle*. I.B. Tauris, London, 2006.

[168] Caprara, Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, pp. 243-244.

[169] LEO, Low Earth Orbit.

[170] Symphonie was initiated as a result of collaboration between Germany and France. The two nations were building two telecommunication satellites: Saros by France and Olympia by Germany. In 1967 the two nations closed an agreement and started production of Symphonie. The Franco-German satellite was launched in 1974 from Cape Canaveral using Delta, an American rocket-launcher.

In July 1966, the Council of ELDO Ministers initiated the reorganization of Europa 1 into a new Europa 2 project. The new program was to add another stage and change the launch base from Woomera, Australia to the equatorial polygon, which had been built at Kourou in French Guyana by CNES. Its first two test launches were programmed for November 1971 and spring 1972; Symphonie's orbit was instead fixed for 1973. The Europa 2 project, however, (and a further improvement named: Europa 3[171]) failed, and the payloads were unable to be placed in orbit. The reasons for the failure were insufficient overall concept of the program that was fragmented among nations, accumulating management errors by various industries that, in absence of a strong central figure, were unable to coordinate the work between them.

Meanwhile, it was decided that ELDO would be responsible for the development of the common launcher only. It was decided that a separate entity should be created to convey all scientific programs from various European nations, especially the United Kingdom, France, the Netherlands, the Federal Republic of Germany, Belgium, Sweden, Denmark, Switzerland, Spain and Italy, so as to realize scientific satellites. The European Space Research Organization (ESRO) was established in June 1962, after a proposal by COPERS of a 'Blue Book' where projects would be decided and shared by the signatory nations. The Book registered the launch of 11 small satellites. Despite Broglio's negative opinion, ESRO activities began with a series of launches from Salto di Quirra using probe rockets. The first satellite took off in 1964 with the English probe rocket Skylark. Up to 1972, ESRO launched 168 probe rockets, 65 of which were from the Sardinian test range, and the others from bases in Andoya, Norway and Kiruna, Sweden.

The participation of Italy in ESRO was less relevant than in ELDO, because the know-how member nations of the European scientific space organization required

[171] The Europa 3 project was to place payloads weighing 700kg in geostationary orbit, thus allowing the semi-direct transmission of television programs. The plan was to give Europa 2 a second stage using hydrogen and liquid oxygen ignition.

had already been obtained by Italy during the San Marco project and its collaboration with NASA. Paris was selected as the headquarters for the location of various ESRO centers and the decision was made to locate other infrastructure as follows: the European Data Analysis Centre (ESDAC) in Germany at Darmstadt and ESRANGE (abbreviation of ESRO Rocket Launching Range) in Kiruna, Sweden. There was a heated debate about where to locate the European Space Research and Technology Center (ESTEC).

The ELDO Convention entered into force on 20 March 1964. It was established that its purpose would be to provide collaboration among the European States in space research exclusively for peaceful purposes and for the development of member countries with the necessary technical facilities for space experiments[172]. Initially, the ESRO research program was oriented towards the observation of solar and cosmic radiation and interaction with terrestrial environment. The first missions were short because of the use of limited sized satellites, launched into rather low orbits. The first ESRO-2B satellite went into orbit on 17 of May 1968[173].

After the British recession and the Italian refusal to finance new projects involving a common launcher, it became clear that ELDO was set to become a bilateral Franco-German firm with Belgium and the Netherlands standing on the sidelines. Other states were increasingly convinced that the European launcher was no longer indispensable, which led to the cancellation of the 'Europa-launcher program' in December 1972[174]. It was understood that there could no longer be two different space agencies, one that handled the launching of sounding rockets and the other that dealt with the creation of a common launcher that seemed always to be going wrong.

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172 From ELDO/ESRO Bulletin c.s. No.1, May 1968, p. 35. A collection of ELDO/ESRO bulletins can be retrieved in the web site of the retired ESA staff personnel (ARES) (http://www.ares.esa.int)

173 Teofilatto Antonio. *Il Sirio e il dopo.* Rome, 2011, p. 25.

174 Amatucci Bruno, Luciano Ragno. *L'Italia nello spazio prima e dopo SIRIO.* Fratelli Palombi Editori, Rome, 1978, pp. 46-47.

During the third European Space Conference it was decided to announce the two things giving the European launcher its payload. There was a continuing request to take advantage of satellites launched into orbit to better promote telecommunications, which was the concept taken to the third European Space Conference when it took an historic decision. First it was decided that ESRO would have to engage in the construction of the first telecommunication satellite, with the preference being to use a European launcher, and most important it was decided to merge ESRO and ELDO into a single organization named ESA. For this reason a European Committee of Senior Officials was established to evaluate all aspects of the merger, headed by the Italian physicist Giampietro Puppi[175].

The new agency was to be formed starting with ESRO, a functional organism that, unlike ELDO, had been started from below, namely supported by various scientists with different experiences in the field of space research, also because with ELDO, insofar as the goals were very ambitious, the last launch of Europa 1 and the first of Europa 2 in 1970 had failed. The formal establishment of ESA took place March 1975 in Brussels. The ESA convention was signed after several attempts were made to find a compromise between France and Germany, the two main promoters. This in fact strongly indicated closer cooperation with the United States, thus sacrificing the development of European launcher, while the French were reluctant to abandon common rocket, and after the cancellation of the Europa program, began to develop a launcher on their own. A compromise was found by combining the two positions that had initiated European participation on the 'post-Apollo program', which had been launched by the Nixon administration

[175] Professor Giampietro Puppi (1917-.2006) was a brilliant Italian physicist. Puppi was also a researcher who distinguished himself with discoveries including the most famous: '*Triangolo Puppi*' the precursor of Enrico Fermi's theory of interactions. He was elected as Scientific Director of CERN in 1962 and then President of the Scientific Policy Committee. As professor he taught in Naples, Venice and Padova but especially in Bologna where he founded a school, which soon acquired great prestige. After being President of European Commission of senior officials he was elected President of ESRO in 1972 and helped it to evolve into ESA. See Bergia Silvia, Capiluppi Paolo, Focardi Sergio, and Giacomelli Giorgio (Edited by). *In memoria di Giampietro Puppi (1917-2006).* Bollettino della Società Italiana di Fisica, Nuova Serie Anno 23, Supplemento al N. 5-6, Bologna, 2007, pp.45-49, 54-55. Retrieved from http://prometeo.sif.it/papers/online/sag/023/05-06/pdf/suppl.pdf

after the Moon landing and the development, at the same time, of the European common launcher[176].

To ensure flexibility in relations between the nations, it was decided that the funding of various scientific projects would be based on the proportion of a country's gross domestic product (GDP). Italy chose to concentrate on two paths: the development of applications in space telecommunications and the building of accommodation inside the new American launcher: the Space Shuttle[177].

It was during this preparatory work that ESA was established; the French finally outpaced the other nations and became the head of European space activities. During preliminary discussions of where to locate the new agency's laboratories and centres of study, the French turned to international law, promising not to make claims on the location of these centres on its territory, requesting only that the headquarters would be located in Paris. When it came to signing the final agreement, France threatened not to sign it, and then to invalidate the agreement's entry into force. Ratification by the nation that housed the headquarters was necessary for the contractors, to agree the financing of the European launcher production[178].

European industry enthusiastically welcomed the launch of such programs, but the frequent political crises and the lack of long-term planning constrained space activities.

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176 Amatucci Bruno, Luciano Ragno. *L'Italia nello spazio prima e dopo SIRIO*. Fratelli Palombi Editori, Rome, 1978, p. 106

177 See Chapter IV for Spacelab project.

178 Di Bernardo, Nicolai Giorgio. *Nalla nebbia in attesa del sole*, Di Renzo editore, Rome, 2005, pp. 90-91.

2. From STV to SIRIO – the Italian Industrial Protagonists

It was too late when Italy realized that the pioneering phase that had been linked to scientific satellites and their ability to measure resistance and friction in the atmosphere at different altitudes was rapidly coming to end. Once again it was the Americans that indicated the new area of space activities that followed on from satellite development, after the end of the Space Race, which had been aimed at demonstrating technological advancement over the Soviets rather than anything else. In the development of a new means of communication, space had become a business field in which to expand the nascent telecommunications sector. On 10 July 1962 American Telegraph and Telephone became the first private company to achieve transatlantic television transmission using the TELSTAR satellite. A few weeks later the United States Congress passed the 'Communication Act', which established new American policy on the telecommunications sector. One year later in the US was founded the company Comsat, which had the task of managing telecommunications, and the foundation of the first international consortium INTELSAT[179], in 1964[180].

This time Italian industries that had hitherto only been involved in the aviation and defence sector, now perceived opportunities to use space for investment, and

[179] INTELSAT was established in August 1964 with the initial participation of 11 countries. Italy was represented by TELESPAZIO, which represented 85 % of global telecommunication traffic. Its main purpose was the design, development and construction of global communication satellite systems, providing all countries services via satellite and delivering public services such as telephony, telegraphy, telex and similar. INTELSAT is composed of an Assembly of Parts including representatives of member states' governments that meet every two years to examine long-term goals. The Meeting of the Signatories represents all Telecommunication Organs signatories of the Operating Agreement, which decide on general norms and the attribution of starting segments to users, establishing the standards of use in the space sector. The Board of Governors, composed of regional representatives numbering from 20 to 25, that have decision-making powers for planning, realization and administration of INTELSAT space sector, including the organization's policy and programs and the Executive Body, based in Washington, US, composed of officials from different nationalities headed by an Executive Chairman (currently David McGlade), who is responsible for management and operative functions. See www.intelstat.com.

[180] Amatucci Bruno, Luciano Ragno. *L'Italia nello spazio prima e dopo SIRIO.* Fratelli Palombi Editori, Rome, 1978, p. 38.

from which to accrue economic returns. Thanks, however, to the role of Broglio and the San Marco satellites produced by his team, Italy was already part of the 'club' of space nations, although all the know-how that had been acquired during the construction and launching of the scientific satellites was still owned by the University of Rome and was never made available to Italian companies, which had forced them to start all over again.

European countries, that possessed a national space plan, had been able to plan for and prepare adequate know-how and infrastructure such as workshops and test facilities, being, in some cases, ready to accept ESRO where their industries were already qualified. Italy was still brooding over its rivalries and divisions but made a great effort to keep up. Italian industry began from a position of handicap and difficulties when applying to win contracts from ESRO. The system of contract assignment, in fact, favoured industries grouped into consortia. These were often multinational, with a single authoritative voice, more funds could be used and the labour divided among industries that were part of the same consortium. The situation changed when ESRO proposed the creation of a multinational consortium among industries of various countries, diversifying production based on the skills retained by each company. In this way, Italian industry was able to overcome the lack of unity in the space sector, and to achieve a fair economic return as compared to domestic investments[181].

The Italian industrial world began to build study centres and laboratories. One was created in Milan in 1963, built as a centre for space engines by Corrado Casci[182], Professor of Milan Polytechnic. For the first time CNMP was able to associate the Milan Polytechnic, the CNR, and industries composed of

[181] Sacerdote, Ugo, *Il ruolo di FIAT Avio e di Aeritalia nelle attività spaziali italiane e nelle collaborazioni europee dagli anni sessanta agli anni ottanta*, paper at the meeting. *Italy in Space*, Forlì, 19-20 September 2003. The report discusses the participation of *Fiat's Ufficio Studi Speciali* in the project.

[182] Corrado Casci (1917-2000) was Professor of Machinery at the Milan Polytechnic, he was very active in all national and international organizations for space research. He was chairman of the Panel on the AGARD Propulsion and Energetics Panel, member of the Space Research Commission of CNR and of the San Marco project work group at the CNR Institute for Space Research.

Montecatini-Edison, Milan; Breda Meccanica Bresciana, Brescia; and Breda Ricerche from Milan to which was later added OTO Melara from La Spezia, which joined for development and research of propulsion and materials technology. The center was funded by the Minister of Public Education, built near Linate airport it was equipped with laboratories and underground bunkers for rocket testing.

Italian industry slowly started to carve out its own space policy. In 1966 the ELDO Conference of Ministers consigned a significant part of the European launcher program to Italian industry, which increased Italy's shareholding thus equalizing its position in ESRO[183]. The Council of Ministers assigned Italy the ELDO/PAS program, which involved the construction of an experimental satellite that was equipped with solid rocket propellant for orbit.

When the operations for the construction of the European launcher 'Europa 1', the United Kingdom became occupied with the construction of the first stage, France built the second stage and Germany the third. The French attempted to convince Italy to sign the ELDO Treaty of Establishment, and proposed that Italy build the STV satellite to launch with Europa 1, with technology that could monitor the rocket path, measure atmospheric friction, control the launcher and be controlled from a ground station. With Broglio fully immersed in the San Marco project, new Italian industrial realities began to arise in the space sector. Industries at that time demonstrated more interest than others in the management of space affairs such as FIAT Avio[184], AERFER[185], MONTEDEL[186], Laben[187], OTE and

[183] Italian share amounted from 9.78 to 12 %.

[184] Today it is known as Advanced Vision Into Orbit (AVIO), FIAT Avio was founded by FIAT in 1908, when Turin industry decided to extend its activities beyond the automobile industry to the aeronautical and naval sector. Even if the aeronautical sector was in its pioneering phase, FIAT Avio took on several commissions and, in the same year that it was founded, began the production of its first aeronautic engine: FIAT SA 8/75. FIAT Avio space activity started in 1912 in Colleferro, Rome, where it began the fabrication of explosives and chemical products, which formed the basis of space propulsion. It was thanks to successes made in experiments on solid propellants that in 1966 FIAT Avio was awarded the contract by ELDO for the production of the ELDO/PAS satellite, the company was to produce separation engines for detachment from the Europa launcher. Today AVIO has its headquarters in Colleferro and, besides being the prime contractor for the new European launcher, Vega, it is involved in

Selenia[188]. The development of the STV was divided between Italian Contraves, which provided analogic telemetric instruments; SELENIA, OTE and MONTEDEL constructed telemetric and control systems; FIAT Avio built mechanical parts for the STV (then ELDO/PAS), AERFER built the STV ignition system for separation engine, and CRA[189] managed assembly of the components. Fiat AVIO, in addition to STV, worked on the creation of thermic shields for Europa 1. Polytechnic of Turin, Galileo Ferrari Institute, the University of Padua, and several laboratories at CNR and CRA[190] provided support to the Italian industries. As the industrial sector had never before applied itself to the space sector it was faced with a difficult challenge.

In 1965, after solicitation from the Aerospace Industrial Association, the industries involved in the project (BPD, Breda Finanziaria, Italian Contraves,

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producing helicopter propellant systems, solid propellant for space engines, automated control systems and aeroderivative turbines for industrial and naval use. See www.avio.com.

185 Aerfer - *Industrie Meccaniche Meridionali e Aeronautiche*, was established in Naples on 26 July 1955, after a merger of *Officine Ferroviare Meridionali* (OFM) and *Industrie Meccaniche e Aeronautiche Meridionali* (IMAM), which grouped all aeronautical activities in the Campania Region. Controlled by Finmeccanica, Aerfer has had a long-tradition in the aeronautic industry and has collaborated with several in the industry, among them Douglas, then McDonnell-Douglas American Industries (the Thor-Delta rocket producers) for which it made components for commercial airplanes. After the Second World War, in 1956, it developed Sagittario II, the first Italian fighter to break the sound barrier. In 1969 it transferred all activities to Aeritalia. See Iorio Giovanni, Serpico Vincenzo. *C'era una volta l'Aerfer…: un'occasione perduta*. Editrice Arcobaleno, Milan, 1994.

186 *Montecatini Edison elettronica* was created on 3 August 1960 in Pomezia, Rome. It is specialized in the production of equipment and accessories for the radio-telecommunication sector.

187 LABEN is today a directorate of Thales Alenia Space Italia, a manufacturer of space systems, in particular specialized in the production of software, electronic systems, data processing equipment and nuclear research device. LABEN also provides teams and instruments and controls for launchers and space transportation systems with ground support equipment for testing of satellites, launchers and probes.

188 Controlled by IRI through Finmeccanica and STET, Selenia *Industrie Elettroniche Associate* was founded in Naples on 22 May 1960 after the merger of Sindel and Microlambda. It was an industry that specialized in the electronic sector specifically for the production of radar produced under US license, the majority of which were used by NATO (for example Pluto and Argos radar). It also was particularly active in the electronic sector producing interception, analysis and disturbance systems of radar signals and building targeting and control missile systems and on board airplane electronics. It had factories in Rome and in Fusaro and Giuliano near Naples. In 1982 all space activities were left to Selenia Spazio, which was incorporated in Aeritalia in 1990, changing its name to Alenia.

189 *The Centro di Ricerche Aerospaziale* was founded in November 1962 inside the Aerospace Engineering School of Rome. For long time it was directed by Luigi Broglio. It was one of the principal creator of the San Marco satellites.

190 Caprara, Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, pp. 218, 219.

FIAR, FIAT, Finmeccanica, Montecatini and Selenia) created the CIA (*Consorzio Italiano Aerospaziale*) consortium that would take a primary role in their representation. CIA was also created to prevent misunderstandings and took on the roles of guidance and leadership. Its activities specifically concerned finalization of satellite studies, system units, interface with the launcher and the NASA control network. It also prepared for integration and testing of the satellite, its equipment and prepared for launches[191].

Meanwhile at ELDO, costs for the launcher had increased. To try to cope, the Directors for Europa 2 decided to reduce the cost of the STV, by creating a simple vehicle with limited lifespan and equipped with a transmitter-receiver. Italy was in the opposition, wishing to press for the creation of a fully-working satellite over long periods so to continue testing for the growing telecommunications sector. Also, when ELDO communicated this budget cut to Italian industry, which had already gone ahead with projects and reduced STV to a simple capsule, an inconsistency was created. After the ELDO council continued to refuse the Italian proposal, Italy abandoned ELDO definitively and the construction of what many on the Board of Directors thought to be the only positive aspect of the Franco-German launcher.

Although there was no way to prove the effectiveness and operation of ELDO/PAS, because of the continuing failure of Europa 1 and Europa 2 launches that were unable to take the ELDO/PAS satellite into orbit. The experience acquired, however, during the production phase contributed to creating a strong team for the implementation of future projects that proved indispensable. Selenia was the company that took most advantage of the experience with ELDO/PAS, from this small group emerged one of the leaders in the Italian space sector[192]. Production of the PAS satellite, in fact, gave Italian industry the possibility of implementing and testing the ground to air systems for space communication. The

[191] Teofilatto Antonio. *Il Sirio e il dopo.* Rome, 2011, p.53.
[192] Amatucci Bruno, Luciano Ragno. *L'Italia nello spazio prima e dopo SIRIO.* Fratelli Palombi Editori, Rome, 1978, p. 39.

first trials were attempted on the Ku-band, anticipating modern services by raising the value of GHz that would allow smaller antennas to be used[193]. Experiments were determinant for the production of SIRIO, which used these frequencies, because gradually launches of more and more telecommunication satellites that communicated at standard frequencies of 4-6 GHz begun to crowd those bands.

In particular Selenia developed units for ESRO that were destined for the satellite programs ESRO-4[194] and Cos-B[195]. All this know-how was immediately used by Italian industry to pursue a new method of space launches. The first move made by the American Telephone & Telegraph (AT&T) was to focus on a new era of application in cosmic technology. AT&T involved European companies in the opportunity for globalizing communication data. In Italy, the AT&T subsidiary Bell System Inc. contacted Italcable[196] that, recognizing the great opportunity offered, accepting the proposal after consultation with the Ministry of Post and Telecommunication on which it depended and, together with RAI, founded the Telespazio Company in 1961[197]. One year later, Telespazio signed an agreement with NASA to share experimentation costs in the telecommunication sector. Meanwhile AT&T and NASA launched the first telecommunication satellites into orbit:, Telstar 1 and Relay 1, and built the first Italian station for space communication in Ortucchio, near Avezzano, Abruzzo, and, in November 1962,

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193 Transmission at that time was from an Intelstat satellite transmitting on frequency of 4-6 GHz that had to be received by stations equipped with antennas that were at least 32 m high.

194 ESRO-4 was the first satellite built by Selenia that was launched into orbit. The satellite contained five experiments to measure and study various characteristics of the layers of the atmosphere surrounding Earth, in particular the ionosphere, atmosphere, radiation bands and particle penetration of solar radiation in the magnetosphere. ESRO-4's results feature prominently in the world's scientific literature on the upper atmosphere. This satellite significantly advanced our basic understanding of the relationship between solar radiation and the Earth's atmosphere and magnetic environment.
http://www.esa.int/About_Us/Welcome_to_ESA/ESA_history/History_ESRO-4_satellite_1972

195 Cos-B was the first astronomic satellite launched by the European Space Agency (ESA) on 9 August 1975 to study the gamma rays from stars and the other celestial bodies, particularly concentrated on the unexplained radiation levels discovered by the first American satellites. http://sci.esa.int/cos-b

196 Italcable-Cablographic, telegraph and radio-electric services, was a society founded on the 9th August 1921 that managed telecommunication services. The company connected the two sides of the Atlantic with several kilometers of submarine cable. It survived until 1994, until its merger with Telecom Italia SpA.

197 Caprara, Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, pp. 255-256.

the first satellite dish pointed towards the sky to receive its first signals in January 1963 from Relay and Telstar.

Europe, meanwhile, founded the European Conference on Satellite (CETS) in response to America's Communications Satellite Corporation (COMSAT)[198], and provided 24-hour a day instant communication everywhere, COMSAT was created, after an United Nations resolution on International Telecommunications Satellite Organization, which aimed to finance the construction of telecommunication satellites for global coverage before 1964, the year of the Tokyo Olympic Games. Italy participated in the organization and financing 2.2 % and prepared to acquire the essential know-how that, a few years later, would lead to the world looking up at the new Italian satellite, this time bearing the name of the brightest star in the sky, instead of the patron saint of marine missions.

The SIRIO project was launched by Professor Francesco Carassa in 1968, he had accused Europe of having made the mistake of not realizing the potential for telecommunication satellites, which in his view was as important as the creation of the European common launcher[199]. The project was initiated, in fact, after the drastic reduction of Italian participation in the development of the European launcher Europa 2, which permitted CNR to redistribute funds to the new project of an Italian telecommunication satellite.

Finally, with the elimination of ELDO from the Italian project, permission was given to CIPE to recoup the ELDO/PAS project with its conversion into SIRIO in January 1969, providing for its launch in 1971. The program was founded by the Minister of Research, Salvatore Lauricella, the *Comitato Interministeriale per la Programmazione Economica* (CIPE) to improve coordination, and the old Space Research Committee of CNR was replaced by a new *Commissione Intercomitati per lo Studio dei Problemi Spaziali* (CIPS) that brought together the managers of the various CNR committees having space business, headed by Giampietro Puppi.

198 Communications Satellite Corporation.
199 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 261-262.

The Minister of State Participation, Franco Maria Malfatti, created a new company Aeritalia that soon became the largest aerospace company. The start of the new society was made possible with the participation of AERFER and FIAT, on the signing of an agreement with *Istituto di Ricostruzione Industriale* (IRI). Turin industry decided to permit Aeritalia to manage both the space and aeronautic sector.

Although Italy did not completely withdraw from ELDO, it was not confident about the realization of a European launcher or to entrust it to launching SIRIO. So when looking for a launcher to use for placing the first Italian telecommunications satellite into geostationary orbit, a CNR exploratory delegation, headed by Professor Carassa, went to NASA headquarters in Washington, in October 1968, to explore the possibility of obtaining launch services and assistance for SIRIO. Thanks to the preparatory work of the Italian Ambassador in Washington, Egidio Ortona, who indicated the already excellent relations with the American Space Agency, and thanks to the successes of San Marco, the expedition was able to convince NASA that, while not hiding the detail of having to support two different projects with two different agencies in the same country, NASA agreed and provided the funds for the Thor-Delta rocket produced by McDonnell-Douglas[200].

Soon it was realized that the launch date planned for SIRIO was optimistic. Although the Cold War had passed its most critical moments, external events delayed the launching of the first Italian telecommunications satellite. First there were student riots that slowed the university system for many months, provoking inevitable consequences in the industrial sector. In 1973 there was the Organization of the Petroleum Exporting Countries (OPEC) energy crisis[201] repercussions with the oil market, blocking of exports, as a result of the

[200] Teofilatto Antonio. *Il Sirio e il dopo.* Rome, 2011, pp. 55-57.

[201] OPEC was founded in 1960, and formed an economic trust between all the major oil producers. Today the OPEC member states controlled 78 % of the world's oil reserves. Originally it was headquartered in Geneva, then, from 1st September 1965 it was transferred to Vienna.

continuous Egyptian defeats during its war with Israel, which was supported by the United States and Europe. The block of oil producers provoked an unprecedented global crisis. However, the delays were not purely external. Difficulties arose also from the new space agencies that, initially, were unable to carry out the roles entrusted to them. Some problems came form the inadequacy of CIA calibration to carry out tests and to integrate the work as a result of lack of funding as it was not covered by contract with CNR[202].

Against the background of all these difficulties, the Italian political sector did not abandon the project. In May 1971 a first ad hoc law was approved that provided SIRIO financing that amounted to 18.7 billion lira[203]. Despite this, from December 1971, all CIA companies ran into a further delay and, again the anticipated launch date that had been proposed by Antonio Teofilatto[204] before 1976, was again found to be optimistic. On 14 October 1972 the Italian Prime Minister, Giulio Andreotti wrote a letter to Carassa committing the Government to the program with the necessary funding[205]. Words became reality when, despite the intense global economic crisis and implementation, for the first time, of austerity policies in early August 1974, law 388/1974 provided funding to SIRIO of 18 billion Lira. Then CNR signed a contract with CIA ordering satellite construction and another with Telespazio for the realization of ground infrastructure to control the satellite in orbit and for a control center for mission management to be installed at Fucino[206] and put into operation 45 days after the

202 Teofilatto Antonio. *Il Sirio e il dopo.* Rome, 2011, pp.78-79.

203 The funds were allocated as follow: 10.2 billion Lira for carriage, 3 billion Lira for the SHF package, 1 billion Lira for the laboratories at the Polytechnic of Milan, 1.5 billion Lira for ground receivers and 3 billion of Lira for the launch using the Thor-Delta rocket. See Teofilatto Antonio *Il Sirio e il dopo,* Rome, 2011, p. 59.

204 Engineer Antonio Teofilatto was Director of the Space and Telecomunication Division in Selenia Company. In 1974 he was appointed General Director of the CIA, granted with broad powers.
storiainrete.com/wp-content/uploads/2010/02/06-doc-asi-12.doc

205 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 267-269.

206 The space telecommunication center at Fucino was the first Italian station for space communication. It was established in Ortucchio, near Avezzano, Abruzzo after an agreement was signed between Telespazio and NASA to spread the experimentation on satellite communications. In November 1962 it built the first satellite dish, which in January 1963, received the first signals from Relay and Telstar. Italy became the fourth country after the US, the UK and France to become a protagonist in the telecommunications sector.

start of the mission. In May 1975, CNR signed an agreement with NASA to supply the Thor-Delta launcher, to ensure compatibility with the network NASA/STDN[207] and to provide technical assistance during prelaunch activities[208].

Everything was ready, and the SIRIO project, although markedly delayed, could begin. The team that worked on the project was composed of Massimo Macchia[209], the director of ESTEC, ESRO center in the Netherlands, who became the project manager; Luigi de Magistris, manager of satellite and launch operations; Cesare Albanesi was in charge of orbital operations and, perhaps the most important, Antonio Teofilatto, a physicist from Selenia, where he lead the Space and Telecommunication Division, was appointed General Director of CIA. Despite this excellent close-knit group of engineers, when the work began to accumulate, more staff members were needed. So Teofilatto brought some of his former colleagues from Selenia into the project. The new members of the team had much experience in the mechanical sector and in telecommunications and electronic systems. In this way, it was possible to create a balanced and competent team that covered all sectors necessary for correct and efficient satellite operation[210].

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207 The network NASA/Spacecraft Tacking Data Network (STDN) needed to check the satellites' trajectory with the ground range and range systems and control of tracking, telemetry and control stations around the world to follow and monitor objects in orbit.

208 Teofilatto Antonio. *Il Sirio e il dopo.* Rome, 2011, p. 63.

209 Among the many positions that Massimo Macchia held he was also Technical Director of Italian Contraves, advisor to Finmeccanica and *Società Italiana per lo Studio della Propulsione a Reazione* (SISPRE). Before he became the SIRIO project manager, he was General Director of laboratories in the Netherland ESTEC of ESRO then ESA.

210 In July 1976 the CIA organization chart for work on SIRIO was President: General Ettore Faragnoli, Amedeo Giacomini and his assistant Giogio Valentini, who worked in the President's office. Technical service: Vincenzo Fasauli, Construction: Gaetano Bellucci; Documentation: Zennaro, Giovanni Codina; Jobs office: Franco Toni, Calibration and tools maintenance: Stefano Bolgnini. Administration and Accounting: Dario Fanfoni; STET consulant: Bruno Verde and Fabio Cappon; Accounts: Gioacchino Santarelli. Contracts and programming: Antonio Fornò; CNR contract administration and supply: Luciana Albanesi. Quality check: Romolo Carosi. System: Claudio Mastracci; Mission analysis: Alessandro Buratti; Components: Curzio Marana; Operation manual: Vittorio Barbagiovanni. Satellite: Claudio Mastracci; Base satellite: Guido Morelli; SHF crammer: Mario Francesi and Paolo Croce; Test group: Giuseppe Talarico, Angelo Iannarelli, Alberto Discepoli. Launch support: Giangrande Barresi; Logistics and safety: Bizzarro and Giuseppe Fabio; Launch squad: Angelo Iannarelli and Alberto Discepoli; Auxiliary propulsion: Paolo Marsili. Antonio. *Il Sirio e il dopo.* Rome, 2011, pp. 66-67

It was sought to mostly involve Italian resources for construction of the satellite to create a 'totally Italian' project. Nevertheless, mainly American foreign suppliers were used for SIRIO. Solar systems came from the United States purchased from Spectrolab, the counter-rotating engine of antenna[211] provided by Ball Brothers and small engines for auxiliary propulsion for orbital control bought from Hughes.

The member companies of the consortium, headed by Antonio Teofilatto, had built an industrially excellent product, and were gathered together in CIA. Among them were SNIA-Viscosa, which developed the solid propellant engine, its casing was in titanium alloy produced by Aeritalia; Montedison Sistemi built the telemetry apparatus, Sun and Earth sensors for orbital orientation were produced by the superior company in the Italian optical sector, Officine Galileo; batteries and control power units were constructed by CGE-FIAR and the propulsion system for orbital route correction was realized by OTO-Melara. Selenia was responsible for the major part of the project, which was to build the experiment with counter antenna, in addition to solar power systems.

On 25 August 1977, six years after initially forecast, SIRIO was brought out from ramp 17B of the Kennedy Space Center at Cape Canaveral at 19.50 hours local time. Again, after a delay caused by the rupture of a connecting ring that kept it tied to the launcher, SIRIO set off towards geostationary orbit for a predicted two years of work. The satellite survived eight years, reflecting the excellent work accomplished by CIA industries. There was to be no such success for the competitor, as the ESA telecommunications satellite for OTS, which was launched a month after SIRIO, from a ramp at a little distance from where SIRIO had *lifted off, exploded in the air.*

[211] Which served to keep the satellites' antenna pointing towards the ground.

3. SIRIO 2 and the Italian Attempt to regain Prestige in European Space Policy

The incredible success of SIRIO did not pass unnoticed by ESA, and Italy attempted to use the know-how acquired with SIRIO 2 to regain the prestige gained during the San Marco launches. It was sought to move toward the 'Europeanization' of SIRIO. So a plan was prepared and it was proposed to ESA that other countries should be involved with the objective of creating a telecommunication satellite that would be launched using the European vector Ariane. Italy provided a capable team, which starting with parts used for SIRIO. It was proposed that other European countries should be included in the construction of SIRIO 2.

Meanwhile, the weakness of CIA, as a result of constant competition between the four companies that formed it, led to the reorganization of the consortium on 4 November 1977. The new *Compagnia Nazionale Aerospaziale*[212] *(*CNA) supported by four shareholders divided between Aeritalia and Selenia that controlled 30 % each, Montedel Sistemi and SNIA Viscosa with 20 %[213]. CNA, however, did not last long because of a series of tensions that began, starting in 1978, specifically between SELENIA and AERITALIA that initiated the separation between 'space' and space telecommunication, which signaled the end of CNA.

In 1978, the ESA Board of Ministers approved the Italian proposal. For the ESA launcher the new European launcher Ariane L05 was proposed, which would complete its first operational launch, following four made during its development phase. The French also participated in the project with a contribution to the program of 15.7 %, the Federal Republic of Germany with 11%, Switzerland with 3.4% and other minor participation by Belgium with 2%, Denmark with 1.7 %

[212] The name change was also decided to remedy the controversial acronym that could be confused with the US security agency.
[213] Teofilatto Antonio. *Il Sirio e il dopo.* Rome, 2011, pp. 224-225.

and the United States with 1%. ESA fixed two mission tasks for SIRIO 2: a new telecommunication system to improve weather information on the African continent, expanding the capacity of global telecommunication systems for acquiring local data and spreading information produced in the centers of data analysis and acquisition named Meteorological Data Distribution (MDD) and the synchronization of atomic clocks at long distance with an accuracy of a nanosecond named Laser Synchronization from Stationary Orbit (LASSO)[214]. In 1979 the ESA commissioned CNA to build SIRIO 2 within 27 months with the help of the industries from French, Spain, Belgium, Austria and Federal Republic of Germany. Parts were re-used from SIRIO 1 to build it, as well as from the ESA meteorological satellite Meteosat.

The construction of SIRIO 2 was faster for SIRIO 1 because the same equipment was used as for the first Italian telecommunication satellite. There were few new parts. In the middle of 1980, however, problems arose from the Ariane development program because its second test launch failed, and the launch date was postponed. The third and fourth launches were successful and were able to take their payloads into orbit, respectively the APPLE satellite[215] and MARECS-A[216] satellite.

Meanwhile, from the middle of 1980, CNA changed its name substituting the wording: *Aerospaziale* with '*Satelliti per le telecomunicazioni*. Aeritalia replaced Selenia in the role of primary company in the new CNS. General Alessandro Mattimano become new President of CNS at the end of 1980.

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214 Teofilatto Antonio. *Il Sirio e il dopo.* Rome, 2011, p. 248

215 The Ariane Passenger PayLoad Experiment (APPLE) was an experimental communication satellite produced by ISRO (Indian Space Research Organization) and launched on 19 June 1981 by Arian launcher from the ESA base in Korou, French Guyana.

216 The Maritime European Communication Satellite (MARECS) was a geostationary telecommunication satellite part of worldwide maritime telecommunication satellite network. It was launched during the third flight of Ariane, on 19 December 1981.

SIRIO 2 was launched from the ESA base in French Guyana on 10 September 1982 during the fifth launch of Ariane 1; but, after 7 minutes a failure in the third stage of the rocket caused SIRIO 2 to precipitate into the Atlantic Ocean.

Despite the failure of SIRIO 2, the Italian debut into the telecommunications sector was satisfactory in regard to the extraordinary technical life that SIRIO displayed during its geostationary orbit. Italian industry was able to compete with that of the better organized European, managing to put aside, at least at the start, their disagreements to take over the role as Italian industrial leader in the space sector on the basis of the extraordinary collaborative work demonstrated of Selenia, SNIA Viscosa, Breda Finanziaria, Italian Contraves, FIAR, Finmeccanica, Montecatini.

Certainly, if the experiences and know-how acquired by Broglio and his team, thanks to San Marco launches, had been shared with the Italian space industries, it would have ensured that the Italian delegates who participated in ESRO and ELDO meetings, also for assignation of contracts, would have been able to speak as a single voice, thanks to the support from the political, scientific community and industrial aerospace sector. This scenario was a common factor for other European nations but not in Italy.

Moreover, the SIRIO success gave prestige to Italian space policies, and to their subsequent relations with ESA, in which the French had begun to increasingly assume the role of leadership, became more complicated, especially in the new European launcher program named Ariane, where Italy, often, clashed with French positions. Italian industry was unable to count on the support of the United States, which had been the Italian main partner for space activities, and was doing everything to prevent construction of an European launcher. Italian industry found itself alone, in comparison to other European companies that already had collaboration agreements.

The Nixon administration alone launched the post-Apollo program, restructuring the NASA space programs, opening up to Europe new forms of collaboration to find funding and to share space projects within a series of programs that brought NASA to the production of a reusable launcher for putting satellites into orbit. Italy through ESA did not miss the opportunity and actively collaborated in a series of programs, more detail of which follow in Chapter IV , the most important of which was the Spacelab project.

CHAPTER IV

Toward a National Space Policy
Collaboration in Space between the United States and Others

1. NASA and ESA on the Space Shuttle: The Spacelab Project

During the Cold War people were forced to live in fear of worsening relations between the United States and the Soviet Union, with the consequential danger of triggering a nuclear war. The world began to relax after 1970, until the complete dissolution of the Soviet Union in 1991 and the subsequent end to the Cold War. The initial stages of the so-called 'Years of Détente'[217] saw as protagonist President Richard Nixon, who became the Thirty-seventh President of the United States after defeating his political opponent Hubert Humphrey, with 43.4 % of the votes against 42.7 % recorded by his Democratic opponent.

The new American President slowly moved towards a general détente in international relations, abandoning the 'Truman Doctrine'[218] and the 'Massive Retaliation Doctrine'[219]. The author of these openings was the American Secretary of State, Henry Kissinger[220] who was kept busy establishing new relations, especially with Communist countries. The most important was recognition by the United States of the People's Republic of China, which had replaced Nationalist China of Taiwan, taking its permanent seat on the United

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217 The term is often used in reference to the general easing of the geo-political tensions between the US and Soviet Union, which began at the end of 1969, as a foreign policy of the presidents Richard Nixon and Gerald Ford. Détente was known in Russian as *разрядка* (razryadka), loosely meaning relaxation of tension.

218 President Harry Truman announced the 'Truman Doctrine', for the first time in 1947. Unlike the previous 'Containment Doctrine', which was a passive strategy for preventing the expansion of Communist countries, the US Truman Doctrine envisaged a more active intervention, to prevent the expansion of Communism, through direct and indirect support to all foreign governments that were openly anti-communist or engaged in fighting against pro-communist guerrillas.

219 Announced on the return of the Republicans at the US Government, the Massive Retaliation Doctrine was a kind of return to more passive defense policy than the Truman Doctrine. Inaugurated on the election of the former General, hero of the Second World War, Dwight Eisenhower to the US Presidency, the Massive Retaliation Doctrine presented by Eisenhower's Secretary of State, John Foster Dulles, comprised the development of cutting-edge weapons, especially nuclear that aimed to create a deterrent to discourage offensive actions against American interests on the part of Soviet block.

220 The Nobel Prize for Peace Henry Kissinger was a diplomat and political scientist that served as Secretary of State under Richard Nixon and Gerald Ford's administrations from 1969 to 1977. Stronger supporter of the Realpolitik, he was one of the promoters of the Détente Policy. He was the architect of the opening of relations with the Popular Republic of China at the end of the Vietnam War by signing the Paris Peace Accords. See: Walter Isaacson, *Kissinger: A Biography*, Simon and Schuster Paperbacks, New York, 2005.

Nations Security Council. Kissinger was also responsible for Nixon's official visit to China, which represented a further step towards the thaw, as the SALT agreements[221] were signed with the opposing block to limit the development and proliferation of nuclear weapons.

The Nixon administration made every effort to rationalize public spending, which had reached unsustainable levels, especially as a result of the Vietnam War. Once again, thanks to the extraordinary genius of Henry Kissinger, a new strategy was put into practice known as 'Strategic Retreat', which aimed to gradually reduce support to the Government of South Vietnam and to withdraw US troops engaged against the Viet Cong[222].

The Vietnam War, however, was not the only item of expenditure that had produced a huge burden on public spending. In his State of the Union address, in 1961, President Kennedy had launched the Apollo project along with a significant increase in the NASA budget. The project's ultimate goal was the conquest of the Moon. When on the 20 July 1969, the Apollo 11 Commander, Neil Armstrong; the lunar module pilot, Edwin Aldrin; and the pilot of the capsule, Michael Collins, reached the Moon on a Saturn V, the most powerful launcher of those times, created by Wernher von Braun, the Moon landing officially ended by winning the Space Race that had begun when the Soviet Union had placed Sputnik into orbit.

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221 Strategic Arms Limitation Talks-SALT covered two types of agreement signed at different times that provided limitations to nuclear weapons and strategic launchers. SALT 1 was signed in 1972 between President Gerald Ford and Leonid Il'ič Breznev the General Secretary of the Soviet Union. SALT 2 was signed on 18 June 1979, between Breznev and the US President Jimmy Carter.

222 The Viet Cong was the military source of the National Liberation Front, a pro-communist party formed in South Vietnam with the support of North Vietnam in 1960 to foment insurgency in the South. It was composed both of regular units from the People's Army of Vietnam, the regular North Vietnamese army, and guerillas especially peasants and people against the pro-Western government. They fought against the US army during the Vietnam War (1959-1975). The Viet Cong dissolved themselves in 1976 when North and South Vietnam were official unified under the communist government of Hanoi. See Charnof David and Tang Nhu Truong, *Memorie di un Vietcong*. PIEMME, Milan, 2008.

The conquest of the moon was a source of great prestige, but also represented the first step of detente with the Soviet Union, as it brought to an end the rivalry between the two superpowers in the space sector. Since that time, the Soviet Union and the United States have been collaborating in space activities, which culminated in the space embrace between the American astronaut Slayton and the Soviet cosmonaut Leonov, during the Apollo-Soyuz mission of 17 July 1975[223].

Expenditure for the Apollo project was huge and, so as to finance other Nixon administration projects, it was decided that after Apollo 11, the Apollo program would be cut by reducing missions. In order to remedy the budget reduction, NASA immediately launched a post-Apollo program, a project that aimed for the realization of a reusable launcher. The program included the possibility of opening up to potential foreign partners, sharing both benefits and costs. NASA was to offer its know-how in exchange for international participation in the expenses.

In late 1969, Thomas O. Paine[224] commenced a series of visits to Europe, Australia, Japan and Canada, to approach potential partners[225]. The first countries to which the United States had turned were European. In the fall of 1969 Paine invited ESRO to participate in the post-Apollo project. The reason that had prompted NASA to turn to Europe was the concern about progress being made in the development of a European launcher, which could be a potential competitor, giving Europe the same complete independence in space access. Paine travelled to Europe with the intention of cooling European expectations about the realization of its own launcher that, according to NASA, would be obsolete before starting. NASA then, with Nixon's approval, presented an official offer to the European nations' that were part of ESRO[226].

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223 See also Chapter I

224 Dr Thomas O. Paine (1921-1992) became third Administrator of NASA on 5 March 1969, in his professional career he was always involved in the research segment, until his appointment as Deputy Administrator of NASA on 31 January 1968. More informations can be found on: http://history.nasa.gov/Biographies/paine.html

225 Vallerani Enrico, *Italy and Space: Habitat Modules.* Mc Grew-Hill Italia, Milan, 1995, p. 6.

226 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 300-302.

After some time, however, the spokesman of the State Department announced after a period of reconsideration, the intention of maintaining the space shuttle project at the national level. It was no longer to be considered a program that would be open to international collaboration. The module named SortieLab would have allowed safe conditions to perform experiments in orbit[227].

Among the European countries, with France being focused on the development of a launcher, and the resources of the United Kingdom being spent on the post-Apollo project, Germany and Italy were the two nations that showed the most interest, and (after the disappointment of the failure of ELDO), readily accepted the offer of cooperation. Alternatively, ESRO asked to develop parts of the Space Shuttle, for example its engine. NASA, however, did not consent to the proposal for creating the Space Tug, so as not to share the innovative technology needed for its construction. Thus the idea was born for creating a module for inhabitation that could be inserted into the Space Shuttle, which would be capable of enabling scientific studies by astronauts in orbit around the Earth, during and after the satellite transport operations.

NASA and ESRO accepted the Sortielab program as a special project that included voluntary participation and contributions from European countries. With France still totally focused on the development of the Europe 3 launcher, at that time renamed Ariane, Germany and Italy showed the most interest in leading the other European nations in the Spacelab program. As a result of the ministerial meeting at the European Space Conference in December 1972, the task of initiating the Spacelab program was officially given to ESRO. In September of the following year, an agreement was signed between the European governments, formally entering into force with the Spacelab program being represented by the ESRO General Director, Alexander Hocker and the Administrator of NASA,

[227] Caprara, Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012,, pp. 24-30.

James Fletcher, and after the 'Brussels package deal'[228] the Spacelab program was authorized to proceed.

ESRO requested the formation of a multinational consortium to proceed with the study phase and for the development of a Spacelab flight unit[229] to be inserted in the Space Shuttle. All stages were to be developed with the indispensable help of American industry, particularly the Californian McDonnell Douglas. The three main industrial groups formed were COSMOS, led by the German company MBB with the participation of Selenia; STAR, led by the British Aircraft Corporation with the participation of the Italian CGE-FIAR and Montedel; the third led by German VFW-Fokker that included Aeritalia[230]. The latter was founded after the decision of FIAT to provide special structures and a strong team that would be exclusively dedicated to the Spacelab Program for the space sector. The team would work under the management of Roberto Mannu and Ernesto Vallerani[231], who had assumed the leadership of the entire Italian participation in the Spacelab Program.

During the meeting in Brussels in July 1973, in addition to the decision to unify ESRO and ELDO into one single organization dedicated to European space policies, Spacelab development was officially authorized under German leadership[232], accounting for 54.94 % of the project with the assistance of the United States and with strong Italian support of 15.94 %[233]. After the study phase,

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228 Brussels Package Deal was a compromise agreement between Ministers of Research of the eleven Country members of ESRO-ELDO. The agreement inserted Spacelab project under German leadership with the other two main European space program (Ariane and space telecommunication satellites)

229 Sortielab program changed its name into Spacelab after ESRO conference of 1972.

230 Caprara, Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, p. 307.

231 Ernesto Vallerani graduated in Engineering at Polytechnic of Milan and specialized at CALTECH in California with a doctorate on spacecraft return to Earth, he staretd to work at FIAT Avio and then at Aeritalia, where he assumed the role of Director of Space Division in 1980. He was Professor at Polytecnic of Turin and Director of Alenia Spazio (today Thales Alenia Space) fron 1991 to 1997.

232 The other European nations that participated in Spacelab program, with relative percentages were: France (10.29 %), Great Britain (6.51 %), Belgium (4.32 %), Spain (2.88 %), Holland (2.16 %), Denmark (1.54 %) Switzerland (1 %) and Austria (0.79 %).
See: http://www.esa.int/Our_Activities/Human_Spaceflight/Space_Shuttle/Spacelab

233 Caprara, Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, p.310.

three different proposals were issued that presented the design solutions that had been identified by each one of the three consortia for the construction of the Spacelab:

- COSMOS, under the leadership of German MBB, and composed of SNIAS (France); MSAS (United Kingdom); Selenia (Italy); ETCA (Belgium); CASA (Spain) and CIR (Holland), proposed a module divided into a support system and an integrated process with the payloads mounted on a supporting beam attached to one of the extremities.
- STAR team, under the leadership of the British Aircraft Corporation, included Dornier (Denmark); Contraves (Switzerland); Thomson CSF (France); GSE-FIAR and MONTEDEL (Italian); which contemplated a more conventional set-up with two solutions: one short module and one longer.
- MESH, under the leadership of ERNO (today EADS Astrium-Germany) and also composed of Aeritalia[234] (Italy); BTM (Belgium); HSD (United Kingdom); Matra (France) and Philips (Netherland) proposed an original concept for a modular that employed the same hardware for the two configurations one short and one long.

The three plans were analyzed at the ESTEC center in the Netherlands. The proposal made by STAR was discarded, while those of MESH and COSMOS[235] were accepted. The two proposals were very simple, but finally the ESRO President decided that MESH would win the competition thanks to a better solution on the future use of Spacelab. Both solutions, indeed, were causing a considerable loss of payload transportation, because of the excessive weight of the Space laboratory. NASA did not give the 'go ahead' until the presentation of a new project that provided for a sizeable weight reduction, as compared to the original model. Thanks to the incredible work of Aeritalia, MESH could submit a new draft with a reduction in weight of about 400 kg, which was finally accepted by NASA[236].

[234] It was ERNO itself that choose Aeritalia as its main partner.
[235] Vallerani Ernesto, *Italy and Space: Habitat Modules.* Mc Grew-Hill Italia, Milan, 1995, p. 16
[236] Caprara Giovanni, Vallerani Enrico. *L'Italia sullo Shuttle*. Mondadori, Milan, 2012, p. 34.

On 5 June 1974, ESA officially assigned the Spacelab development project to MESH. Spacelab construction was divided as follows: ERNO Program system analysis; Aeritalia produced the module structures and thermal control (two of the most important parts of the project); DORNIER built the environmental control and 'life support'; AEG Telefunken from Germany produced the Electrical power system; MATRA (France) the system for the management and control of onboard data; Hawker Siddley Dynamic (UK) constructed pallet structure; Bell Telephone Manufacturing from Belgium realized Electrical equipment; SABCA (Belgium) built the connecting element called the 'Utility bridge'; INTA (Spain) constructed mechanical equipment for ground support; FOKKER-VFW from Holland created airlocks for research; Danish KAMPSAX built the electronic control system and CIR from Switzerland built the electrical simulators and ground control[237].

Thus Aeritalia, one of the companies that had made the largest contribution to the consortium, could start the work, but not without difficulty. The major problem encountered was linked to the welding of the aluminium panels, a new technology that had never been performed in Europe before. It was therefore necessary to reorganize the working staff. First of all the Engineer Roberto Mannu was recalled from Seattle to assume the role of Project Manager, soon the new head of the project began to recruit new staff. Ernesto Vallerani mantained Technical Management and the responsibility for relations with ERNO, ESRO and NASA. Engineers Paolo Piantella and Pier Luigi Degli Esposti were devoted to studies on thermal control. The Manager for control activities became Engineer Luigi Maria Quaglino, who organized a monitoring room with diagrams to be updated daily. In this way the Aeritalia staff began an ambitious project that required technology applications that, until then had never been used.

Although the start seemed to be good, something went wrong during the first Preliminary System Design Review. The Spacelab parts that had been built by the

[237] Vallerani Ernesto, *Italy and Space: Habitat Modules.* Mc Grew-Hill Italia, Milan, 1995, pp. 21.

companies in the consortium flocked to Bremen for the first assembly, but this arrangement did not work and the result was a total disaster. In addition, accompanying documentation was incomplete, the planning phase was late, the estimated costs continued to rise and the software produced by the French industry MATRA resulted as totally inadequate. The Spacelab project certainly did not start under the best auspices. ESA decided to reconsider the Spacelab project with significant cost reductions and reduced timetable[238].

The NASA-ESA agreement on Spacelab provided, in addition to construction of the Space laboratory, selection of European astronauts who were to perform missions on the Spacelab in cooperation with American cosmonauts. Every European country that was a member of ESA issued a recruitment call that was managed autonomously. Individual nations indicated the type of exams in the recruitment notice. In the end, the five selected candidates had to be assessed by an official ESA commission. In Italy, the Minister of Research managed selection with the help of the Airforce. A total of 248 applications arrived. The exams took place from August to September 1977, with both scientific and technical knowledge assessed[239] as well as psycho-physical ability[240] for orbital flight[241]. On 22 December 1978, the ESA General Director Roy Gibson announced the results of the first selection of European astronauts to be trained by NASA for the Shuttle/Spacelab missions[242]. The choice of final aspirants showed the poor consideration that the French ESA had of Italy. Despite Italy having been the second major contributor to the Spacelab project, NASA chose none of its astronauts for final selection[243]. The three final candidates examined by NASA

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238 Caprara Giovanni, Vallerani Enrico. *L'Italia sullo Shuttle*. Mondadori, Milan, 2012, p.36

239 The exams covering general culture and evaluation of scientific knowledge were given by a special commission nominated by CNR and headed by Luigi Broglio. The Commission required good English language skills in addition to an evaluation of technical-scientific knowledge.

240 The Aeronautical Institution of Space Medicine checked candidates' psychological and physical fitness.

241 Caprara, Giovanni. *Storia italiana dello spazio*, Saggi Bompiani, Milan, 2012, pp. 313-314.

242 See: http://www.esa.int/Our_Activities/Human_Spaceflight/Space_Shuttle/Europe_s_involvement_Spacelab

243 After the final candidates had been reduced first to five then to four, the Italian electronic engineer and physicist Franco Malerba, was present during NASA selections. After a

were the German Ulf Merbold[244], Swiss astro-physicist and pilot for Swissair Claude Nicollier and nuclear physicist from the University of Groningen Wubbo Ockels. Finally NASA chose Ulf Merbold.

After the reductions to the project, the Spacelab program began to progress more quickly. In April 1975 Aeritalia reached the first important milestone, when the first aluminum panels left the factory as the first order processed. Finally, in autumn 1977, the development of the flight unit could begin. The construction was finalized at the end of February 1979, when it was shipped from Turin for arrival in Bremen the following 5 March, ready for the test phase. Work progress was some months late as compared to the schedule, but also the development of the Space Shuttle itself was delayed, so the delivery of the flight unit to NASA was postponed until the end of 1980[245]. The integration of the activities for various module parts was completed in Bremen in November 1981. A total review was performed and NASA and ESA judged that Spacelab was feet to fly. Spacelab arrived in Cape Canaveral under the supervision of the Vice President of the United States, George Bush, on 5 February 1982. Then it was installed in the Shuttle Columbia STS-9, which was then taken to the platform for take off[246]. The Shuttle crew was composed of Commander John Watts Young[247], one of the 12 people who had walked on the Moon, pilot Brewster Shaw, mission specialists Owen Garriott and Robert Parker, the two load-specialists Byron Lichtenberg and Ulf Merbold, who became the first European astronaut.

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subsequent cut, however, the number of final candidates was lowered to three and Franco Malerba was rejected. The motivation was never clear. Malerba, in fact, passed all the tests and, according to many participants and examiners, he had proved to be the best candidate. Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012,, pp. 314-315

244 Ulf Merbold was born 20 June 1941. He studied physics at the University of Stuttgart graduating in 1968. After the doctorate earned in 1976, he joined the Max Planck Institute for Metals Research in Stuttgart where he studied low temperature physics.

245 Vallerani Ernesto, *Italy and Space: Habitat Modules*. Mc Grew-Hill Italia, Milan, 1995, p.46.

246 Caprara Giovanni, Vallerani Enrico. *L'Italia sullo Shuttle*. Mondadori, Milan, 2012. P. 36.

247 Young was the ninth man who walked on the Moon. He studied flight technics at Georgia Institute of Technology graduating in 1952. After graduation he joined the US Navy. As pilot he flew experimental planes. He participated in the Gemini mission, piloting the capsule on 17 September 1962. After the Germini program he participated in the Apollo missions.

Shuttle Columbia departed from Kennedy Space Center on 28 November 1983 at 11:00 hours. All the major actors from NASA and ESA were there to view the final final phase, representing Italy was the Minister of Research Luigi Granelli. The first Spacelab mission ended 10 days later. Shuttle Columbia landed at Edwards Airforce base in the Mojave Desert on the 8th of December[248].

The Spacelab maiden flight was the best start possible for an instrument that allowed hundreds of scientific and technologic experiments to be carried in microgravity conditions. Conceived to undertake orbital experiments within the International Space Station, Spacelab performed sixteen missions in fifteen years. The in air explosion of Challenger halted the spacelab mission from 1986 to 1991.

Despite the poor European recognition of Italy, Italian industry obtained impressive know-how. Aeritalia, succeeded in the most difficult task of building something that had never been realized before, and managing unknown technology. The Italy-US partnership proved to be a decisive winner and NASA recognized the extraordinary work accomplished by Italian industry. This was a merit that French-led ESA hardly recognized, demonstrating a jealousy that increased over the years following.

[248] In his work *Italy and Space: Habitat Modules* at Chapter 11, Ernesto Vallerani gives a detailed account of the first mission with the Spacelab onboard the Shuttle Columbia. Together with the emotions and satisfaction for this success, he reports the technical details of the experiments that the astronauts have been unable to complete within the Spacelab.

2. *From "Piano Spaziale Nazionale" to ASI – The End of the Pioneering Phase of Italian Space Program*

Italy found itself managing a number of projects over the years. At the same time relations with European agencies and those of other countries increased. With this growth in program management at the Ministry of Research, the entity in charge of political management of Italian space policy, was enhanced.

Events suggested there was a need to standardize management of space activities to relieve the Ministry of Research. The Ministry had, until then, handled international relations with European agencies, it should only have had to attend to national policies. The ministers of various governments[249] worked on elaborating a plan to set up an agency like NASA, CNES and DLR that could handle Italian space policies. The final impulse came from Minister Vito Scalia and Prime Minister Francesco Cossiga in 1979, and a special committee was set up within the Ministry that was chaired by Professor Francesco Scandone. The board of experts had the task of drawing up a plan that would lead to the creation of a national space plan: *Piano Spaziale Nazionale* (PSN). Once the work of the Commission had been concluded, Scalia presented the founding document of *Piano* to CIPE, which assigned management to CNR. An operational structure was formed to define the technical content of programs and verify their subsequent implementation. PSN was approved on 25 October 1979. CIPE assigned PSN the task of maintaining relations with space agencies in other countries by launching bilateral programs[250].

Luciano Guerriero[251] was designated head of *Piano Spaziale Nazionale* in 1980. PSN offered a solid foundation from which Italy could manage space projects. A

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249 The ministers who contributed to the drafting of the *Piano Spaziale Nazionale* were Mario Pedini, Dario Antoniozzi, Vito Scalia and Giorgio Postal.

250 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 320-321.

251 Luciano Guerriero is an Italian physicist. He graduated from the University of Padua in 1952. He studied elementary particles at the University of Padua and Bari and at the Massachusetts Institute of Technology. He was Director of the Physics Institute at the University of Bari. He was responsible for space activities, first as Director of *Piano Spaziale Nazionale* and then as

total expenditure of 200 billion Lira was provided in a five-year plan that could be upgraded as work evolved.

Costs were shared by setting medium-term goals to be accomplished in the period 1979-1981 and then in the years 1981-1983. A sum of 98 billion Lira were made available during the first three years as follows: 12 billion for basic scientific research, 7 billion for the San Marco Project, 7 billion for experiments on board the European Spacelab, 52 billion for space telecommunication programs that provided for the construction of Italstat satellite operating on frequencies 20-30 GHz, 6 billion for Earth remote sensing, 7 billion for advanced propulsion systems and 7 for future programs[252].

PSN transferred research commitments from planning to technology. This permitted the better identification of priorities and facilitated collaboration in science and industry[253].

The Ministry of Research maintained management of the ESA projects, for example the Spacelab and Ariane programs, even if *Piano Spaziale Nazionale* had controlled them better. Finally, Italy was in the possession of having a single voice to represent it within European organizations, which had been the missing voice during the formative phase of European space organizations.

The first project managed by *Piano Nazionale Spaziale* concerned the Italian ballistic missile named Alfa[254].

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first President of *Agenzia Spaziale Italiana.* Today, Professor Guerriero is a member of the International Astronautic Academy and Director of the School of Specialization in Signal Processing at the University of Bari.

252 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp.327-328.

253 Ferrone Enrico, *Carlo Buongiorno: Lo spazio di una vita.* Lo Gisma editore, Florence, 2011, p. 209.

254 Alfa was a two-stage missile drone, 6.5 m long. It was constructed using a fiberglass structure of 1.37mt diameter. It contained 6 tonne of polybutadiene propellant with a mixture of aluminium, percolating ammonium and ligand. The exhaust gases were issued from four graphite nozzles reinforced with carbon fibre. Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp.331-333

Alfa had distant origins. The project began during the 1950s and concerned the construction of a European atomic weapon in a joint project with Germany, France and Italy. The common project was abandoned when De Gaule decided to continue the project alone. Italy did not abandon the project and decided to continue with missile development. The Alfa missile was the Italian version of the American Polaris A1. The project of a missile built entirely under Italian license arose after the Pentagon refusal to give the Polaris A1drawings to Italy.

The Italian Navy had prepared the Garibaldi cruiser to launch Polaris missiles under an agreement with the United States, but they were never filled following the US-Soviet agreement following the Cuban Missile Crisis. However, the Navy did not abandon the project and funded a study on a strategic launcher to be placed on its cruiser instead of the Polaris. Industries involved in the production of Alfa included Aeritalia; SNIA Viscosa; SISTEL; Oleodinamica Magnanghi[255] and Selenia[256]. Unfortunately, Italy signed the Treaty on the Non-Proliferation of Nuclear Weapons in 1975 and the Alfa project was abandoned[257].

Despite the non-completion of the project, the acquired know-how had never been so far advanced allowing the launch of the rocket. Italian industries were, in fact, involved in launcher development for the first time. This proved useful during the development of other projects financed by *Piano Spaziale Nazionale.*

PSN financed not only Italian projects but also European programs developed by ESA. PSN decided to participate in ESA launcher development by financing the

[255] Magnaghi was an Italian industry founded in 1936. It specialized in the aeronautical sector, specifically on the development of landing systems. In addition it produced hydraulic actuators, electro-distributors and valves,

[256] Alfa construction was divided between involved industries as follow: Aeritalia built the structure; SNIA Viscosa developed the propellant system; SISTEL electronics; Selenia provided launch centers and Oleodinamica Magnanghi built the hydraulic servo control for mobile nozzles.

[257] Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 331-334.

production of Italian boosters for Ariane 2[258]. The project indicated the building of auxiliary propulsions to permit the European launcher to transport heavier payloads into orbit because of the increasing weight of the telecommunication satellites required a more powerful launcher. Works started in May 1980 after ESA approval of a follow-up development program for Ariane[259]. The boosters[260] were produced by SNIA BPD in Colleferro and were tested at Salto di Quirra in Sardinia[261].

The Guerriero administration of *Piano Spaziale Nazionale,* chose to maintain the privileged relationship with the Americans. The San Marco Project had proved that the United States was a good partner and Guerriero suggested continuing collaboration on new projects[262]. A group headed by Guerriero went to the United States to discuss new collaborative projects. They visited the Goddard Space Flight Center and Jet Propulsion Laboratory at Pasadena and met some supporters of the American space program. The Italian team proposed several collaborations with NASA because the visit's specific purpose was to close a collaboration agreement with the Americans for the new technologies of wire-satellites.

The first proposals focused on participating in Space Shuttle development with the Americans, and contributing to the cost of development. NASA decided to completely eliminate the ELV launcher[263], and committed the Space Shuttle to

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258 Ariane 2 program was renamed Ariane 3 after adding of Italian boosters.

259 France granted 60 % to Ariane upgrading. Germany and Italy participated with 18 % each.

260 Boosters produced by SNIA BPD were attached to the first stage of launcher to give a greater initial push. It was 7.6 m long with a diameter of 1.07 m. Every booster had 7.5 tonne of propellant and produced a thrust of 62.5 tonne for 20 seconds. After ESA's decision to produce a more powerful launcher, boosters were extended to 12.2 m to add 2 tonne more of propellant.

261 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 335-336.

262 In addition the major exponents of the Italian space policy have directly affairs with US. For example Professor Guerriero had contacts with Massachussets Institute of Technology; Ernesto Vallerani studied at California Institute of Technology and Carlo Buongiorno in New York. So Guerriero and his collaborator decided to travel in US to visit several space centers ant to improve partnership with Americans.

263 Expandable Launch Vehicle was a vehicle developed to carry payloads into space. The program was eliminated during NASA restructuring during Post-Apollo, and the subsequent development of reusable launchers, because it was designed to be used once and the components could not be recovered for re-utilization after launch.

commercial and scientific satellite launches so as to further reduce costs[264]. CIA proposed collaborating with NASA in the development of a propulsion system that would be able to put small satellites into orbit[265] directly from the Space Shuttle cargo bay[266]. The PAM-L project, then renamed Italian Research Integrim Stage (IRIS) aimed to create a propulsion system that would be able to put satellites into orbit that weighed less than 600 kg. The agreement terms were discussed with the Vice Presidents of McDonnell-Douglas Astronautics Company and advocated from CIA at Motel Warkulla on Cocoa Beach on 28 January 1977[267]. After the SIRIO launch CIA started development of IRIS. Italian industry also developed the payload that IRIS would place in a nearly circular orbit. The project resumed LAGEOS 1, a satellite for Earth geodetic observations that had been launched by NASA in 1976. LAGEOS 2 was projected to observe the movement of continental plates to identify the causes of earthquakes. It was built by Aeritalia, which had assumed the role of industry program manager, with the help of SNIA BPD that developed the rocket solid propellant MAG1s and Laben, FIAR and Microtecnica[268]. Unfortunately, the IRIS and LAGEOS 2 projects were delayed because of a misunderstanding, and decreasing interest after PSN decided to concentrate its efforts and funding on telecommunication satellites. In particular it aimed to develop Italstat, a telecommunications satellite that became the founder of a series of other telecommunication satellites that would permit space communication throughout Italy.

The American supporters of PSN suggested a more ambitious plan. The proposals began with an idea from Professor Colombo[269] to realize a system that connected

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264 Teofilatto Antonio, *Il Sirio e il dopo,* Rome, 2011, p. 269.

265 Satellites weighting from 600 to 900 gr.

266 After the funding cuts to the NASA budget, made by the Nixon administration, the American Space Agency decided to commit all satellite launches to the Space Shuttle. For this reason NASA created rocket engines to take heavy and medium loads into orbit. McDonnell-Douglas Astronautics Company developed the Payload Assist Module system (PAM-A) to take heavy satellites of class 'Agena' (from 2 500 to 1 200 kg) into orbit and the PAM-D for class delta satellites (from 800 to 1 200 kg). Boeing industry created the Interim Upper Stage (IUS) system to launch heavy satellites weighing from 2 000 to 5 000 kg into orbit.

267 Teofilatto Antonio, *Il Sirio e il dopo,* Rome, 2011, p. 273.

268 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp. 340-341.

269 Giuseppe Colombo was an Italian scientist born in Padua in 1920. He graduated from University Normale in Pisa. He became ordinary Professor of applied mechanics at the

satellite to the Shuttle cargo bay with a wire, with an initial funding of US$ 100 000 from NASA, the project became a reality. There were three proposals to use satellite wire; one to study the lower atmosphere; one to assist the launch into orbit of the transporting vehicle and a third proposal that suggested to using the wire for power generation to take advantage of the crossing of the magnetic field, PSN chose the latter[270]. NASA administrator James Beggg and CNR President and superintendent of PSN Ernesto Quagliariello, therefore, signed the Memorandum of Understanding in Rome, on 7 May 1984. The project was named Tethered Satellite System (TSS), provided by NASA, it would provide the delivery system for the 20 km long wire from the American company Martin Maietta. PSN and NASA chose 12 different experiments to be performed with TSS in 1985. Cortland Cable of New York produced the wire and Italian industry built the test satellite. BPD constructed the cold gas propulsion satellite systems and satellite stabilization, Laben and Fiar produced the electronics and power systems and Officine Galileo created orientation sensors. Unfortunately the Challenger disaster delayed the TSS program[271].

The political, technical and industrial management of Italian space activities required a step towards the creation of an Agency with the responsibility of the space sector. One of the protagonists of the centralization of the various Italian examples of Space activities was Luigi Granelli, Minister of Research from 1986 to 1987. He proposed a law for the establishment of *Agenzia Spaziale Italiana* (ASI) on October 1985. ASI was established three years later with law 186 of 1988. The law established that the Ministry of Research would have the political mandate but, although CNES and NASA were involved, ASI did non

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University of Pisa. He worked at the Smithsonian Astrophysical Observatory in Cambridge, US, from early 1960 and collaborated with NASA Jet Propulsion Laboratory and CALTECH where Colombo taught for many years. He gained popularity participating in the Mariner-10 mission, the first probe to reach Mercury. Thanks to his recalculation of the trajectory, the probe managed to accomplish three flybys of planets rather than only one as had been originally planned.

270 In explaining the reasons leading up to the selection of the PSN electromagnetic mission, Guerriero said that the choice was natural, because of the prevalence of research went in that direction. Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, p.345.

271 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, pp.343-347.

own/controlled any centres. Another problem was the lack of transitional provisions that did not allow for the harmonization of both the Board of Directors and the Scientific Committee. Initially, the two bodies failed to manage the agency, pausing at every difficulty[272]. Another problem was that staff that worked in the Space Activity Office of CNR could apply for transfer to ASI. The result was that for months ASI staff came entirely from CNR, and for this reason there was a total lack of administrative staff[273].

Guerriero was named as ASI presidency in July 1988. Buongiorno became the General Director. The Board of Directors was composed of Broglio[274], Enrico Cerrai, President of the Scientific Council of CISE, Luigi Napolitano, Director of Umberto Nobile Aeronautics Institute in Naples University , Saverio Valente, Physicist, Italian delegate at the Scientific Committee of ESA, Angelo Bagnato, General Director of Spei Leasing of IMI group, Vittorio Olcese, Former under-sectretary of Defense during the Craxi government, Giovanni Battista Urbani, Senator, Vice President of the Senate Industrial Commission during eighth legislature and Mario Bova, Director of the International Relation Office at the Ministry of Research. ASI was both a public entity controlled by the Ministry of Research and a private entity in the administration of strictly space matters. The ASI law, however, did not provide for the creation of a technological-scientific center on ASI property.

The establishment of *Piano Spaziale Nazionale*, under the direction of the Ministry of Research, brought project planning towards better collaboration between the private and public sectors. Thanks to *Piano,* Italian industry obtained satisfactory results in a great number of European and International programs[275]. The creation of ASI, although fraught with initial difficulties, gave Italy a single

[272] Ferrone Enrico, *Carlo Buongiorno: Lo spazio di una vita.* Lo Gisma editore, Florence, 2011, pp. 212.

[273] Di Bernardo Nicolai Giorgio, *Nella Nebbia in attesa del sole,* Di Renzo Editore, Roma, 2005.

[274] Broglio was appointed member of the ASI Board of Directors, despite his initial opposition. He accepted the nomination setting two conditions. He would not participate in discussions on San Marco and he would resign if his program was cancelled.

[275] Ferrone Enrico, *Carlo Buongiorno: Lo spazio di una vita.* Lo Gisma editore, Florence, 2011, p. 174.

agency to manage the orientation of space activities and the possibility of centralizing the academic and scientific world. The foundation of ASI coincided with the last launch of the San Marco satellite. The pioneering phase of Italian Space had gone from the waters of Kenya to ASI headquarter in Rome, launching of the first Italian satellite from Wallops Island was but a fading memory.

CONCLUSIONS

The Italian challenge in its path toward the conquest of the Space is definitely an amazing journey that strongly combines scientific achievements primates with many missed opportunities.

The ambiguous relationship between the academic world once led by Broglio, who allowed Italy to became the first European country to launch satellites into space, and the industrial world, despite the establishment of a sole institution dedicated to the management of space activities, is still present in the form of fracture even today.

The reasons why Broglio and the industrial world were driven to compete are still shrouded in mystery and answers belong to the simple field of hypotheses. Why Italy did not start a project to build a launcher, having shown to possess cutting edge knowledge, better than other European nations at that time? The reasons of this fault has to be found in a real lack of know-how or in a possible conflict of interests capable of preventing the construction of the Italian launcher? All this questions have different answers related to personal point of view, without objective reasons.

Industry maintains resentment against Broglio accusing him of lack of foresight and an excessive attachment to his work and to his vision, completely disconnected from the dynamics that, after the launch of the San Marco, drove the progress in space exploration. Broglio, as well as his successors in the Faculty of Aerospace Engineering at the University La Sapienza in Rome, accused industry of abandoning the joint project, just as when Broglio agreed with the Americans a memorandum for the construction of the first Italian launcher, the San Marco Scout. Inexplicably industry turned away, refusing to build it.

On this behaviour of the Italian industry, that heavily aimed to contracts linked to Europe and its Ariane, still hovers the shadow of a French boycott, deliberately pointing to block the construction of an all Italian launcher.

From any point of view taken about the pioneering phase in the history of Italian space conquests, this divergence did nothing but slow down space activities, giving the impression to start from scratch in each project that the industrialists or academics were preparing to carry out. Even today, although ASI was born with the clear intent to convey in a single voice the positions of the industrial and the academic worlds, it is a challenge which has yet to be won, as stated last year by the current president of ASI Roberto Battiston in interview with the journalist Giorgio Di Bernardo Nicolai,[276].

The greater merit to be attributed to Broglio is the start of a partnership with the Americans, thanks to which it is easier to understand the successes achieved by Italy in the space segment. NASA played a key role by sharing with our country means, resources and know-how that certainly contributed to enrich scientific knowledge and technology for a country like Italy coming out from a devastating war, flared by heavy restrictions imposed by victorious nations

Broglio and his academic followers sensed the ambiguity in the European environment and shared Amaldi's ideas for the creation of a single European entity devoted to manage only scientific programs, free of any contamination from the military world. The more confrontational relationship was definitely the one with the European agencies, with ESRO and ELDO first, and ESA after. Italian delegates suffered from a lack of support which other countries instead enjoyed. Italy struggled to assert its instances and eventually lost all the advantage obtained with the launches of San Marco, suffering a delay in European projects close to the development. Eventually profits and gains reached the space segment and industries started to consider the European agencies, not as a tool to enrich their knowledge but as a means of profit.

[276] Full interview can be found in: (https://www.youtube.com/watch?v=UQO44S9sJcE)

Undoubtedly, while criticizing the initial approach, it is impossible to deny, for Italian industries, the achievement of a knowledge and preparation, in the space segment, highly competitive compared to European consortia and even to the American ones. Our industries showed the courage to jump into the achievements of projects requiring a degree of knowledge not affordable by industries until then mainly devoted to the aeronautical field. Fiat Aviazione, then Aeritalia, Selenia, SNIA BPD, Italian Contraves, and others, were able to rationalize funds, very limited in comparison to those available to NASA, managing to create cutting-edge projects, for the time, which made up examples for future programs. The launch of the SIRIO satellite, capable of broadcasting at higher frequencies than other competitor telecommunications satellites, is an example of how our industries were ahead. The Spacelab project proved to the world that our industries were able to play a leading role, also participating in the development of what, at the time, was a revolutionary asset, able to modify the concepts of space transportation, enlarging the borders and enabling movement of a large number of people.

Despite this great effort, however, ESRO and ELDO before and ESA after, never seemed to give due credit to the Italian companies, may be a symptom of the fact that the ESA was increasingly becoming Franco-centric, thus giving greater prominence and more generous amount of funding to the projects presented by the French CNES. The choice to use as European launch site the test range of Korou, which construction had been properly initiated by the French in Guynea, without taking into consideration the proposals of Broglio for the expansion of the already active site of Santa Rita offshore Kenya, was the first indicator that ESA, rather than an agency where joining forces of all European countries, was becoming the tool of CNES to raise funds for its projects. Another example was the exclusion of the Italian astronaut candidate from the short list submitted to NASA, for the choice of the European astronaut participating to the first Shuttle mission with the Spacelab onboard.

The difficult relationship between ESA and Italy, after the founding of the ASI and the fall of the Berlin Wall, reached levels of open conflict. The French influence on the agency led to several failures, most notably the failure of the Hermes[277], the European shuttle, of which France was project leader. ESA, overwhelmed by the enthusiasm for the global end of the Cold War, began to approve several projects, with wrong assessment in costs, due to the advanced technology required. France poured on Italy its disappointment at the failure to start the realization of the Hermes, trying to win, as compensation, projects proposed to ESA by Italy. The Secretary of ESA at that time, Jean-Marie Luton, personally vetoed two Italian projects, one concerning a logistics module for supplies and the other for the construction of a rocket capable of launching small satellites. The fact that Italy would be able to launch its rocket only in 2012[278], further exemplifies the French success in blocking the Italian initiatives. Luton said about those projects: "Initiatives like this can cause difficulties for the ESA" about Italy added: "There is a political problem that Italy must solve between Europe and the United States[279]."

It was soon clear that the success of Italy in the space belonged to the past, the conflicts within ESA remained the same, while the excellent relations with the US consolidated allowing, few years after the foundation of ASI, to gain successes in the programs launched by the previous National Space Plan. These included the first flight of the "Tethered" captive satellite, dreamed by Professor Colombo, launched on 31 July 1992 from Cape Canaveral with the Shuttle Atlantis[280], with

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277 The Hermes project was launched in 1987. according with the program the first launch was scheduled in 1995 with the new European launcher Ariane 5, from the site of Korou. It was tailored for a three member crew and a loading capability of 3000kg.

278 The VEGA launcher project was realized within ESA, with an Italian contribution of 65%, followed by the French partecipation of 12,5%. VEGA was a launcher smaller than Ariane 5. It is about 30mt high weighting more than 128 tonns. It is a three stages launcher, with solid propellant, able to put in a lower polar orbit (90° to the equator at an altitude of about 700km) payload ranging between 300 and 1500 kg. Industries participating in the project were ELV, an holding owned for the 70% by AVIO group and for the remaining 30% by ASI. The AVIO Group also realized all the stages of the Italian launcher, while VITROCISET realized various round facilities, including the launch tower and the integration and test bench. The most recent launch of VEGA dates 23 June 2015. http://www.asi.it/it/attivita/trasporto-spaziale/vega.

279 Caprara, Giovanni. *Storia italiana dello spazio,* Saggi Bompiani, Milan, 2012, P. 378.

280 Indeed, the first mission of the Tethered did not go as planned. At 256mt from the shuttle, the thread blocked and the attempts to unlock it were unsuccessful. Despite this hiccup the

Franco Malerba onboard, first Italian astronaut to participate in the operations. In the same year, on October 23, it was also employed IRIS, a mini engine able to put in orbit the satellite LAGEOS 2, starting from the cargo bay of the Shuttle Columbia.

There were more projects out of the collaboration between Italy and US, but unfortunately this time seems to come to an end. The new ASI policy is definitely geared towards a rationalization between projects and available funds. The intention is to try to avoid situations experienced in the past, when the launch of too many programs was not online with the funds availability. In the meantime the strong reduction of public founding to the space research in general in the US, and toward NASA in particular, is creating a situation where the private actor begins to cover areas left by the Obama Administration. Space for collaborations between governments is becoming poor.

According to engineer Roberto Somma, who worked in Thales Alenia Space, the contacts with the US space organization are weakening mainly for this depletion of founds, thus losing new opportunities for development in the space segment [281].

Since the time of the epilogue of the Cold War the Space has played an import role in favour of world peace. New nations are now entering the space segment, together with China has to be recorded the entrance of India and Arabic Countries. To work together could be again a new occasion to improve peaceful relationship between countries, as it happened with the embrace of the astronauts of the Apollo-Soyuz that led to a thaw between the two super powers in 1975.
Not to be underestimated is also the technological output coming from the space activities. As seen in Chapter I, after the Space Race, those activities have been the phenomenon that characterized the *modus vivendi* of the society in the second

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experiment gave good signs of operation generating electric current, even if at an intensity much lower than expected. Unfortunately, also the second attempt failed to pass. The thread of Professor Colombo, in fact, during the second mission on 22 Febbraio1996, aboard the Shuttle Columbia, carrying the Italian astronauts Umberto Guidoni and Maurizio Cheli, broke completely wasting the satellite connected to him.

281 Author's interview with Roberto Somma, Roma, 14 July 2015

half of the last century and it is continuing in this century. The development of computers, mobile phones, internet, are all products that came from the space technologies.

In conclusion, if we can easily say that the role played by the United States, in the pioneering phase of the Italian access to space, has been a positive contribution, it remains rather discordant the view on the European contribution in sharing programs with our Country. The US gave the right impetus, allowing Italy to reach an essential level of technical and scientific knowledge to realize the programs analyzed in this thesis.

If , on the one hand, Broglio's heirs in the academic world see the role played by Europe more like a brake on purely national space policies, on the other hand, industry representatives consider Europe as the best tool to realize projects, having better access to funds and assets to be employed in competitive programs, capable to secure the market against the appetites of other nations, old and new on the scene.

It is impossible to underline, any way, that the merging of resources and capabilities coming from different countries allows better synergies, but the space vision actually enforced by NASA, and the other major space organization, is mainly conditioned by a growth of the commercial aspect appreciated by industry, leaving behind the more ambitious pure scientific programs that, in these days, seems to be relegated to the world of the science fiction and the imaginative visions.

ACRONYMS

ASI:	Agenzia Spaziale Italiana
CIA/CNA:	Compagnia Italiana Industriale then Compagnia Nazionale Aerospaziale
CIAS	Commissione Interministeriale per l'Attività Spaziale
CIPE:	Comitato Intermisteriale per la Programmazione Economica
CISPS:	Commissione Intercomitati per lo Studio dei Problemi Spaziali.
CNES:	Centre National d'Etudes Spatiales
CNPM:	Centro Nazionale di ricerca sulla tecnologia della Propulsione dei Materiali
CNS	Compagnia Nazionale Satelliti per telecomunicazioni
CNR:	Consiglio Nazionale delle Ricerche
COPERS	European Commision fo Space Research
COSPAR:	Committe on Space Resarch
CRA:	Centro Ricerche Aerospaziali
CRS:	Commissione Ricerche Spaziali
DLR:	Deutschen zentrum fur Luft und Raumfahrt
ECS	European Commission Satellites
ELDO:	European Launcher Development Organization
ENI:	Ente Nazionale Idrocarburi
ESA:	European Space Agency
ESC:	European Space Conference
ESRO:	European Space Research Organization
ESTEC:	European Space Technical Centre
EVA:	Extra Vehicular Activity
INTELSAT:	International Telecomunications Satellite Organization
IRI:	Istituto di Ricostruzione Industriale

IRIS:	Italian Research (or Recoverable) Interim Stage
LEO:	Low Earth Orbit
NASA:	National Aeronautics and Space Administration
NATO:	North Atlantic Treaty Organization
OTS:	Orbital Test Satellite
PAM:	Payload Assist Module
SIRIO:	Satellite Italiano di Ricerca Industriale Orientata
STS:	Space Transportation System (Shuttle)
STV:	Satellite Test Vehicle
TV:	TeleVision
UN:	United Nations
US:	United States
USSR:	Union of Soviet Socialist Republics.

Annex 1[282]

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies

Signed at Washington, London, Moscow, January 27, 1967
Entered into force October 10, 1967

The States Parties to this Treaty,
Inspired by the great prospects opening up before mankind as a result of mans entry into outer space,
Recognizing the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes,
Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development,
Desiring to contribute to broad international co-operation in the scientific as well as the legal aspects of the exploration and use of outer space for peaceful purposes,
Believing that such co-operation will contribute to the development of mutual understanding and to the strengthening of friendly relations between States and peoples,
Recalling resolution 1962 (XVIII), entitled "Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space," which was adopted unanimously by the United Nations General Assembly on 13 December 1963,
Recalling resolution 1884 (XVIII), calling upon States to refrain from placing in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction or from installing such weapons on celestial bodies, which was adopted unanimously by the United Nations General Assembly on 17 October 1963,

[282] (downloaded from http://www.state.gov/t/isn/5181.htm#treaty 18 September 2015

Taking account of United Nations General Assembly resolution 110 (II) of 3 November 1947, which condemned propaganda designed or likely to provoke or encourage any threat to the peace, breach of the peace or act of aggression, and considering that the aforementioned resolution is applicable to outer space,

Convinced that a Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, will further the Purposes and Principles of the Charter of the United Nations,

Have agreed on the following:

Article I

The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.

Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation.

Article II

Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

Article III

States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of

maintaining international peace and security and promoting international co-operation and understanding.

Article IV

States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.

The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military maneuvers on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited.

Article V

States Parties to the Treaty shall regard astronauts as envoys of mankind in outer space and shall render to them all possible assistance in the event of accident, distress, or emergency landing on the territory of another State Party or on the high seas. When astronauts make such a landing, they shall be safely and promptly returned to the State of registry of their space vehicle.

In carrying on activities in outer space and on celestial bodies, the astronauts of one State Party shall render all possible assistance to the astronauts of other States Parties.

States Parties to the Treaty shall immediately inform the other States Parties to the Treaty or the Secretary-General of the United Nations of any phenomena they discover in outer space, including the Moon and other celestial bodies, which could constitute a danger to the life or health of astronauts.

Article VI

States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the Moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization.

Article VII

Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies.

Article VIII

A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party, which shall, upon request, furnish identifying data prior to their return.

Article IX

In the exploration and use of outer space, including the Moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space, including the Moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, may request consultation concerning the activity or experiment.

Article X

In order to promote international co-operation in the exploration and use of outer space, including the Moon and other celestial bodies, in conformity with the purposes of this Treaty, the States Parties to the Treaty shall consider on a basis of equality any requests by other States Parties to the Treaty to be afforded an opportunity to observe the flight of space objects launched by those States.

The nature of such an opportunity for observation and the conditions under which it could be afforded shall be determined by agreement between the States concerned.

Article XI

In order to promote international co-operation in the peaceful exploration and use of outer space, States Parties to the Treaty conducting activities in outer space, including the Moon and other celestial bodies, agree to inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of such activities. On receiving the said information, the Secretary-General of the United Nations should be prepared to disseminate it immediately and effectively.

Article XII

All stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited.

Article XIII

The provisions of this Treaty shall apply to the activities of States Parties to the Treaty in the exploration and use of outer space, including the Moon and other celestial bodies, whether such activities are carried on by a single State Party to the Treaty or jointly with other States, including cases where they are carried on within the framework of international intergovernmental organizations.

Any practical questions arising in connection with activities carried on by international inter-governmental organizations in the exploration and use of outer space, including the Moon and other celestial bodies, shall be resolved by the States Parties to the Treaty either with the appropriate international organization or with one or more States members of that international organization, which are Parties to this Treaty.

Article XIV

1. This Treaty shall be open to all States for signature. Any State which does not sign this Treaty before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.
2. This Treaty shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland and the Union of Soviet Socialist Republics, which are hereby designated the Depositary Governments.
3. This Treaty shall enter into force upon the deposit of instruments of ratification by five Governments including the Governments designated as Depositary Governments under this Treaty.
4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Treaty, it shall enter into force on the date of the deposit of their instruments of ratification or accession.
5. The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification of and accession to this Treaty, the date of its entry into force and other notices.
6. This Treaty shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.

Article XV

Any State Party to the Treaty may propose amendments to this Treaty. Amendments shall enter into force for each State Party to the Treaty accepting the amendments upon their acceptance by a majority of the States Parties to the Treaty and thereafter for each remaining State Party to the Treaty on the date of acceptance by it.

Article XVI

Any State Party to the Treaty may give notice of its withdrawal from the Treaty one year after its entry into force by written notification to the Depositary

Governments. Such withdrawal shall take effect one year from the date of receipt of this notification.

Article XVII

This Treaty, of which the English, Russian, French, Spanish and Chinese texts are equally authentic, shall be deposited in the archives of the Depositary Governments. Duly certified copies of this Treaty shall be transmitted by the Depositary Governments to the Governments of the signatory and acceding States.

IN WITNESS WHEREOF the undersigned, duly authorized, have signed this Treaty.

DONE in triplicate, at the cities of Washington, London and Moscow, this twenty-seventh day of January one thousand nine hundred sixty-seven

SIGNATORY COUNTRIES (omissis)

Annex 2[283]

No. 6663

UNITED STATES OF AMERICA
and
ITALY

Exchange of notes (with Memorandum of Understanding dated 31 May 1962) constituting an agreement relating to a space science research program. Rome, 5 September 1962

Official texts: English and Italian.

Registered by the United States of America on 24 April 1963.

ÉTATS-UNIS D'AMÉRIQUE
et
ITALIE

Échange de notes (avec Mémorandum d'accord du 31 mai 1962) constituant un accord relatif à un programme de recherche scientifique spatiale. Rome, 5 septembre 1962

Textes officiels anglais et italien.

Enregistré par les États-Unis d'Amérique le 24 avril 1963.

[283] Downloaded from https://treaties.un.org/doc/publication/unts/volume%20461/volume-461-i-6663-other.pdf on 25 September 2015

« Il Governo degli Stati Uniti conferma il Memorandum d'intesa firmato il 31 maggio 1962 tra la National Aeronautics and Space Administration degli Stati Uniti e la Commissione Spaziale Italiana, copia del quale è qui acclusa. Resta inteso che l'applicazione e la direzione della partecipazione degli Stati Uniti nel proposto esperimento scientifico saranno sotto la responsabilità della National Aeronautics and Space Administration e che l'applicazione e la direzione della partecipazione italiana saranno sotto la responsabilità della Commissione Spaziale Italiana. La realizzazione ed i tempi di esecuzione dell'esperimento scientifico saranno stabiliti di mutuo accordo tra i due enti scientifici interessati e sottoposti alle condizioni che i due enti hanno previsto nel Memorandum d'intesa.

« Ho l'onore di proporre che la presente Nota, unitamente alla risposta di Vostra Eccellenza nello stesso senso e confermante l'accluso Memorandum d'intesa, costituisca un accordo tra i nostri due Governi, il quale entrerà in vigore alla data della risposta di Vostra Eccellenza. »

Ho l'onore di comunicarLe, Signor Vice Presidente, che il Governo italiano concorda con quanto precede.

Voglia gradire, Signor Vice Presidente, i sensi della mia più alta considerazione.

Allegato :
Memorandum d'intesa del 31 maggio 1962

PICCIONI

Onorevole Lyndon B. Johnson
Vice Presidente degli Stati Uniti d'America
Roma

MEMORANDUM D'INTESA TRA LA COMMISSIONE ITALIANA PER LE RICERCHE SPAZIALI DEL CONSIGLIO NAZIONALE DELLE RICERCHE E LA U. S. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

1. La Commissione Italiana per le Ricerche Spaziali del Consiglio Nazionale delle Ricerche (la Commissione) e la « National Aeronautics and Space Administration » degli Stati Uniti di America (NASA) affermano il reciproco desiderio di condurre una serie di esperimenti che si prevede porteranno al lancio di un satellite scientifico entro un'orbita equatoriale, con lo scopo di misurare le caratteristiche atmosferiche e ionosferiche in una regione dell'atmosfera terrestre fino ad oggi inesplorata. I dati scientifici derivanti dagli esperimenti saranno liberamente consultabili.

É previsto che questo programma sperimentale si articolerà in tre fasi :

a) *prima fase :* i principali elementi della strumentazione scientifica del satellite verranno sottoposti ad una prova di volo utilizzando un adatto razzo sonda. Questo lancio sarà effettuato dal Poligono di Wallops Island e/oppure da una piattaforma italiana del tipo San Marco ubicata presso l'Equatore ;

b) *seconda fase :* un prototipo definitivo del satellite strumentato verrà messo in orbita per mezzo di un vettore Scout lanciato dal Poligono di Wallops Island ;

c) *terza fase :* il satellite scientifico, con a bordo la strumentazione necessaria agli esperimenti sopradetti, verrà messo in orbita equatoriale per mezzo di un vettore Scout lanciato da una piattaforma del tipo San Marco, situata in acque equatoriali.

2. I due organismi scientifici cooperanti passeranno da ciascuna delle suddette fasi alla successiva in seguito a mutuo accordo sulla realizzabilità tecnica della nuova fase e, particolarmente, a condizione che i requisiti ambientali per la terza fase del programma siano stati soddisfatti.

3. La Commissione si assumerà in generale la responsabilità per quanto segue :

a) spese di mantenimento del personale italiano destinato ad essere istruito nelle operazioni di lancio, de osservazione, di riduzione e di analisi dei dati ed in altri settori del programma come mutuamente concordato ;

b) progetto, costruzione e prove di tutti i satelliti e loro completa strumentazione;

c) studi e provvedimenti quali risulteranno necessari per assicurare delle condizioni ambientali mutuamente accettabili per il trasporto, il maneggio ed il lancio dello Scout nella terza fase del programma ;

d) disponibilità equipaggiamento, manutenzione e funzionamento delle piattaforme rimorchiabili tipo San Marco ;

e) realizzazione di un adatto complesso di lancio per la terza fase del programma, ivi incluse le misure di sicurezza del poligono come da mutuo accordo ;

f) lancio del satellite nella terza fase del programma ;

g) analisi dei dati in tutte le fasi del programma ;

h) strumentazione per l'osservazione e l'acquisizione dei dati richiesti nella terza fase che fossero specifici del progetto San Marco e che la NASA non avesse disponibili ;

i) spese di carattere logistico ed altre spese specifiche del progetto San Marco.

4. La NASA sarà responsabile in generale per quanto segue :

a) approvvigionamento di un adatto razzo sonda e di un razzo di riserva, secondo mutuo accordo, per la prima fase del programma ;

b) approvvigionamento di vettori orbitali Scout con vettori di riserva per la seconda e terza fase del programma ;

c) istruzione tecnica del personale italiano secondo quanto sarà possibile ottenere senza un eccessivo aggravio finanziario ;

d) consulenza tecnica come del caso ;

e) eventuali ulteriori prove a terra della strumentazione scientifica se si renderanno necessarie ;

f) fornitura dei dati necessari per facilitare il progetto, la costruzione e le prove dei satelliti e della loro strumentazione ;

g) osservazione ed acquisizione dei dati nella prima e seconda fase del programma quale può essere conseguita usando la strumentazione NASA già esistente per l'osservazione e l'acquisizione dei dati da razzi sonda e satelliti scientifici ;

h) uso della Stazione Minitrack di Quito (Ecuador), per l'osservazione e l'acquisizione dei dati nella terza fase del programma ; rete di comunicazioni per il funzionamento di altre stazioni di osservazione come risulterà possibile evitando le interferenze, e salvo il benestare di ogni governo straniero interessato. Il personale e l'equipaggiamento speciale eventualmente necessario al sopraddetto scopo saranno sotto la responsabilità della Commissione.

5. Nessuno scambio di fondi è contemplato fra i due enti scientifici cooperanti.

6. Ciascun organismo conviene di designare un direttore del progetto che sarà responsabile del coordinamento delle convenute attività e responsabilità di ciascun ente nei riguardi dell'altro. Insieme essi nomineranno un gruppo di lavoro misto formato da esperti nei singoli rami. I particolari relativi alla realizzazione del programma saranno decisi di mutuo accordo nell'ambito di tale gruppo di lavoro.

7. La successione nel tempo di ciascuna delle tre fasi sarà decisa di comune accordo.

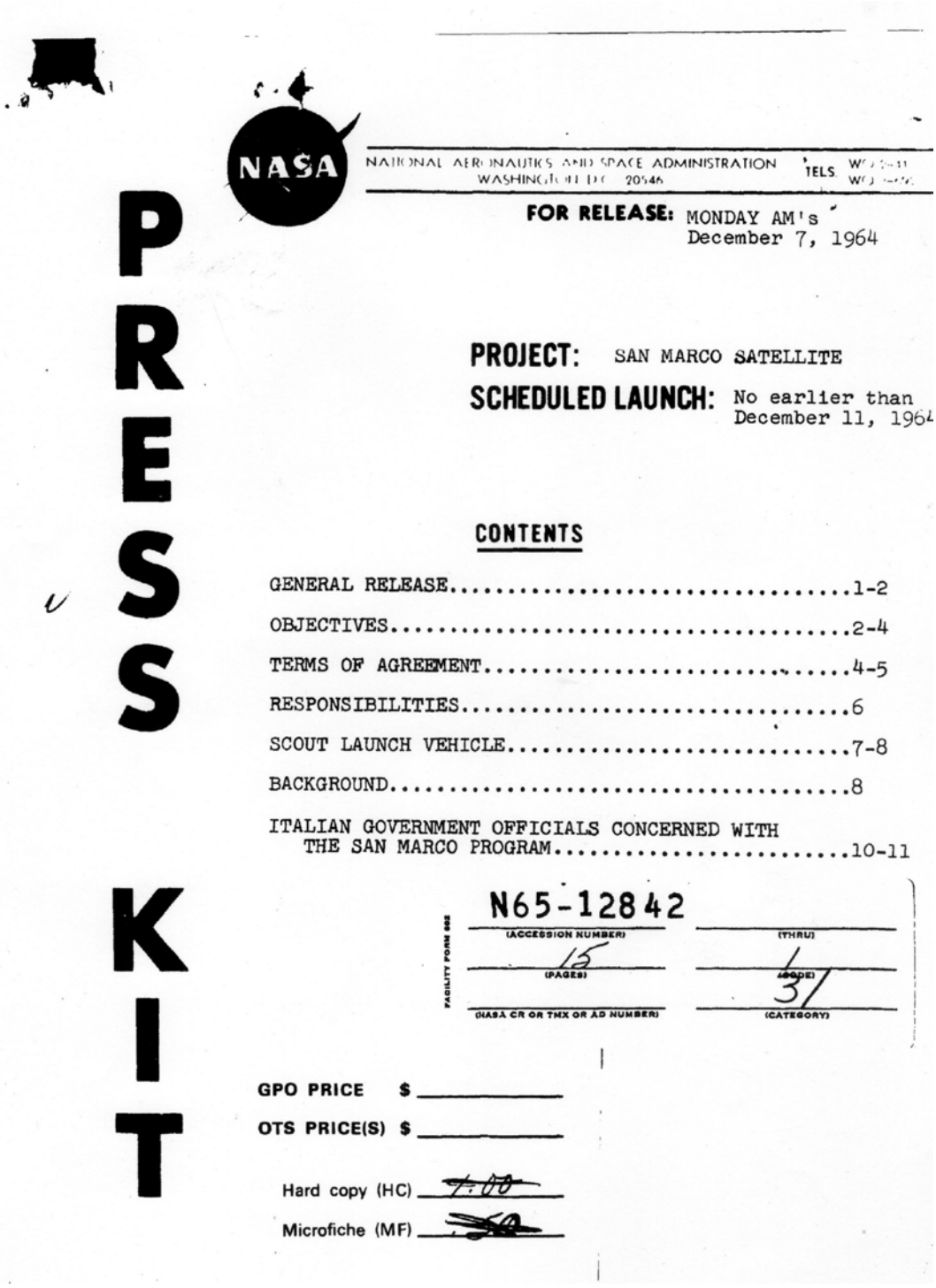
8. Tutti i lanci che fanno parte di questo programma saranno effettuati da località che verranno scelte d'accordo dai due enti scientifici i quali dovranno consultare i loro rispettivi Governi come del caso.

9. Questo Memorandum d'intesa dovrà essere sottoposto al consenso del Ministero degli Affari Esteri italiano e del Dipartimento di Stato degli Stati Uniti di America, espresso attraverso uno scambio di note.

Ginevra, 31 maggio 1962

Per la Commissione :	Per la NASA :
Prof. Luigi BROGLIO	Dr. H. L. DRYDEN

Annex 3[284]



NASA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON D.C. 20546

TELS.

FOR RELEASE: MONDAY AM's
December 7, 1964

PROJECT: SAN MARCO SATELLITE

SCHEDULED LAUNCH: No earlier than
December 11, 1964

PRESS KIT

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[284] Downloaded from NASA website https://www.nasa.gov on 12 September 2015

NEWS NASA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546
TELS. WO 9-4155
WO 3-6925

FOR RELEASE: MONDAY AM's
December 7,1964

RELEASE NO: 64-301

ITALIAN SAN MARCO SATELLITE LAUNCH SET FROM WALLOPS

The Italian Commission for Space Research and the National Aeronautics and Space Administration soon will place in orbit the first San Marco satellite designed and built by the Italians to conduct continuous measurements of Air Density.

The launch, scheduled from Wallops Island, Va., no earlier than Dec. 11, will be conducted by a NASA-trained Italian launch crew. A four-stage solid propellant Scout, designated San Marco Scout 1, will be the launch vehicle.

This will be the first time in the NASA international cooperative program that a satellite launch operation has been conducted by a team of foreign nationals. United States launch crews have placed in orbit two United Kingdom satellites and one Canadian satellite.

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The 254-pound San Marco satellite will be launched in an easterly direction from Wallops Island. Inclination to the equator will be 37.7 degrees. Its orbit is expected to have a perigee (low point) of approximately 135 statute miles (214 kilometers) and an apogee (high point) of about 420 statute miles (677 kilometers).

OBJECTIVES

Objectives of the mission are (1) to serve as a training exercise for the Italian launch crew in preparation for a sea platform operation; (2) to qualify the San Marco spacecraft for a later launch into an equatorial orbit from a sea platform in the Indian Ocean near the Equator; and (3) to provide measurements of air density and to investigate ionospheric characteristics related to interference with long-range radio transmissions.

Instrumentation in the 26-inch spherical spacecraft was tested in two suborbital flights from Wallops Island last year -- April 20 and Aug. 2. Launch vehicle used was the two-stage Shotput rocket.

This first attempt at continuous measurement of air drag forces on a spacecraft is made possible by a payload configuration consisting fundamentally of two concentric structures -- a heavy spherical structure contained in a much lighter spherical outer shell. The two spheres are linked by non-rigid connections.

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When the orbiting light outer shell encounters the thin upper atmosphere, it is retarded by this drag to a slight degree. The heavy inner core, however, continues traveling unaffected except for the force transmitted by the flexible connections. The result is that the distances between the outer shell and the "floating" inner core change.

Equivalent position changes take place in three flexible arms that connect the core and the shell. The precise degree of movement, reflecting atmospheric drag -- hence, the air density -- is measured by strain gauges and transmitted to ground stations by radio.

A second experiment, with instruments attached to the inner core, will investigate certain characteristics in long-range radio transmissions.

The equatorial region also is the zone of greatest exposure to solar radiation which heats the atmosphere. This heating causes the atmosphere to expand and swell to its highest point in the equatorial region.

Both experiments will operate at maximum advantage when the San Marco satellite is launched into an equatorial orbit from the sea platform.

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The project was conceived by Professor Luigi Broglio, Chairman of the Italian Commission for Space Research and Project General Director of the San Marco Project. The payload was developed by Professor Broglio and his group at the Aerospace Research Center in Rome.

TERMS OF AGREEMENT

The San Marco Project, involving the first satellite wholly designed and built in Western Europe, stems from an agreement signed by representatives of Italy and the United States Sept. 5, 1962. Basic objective of the cooperative venture in space is to perform high altitude measurements of atmospheric and ionospheric characteristics in the equatorial region.

Under terms of the agreement between the two countries NASA is providing the launch vehicles, use of its facilities, and training for Italian personnel for the initial phase of the program.

The Italian group is responsible for the design, fabrication, and testing of all payloads and experiments including construction of the satellite structure and telemetry, as well as for the orbital launchings. The Italian team also is establishing the equatorial range, including the mobile platforms, and such tracking and data acquisition facilities

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as are peculiar to project San Marco and which are not available from NASA.

No exchange of funds between the two countries is involved. Scientific data resulting from the program will be made available to the world community of scientists.

The project is designed to culminate in the launching of a satellite into an equatorial orbit by the Italians. This launch, again using a NASA Scout launch vehicle, is to take place from a towable platform (similar to a Texas tower) located near the equator on the continental shelf off the east coast of Africa.

Tests of launch platform operations were conducted in March of this year at the equatorial site with sounding rockets of the Nike-Apache class.

Nearly 75 members of the Italian San Marco project team have been in training at intervals for the past two years at Wallops Station and other NASA facilities, and at the site of the prime contractor for Scout, Ling-Temco-Vought in Dallas, Tex.

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RESPONSIBILITIES

The NASA Goddard Space Flight Center has assisted in testing of the payload and in training Italian personnel pending completion of test facilities in Italy and will assist in worldwide tracking and data acquisition. NASA's Langley Research Center is responsible for technical direction of the NASA portion of the program, including training by the Scout Project Office on the Scout launch vehicle. NASA's Wallops Station is responsible for the training of range support and operations personnel.

The San Marco Scout launch at Wallops Station will be conducted by the Italian launch crew, assisted by Ling-Temco-Vought personnel. Professor Broglio will direct the Italian space commission team effort during the forthcoming operation. Prof. Michele Sirinian is Launch Crew Director and Dr. G. Ravelli is Chief Spacecraft Engineer.

NASA Program Manager is R. D. Ginter of the Office of Space Science and Applications. The Langley Research Center Vehicle Project Manager is Roland D. English and Louis P. Tosti is Langley Field Operations Director. The Wallops Project Engineer for the launch is Tom W. Perry. Raymond H. Stanley of Wallops is Technical Advisor for Range Instrumentation Systems Design, Implementation and Training. Anthony Caporale is the Goddard Project Engineer.

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SCOUT LAUNCH VEHICLE

Scout is a multi-stage launch vehicle using four solid propellant rocket motors capable of carrying payloads of varying sizes on orbital, space probe or reentry missions. Scout is 72 feet long and weighs 20 tons at liftoff.

Scout was developed by NASA's Langley Research Center, Hampton, Va. It is manufactured by Ling-Temco-Vought, Inc., Dallas.

The four motors are interlocked with transition sections which contain guidance, control, ignition, instrumentation systems, separation mechanisms, and spin motors. Guidance is provided by a strapped-down gyro system and control is achieved by a combination of aerodynamic surfaces, jet vanes and hydrogen peroxide jets.

Scout is capable of placing approximately 240 pounds into a 300-mile orbit or of carrying a 100-pound scientific probe some 7,000 miles away from Earth.

Scout stages include the following motors:

First Stage: Algol IIB - 105,000 pounds thrust, burning time 68 seconds.

Second Stage: Castor I - 62,000 pounds thrust, burning time 42 seconds.

Third Stage: Antares II (ABL X-259) - 22,000 pounds thrust, burning time 36 seconds.

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Fourth Stage: Altair II (ABL X-258) - 5,800 pounds thrust, burning time 24 seconds.

BACKGROUND

The San Marco project is part of NASA's international program, which has among its objectives:

1. To provide the opportunity for scientists of other nations to participate in and contribute to man's understanding and use of his spatial environment;

2. To support the operating requirements of the NASA program;

3. To demonstrate the open character and peaceful purposes of the U.S. space program.

Arrangements for such flight projects as San Marco call for mutual agreement between NASA and the central civilian agency appointed to act on behalf of a given participating government to cooperate on a specific project which has scientific validity and is of mutual interest.

A program usually begins with receipt by NASA of a proposal from the foreign group. Upon preliminary agreement among the concerned scientists, a Memorandum of Understanding which defines what each party will do is negotiated between NASA and the designated foreign agency. In cases involving a sizable commitment of resources (such as San Marco), the Memorandum of Understanding is ratified through diplomatic channels by the participating goverments.

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Scientific information obtained from the project is shared by both parties and the results are made available to the world scientific community.

To date, NASA has agreements to launch cooperative satellites with the United Kingdom, Canada, Italy, France and the European Space Research Organization (ESRO) composed of nine Western European nations.

In the cases of the Ariel I (launched April 1962) and Ariel II (March 1964) the United Kingdom's contribution was the design and preparation of the experiments placed on board the spacecraft. The United States provided the spacecraft and launch vehicle, and launched the satellite.

The Alouette (launched September 1962) project with Canada involved greater foreign participation, in that the Canadians not only prepared the experiments, but designed and engineered the spacecraft itself, while the United States provided the launch vehicle and launched the satellite. Similarly, the FR-1 and UK-E spacecraft will be conceived, designed and built by the French and British respectively, and launched by NASA from the Western Test Range.

The San Marco program provides still greater extension of foreign participation. The United States provides the Scout launch vehicle. But the Itallians, in addition to designing and engineering the spacecraft and its experiments, also are designing and assembling the launch complex, arranging

-more-

for the site, and, after receiving NASA training, an Italian crew will launch the satellites.

The planned Italian San Marco Range will be a complex facility, including two mobile sea-going platforms especially equipped with launchers, control and guidance equipment, radar and range safety devices, air conditioned working shelter and test rooms, command and tracking stations, etc.

One of the two platforms is used mainly as a launching pad and the other as the control and operations center. They are connected to each other by special submarine control and power cables.

The first of the two platforms, the "Santa Rita" was used in the March operations at the Equator.

ITALIAN GOVERNMENT'S TOP OFFICIALS CONCERNED WITH THE SAN MARCO PROGRAM:

Professor Giovanni Polvani, Chairman, National Research Council and Chairman, National Institute of Space Research.

Gen. Cesare De Porto, Chairman, Ad Hoc San Marco Working Group of the National Institute of Space Research.

Ambassador Egidio Ortona, Director General, Economic Affairs in the Ministry of Foreign Affairs.

Professor Luigi Broglio, Chairman, Italian Space Commission and San Marco Project General Director and Test Director.

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Professor Carlo Buongiorono, Assistant Project General Director.

Dr. Giorgio Ravelli, San Marco Project Payload Manager.

Instrumentation Engineers:

Dr. Ugo Ponzi, Balance Experiments

Dr. Carlo Arduini, Therman Control System

Dr. G. Barresi, Payload Telemetry

Dr. G. Pellegrineschi, Payload RF System

Dr. V. Mazzaglio, Space Simulator Tests

Professor P. F. Checcacci, Ionospheric Experiments

G. Tarabra, Payload Structure

Data Acquisition and Evaluation:

Professor Paolo Santini, Orbit Analysis

Dr. Severino Giorgi, Data Reduction

Dr. Fabrizio Barbieri, Data Acquisition

Payload Experiments:

Professor Luigi Broglio, Balance Experiment

Professor Nello Carrara, Ionospheric Experiment

Vehicle and Launch Team:

Professor M. D. Sirinian, Assistant Test Director

Dr. G. Spampinato, Test Conductor

Dr. G. F. Manarini, Electronics Supervisor

Range Control:

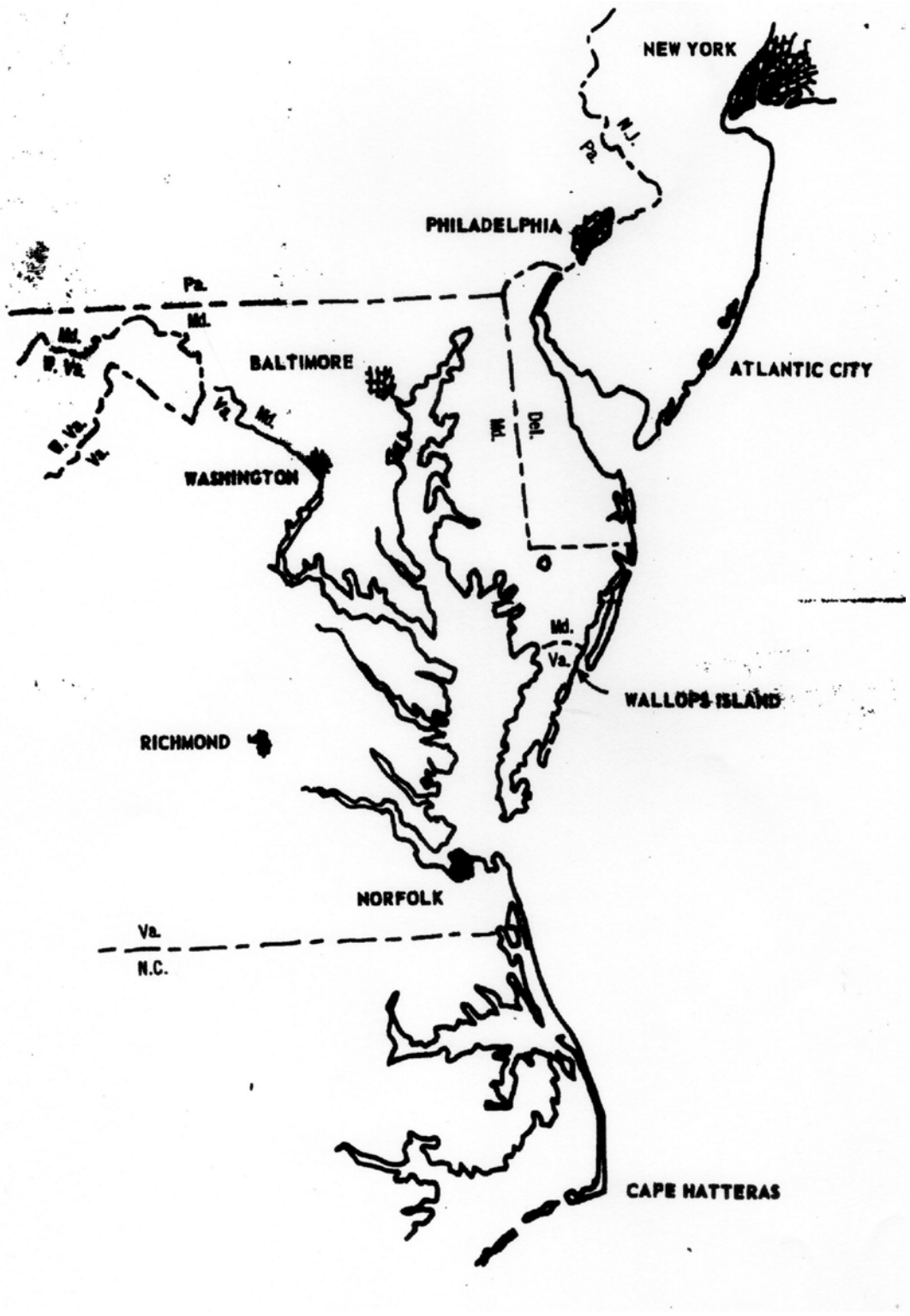
Dr. R. Solimena, Range Instrumentation

Dr. A. Berlese, Range Safety Officer

NASA Liaison:

Dr. Franco Fiorio

-End-


NEW YORK
N.J.
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PHILADELPHIA
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W. Va.
BALTIMORE
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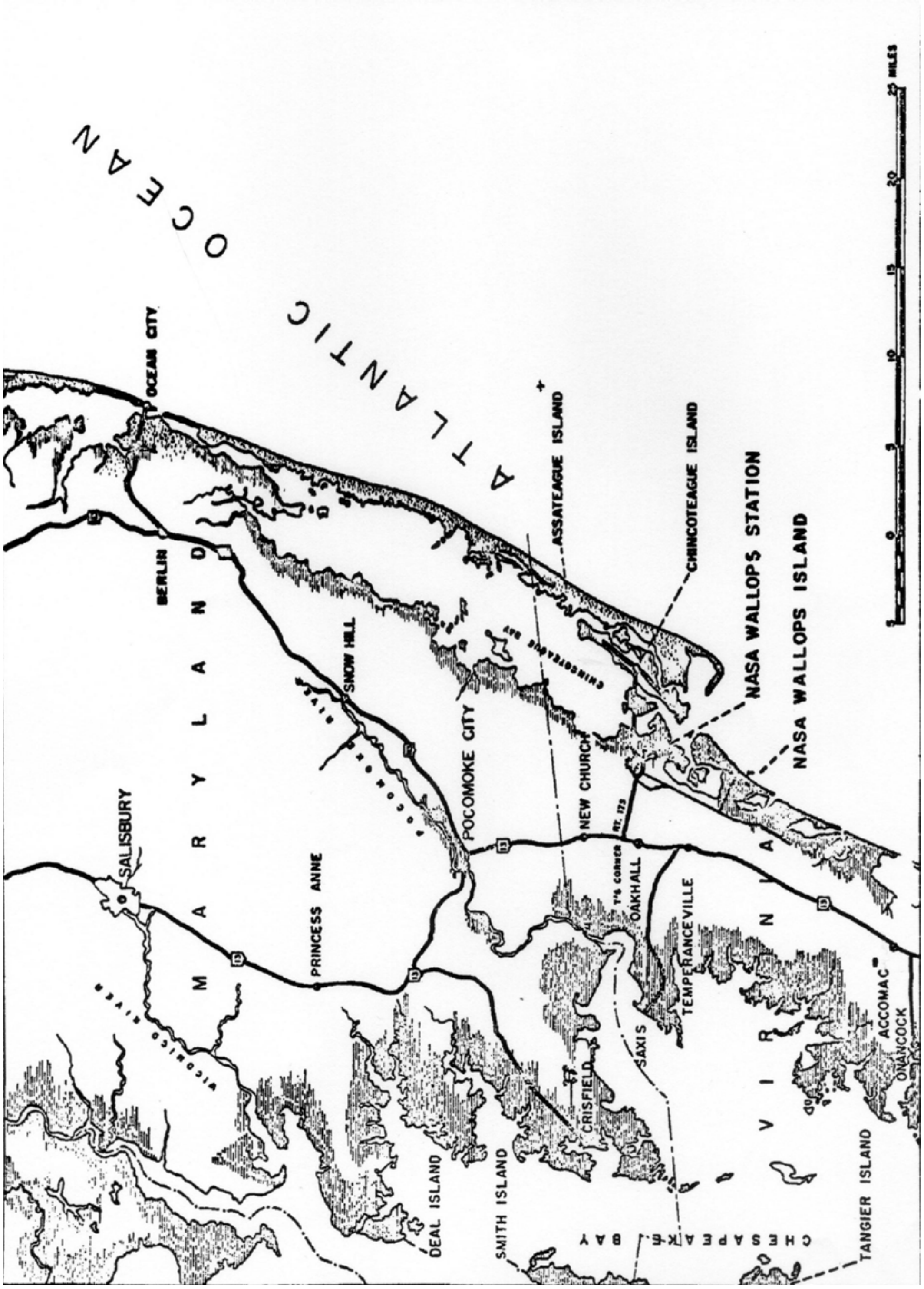
RICHMOND
NORFOLK
Va.
N.C.
CAPE HATTERAS



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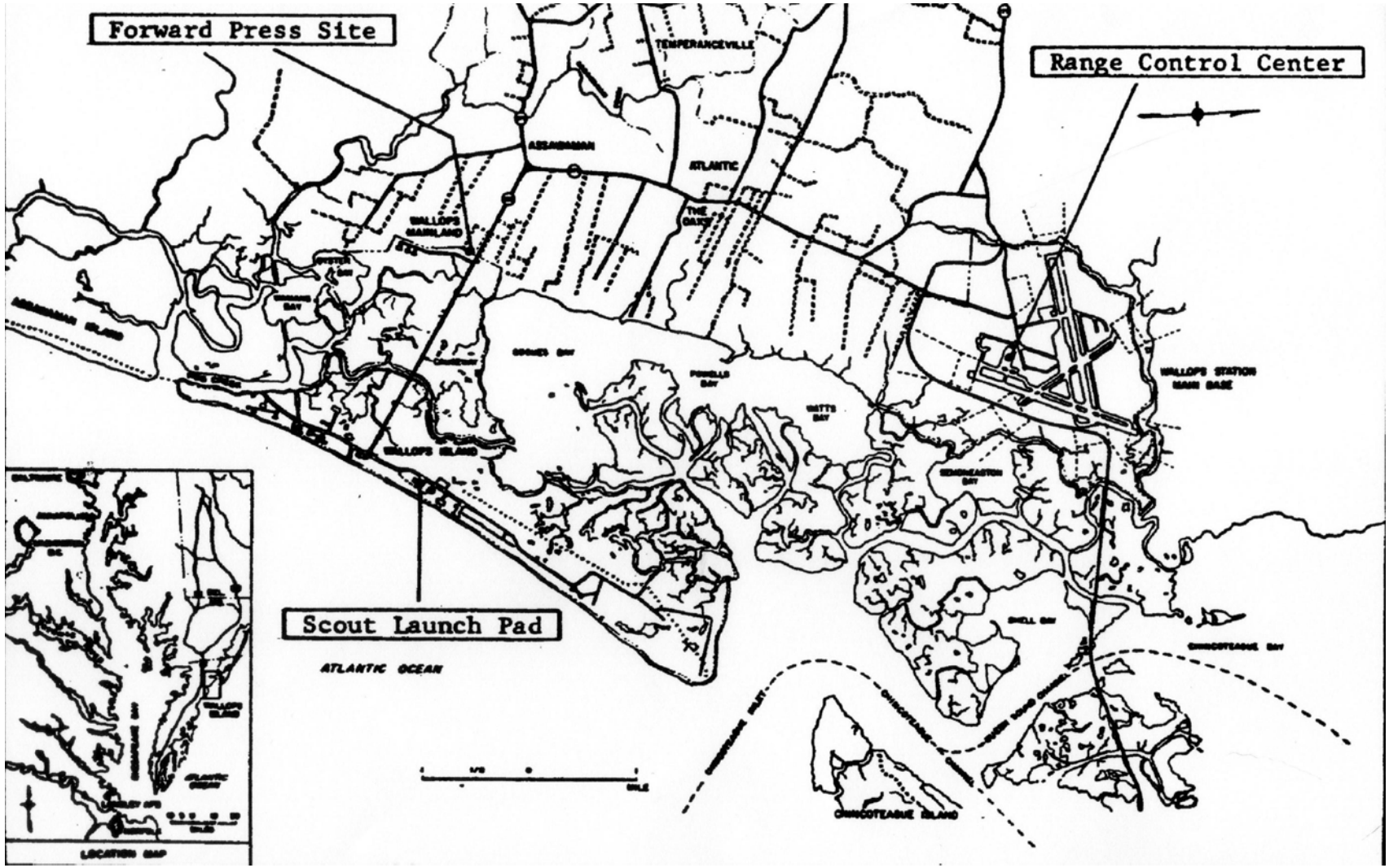
VIRGINIA
OCEAN CITY
BERLIN
SNOW HILL
SALISBURY
PRINCESS ANNE
POCOMOKE CITY
NEW CHURCH
OAKHALL
T'S CORNER
RT. 175
TEMPERANCEVILLE
SAXIS
CRISFIELD
DEAL ISLAND
SMITH ISLAND
TANGIER ISLAND
ACCOMAC
ONANCOCK
CHESAPEAKE BAY
ASSATEAGUE ISLAND
CHINCOTEAGUE ISLAND
CHINCOTEAGUE BAY
NASA WALLOPS STATION
NASA WALLOPS ISLAND
WICOMICO RIVER
POCOMOKE RIVER
25 MILES


Forward Press Site
Range Control Center
Scout Launch Pad
ATLANTIC OCEAN
TEMPERANCEVILLE
ASSAWOMAN
ATLANTIC
THE GATE
WALLOPS MAINLAND
WALLOPS ISLAND
WALLOPS STATION MAIN BASE
CHINCOTEAGUE ISLAND
CHINCOTEAGUE BAY
LOCATION MAP

Annex 4[285]

No. 10505

UNITED STATES OF AMERICA
and
ITALY

Exchange of notes constituting an agreement concerning the conditions under which launching and associated services for NASA experimental satellites will he furnished to NASA at the San Marco range (with memorandum of understanding dated 18 February 1969). Rome, 30 April and 12 June 1969

Authentic text: English.

Registered by the United States of America on 2 June 1970.

ÉTATS-UNIS D'AMÉRIQUE
et
ITALIE

Échauge de notes constituant un accord relatif aux conditions auxquelles des services de lancement et des services connexes seront fournis à la NASA au polygone de San Marco pour ses satellites expérimentaux (avec mémorandnm d'accord du 18 février 1969). Rome, 30 avril et 12 jnin 1969

Texte authentique : anglais.

Enregistré par les États-Unis d'Amérique le 2 juin 1970.

[285] Downloaded from UN website https://treaties.un.org/doc/Publication/UNTS/Volume%20732/v732.pdf on 18 September 2015

EXCHANGE OF NOTES CONSTITUTING AN AGREEMENT [1] BETWEEN THE UNITED STATES OF AMERICA AND ITALY CONCERNING THE CONDITIONS UNDER WHICH LAUNCHING AND ASSOCIATED SERVICES FOR NASA EXPERIMENTAL SATELLITES WILL BE FURNISHED TO NASA AT THE SAN MARCO RANGE

I

The American Ambassador to the Director General of Economic Affairs, Ministry for Foreign Affairs of Italy

Rome, April 30, 1969

No. 257

Excellency :

I have the honor to refer to the Memorandum of Understanding between the National Aeronautics and Space Administration (NASA) of the United States of America and the Università degli Studi di Roma d'Italia dated February 18, 1969, concerning the conditions under which launching and associated services for NASA experimental satellites will be furnished to NASA at the San Marco range.

The Memorandum of Understanding, which is set forth in the Annex to this Note, provides, *inter alia*, that it shall be subject to confirmation by the Government of Italy and the Government of the United States of America through an exchange of diplomatic notes.

The Government of the United States takes note of the recent reorganization of Italian agencies concerned with space activities, and understands that the National Council of Research will have the sole responsibility within Italy to confirm the acceptable character of missions proposed for the NASA launchings and to approve the financial arrangements agreed in principle in Article III of the Memorandum of Understanding.

I now have the honor to inform you that the Government of the United States confirms the provisions of the Memorandum of Understanding referred to above, as well as the intent by NASA to launch at least two spacecraft from the San Marco range before December 1971.

If the Government of Italy would also confirm the provisions of the

[1] Came into force on 12 June 1969 by the exchange of the said notes.

Memorandum of Understanding and this note, I have the honor to propose that my note and Your Excellency's reply to that effect shall constitute an agreement between our two governments regarding this matter, which shall enter into force on the date of your reply and which shall terminate on December 31, 1971, unless extended by mutual agreement, notwithstanding Article VI of the Memorandum of Understanding to the contrary.

Accept, Excellency, the renewed assurance of my highest consideration.

Gardner ACKLEY

Annex :
Memorandum of Understanding

His Excellency Ambassador Gian Vincenzo Soro
Director General of Economic Affairs
Ministry for Foreign Affairs
Rome

MEMORANDUM OF UNDERSTANDING BETWEEN THE UNIVERSITÀ DEGLI STUDI DI ROMA D'ITALIA AND THE UNITED STATES NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Affirming their mutual interest in peaceful space research, the Università degli Studi di Roma d'Italia and the United States National Aeronautics and Space Administration (NASA) set forth in this Memorandum their general understanding of the conditions under which launching and associated services will be furnished to NASA at the San Marco range of the Centro Ricerche Aerospaziali della Università degli Studi di Roma d'Italia (CRA) for experimental spacecraft, on a cost-reimbursable basis, and of their responsibilities in connection with the launchings.

The CRA and NASA intend to conclude contracts expressing the specific terms and conditions under which the launching and associated services for NASA experimental satellites to be launched from the San Marco range will be provided. These will be in accord with the general understandings set forth in this Memorandum.

Article I

RESPONSIBILITIES

A. *NASA will be responsible for :*

1. Furnishing the CRA with its requirements for a particular satellite launch project at the earliest possible date and, in any event, sufficiently in advance of the target date of the launch to enable completion of financial, procurement, and operational requirements of both parties. Such advice will include details of the spacecraft mission, payload description, orbital characteristics, launching parametres,

planned launch date and back-up launching requirements, and other information needed by the CRA for planning purposes.

2. Providing flight-ready spacecraft at the launch range, as required for each mission.

3. Providing suitably configured Scout launch vehicles, including heat shields, spacecraft tie-down and separation mechanisms and vehicle spare parts, as required for each mission.

4. Providing ground-support equipment (GSE) peculiar to each mission and personnel required for its operation, except for certain items of GSE which the CRA may specifically agree to provide and/or operate.

5. Providing training or requalification for Italian personnel, as may be mutually agreed.

6. Providing technical consultations and data, as mutually agreed.

B. *The CRA will be responsible for :*

1. Establishment, equipping, maintenance and operation of San Marco range facilities, including platforms, range equipment, and Scout checkout and launch equipment, as required for the Scout vehicle as configured at the time of delivery.

2. Assembly, checkout, and launching of the Scout vehicle, including range safety.

3. Mating spacecraft to the vehicle, subject to mutual agreement for each mission.

4. Tracking and data acquisition facilities and operations, as mutually agreed.

5. Support of Italian personnel in any mutually agreed training or requalification program.

Article II

IMPLEMENTATION

A. There will be established a joint San Marco Range Operations Working Group (SMROWG) with Co-Chairmen from the CRA and NASA with the following overall functions relating to all launch projects carried out under the general terms of this agreement :

1. Establish operational requirements and coordinate San Marco range launch schedules as appropriate to accommodate launch projects agreed to under this Memorandum of Understanding.

2. Monitor launch operations phase.

3. Determine training requirements for Italian personnel.

4. Provide basic information and data pertinent to the drafting of launch services contracts subsequently negotiated pursuant to this Memorandum.

5. Review the implementation of the responsibilities agreed to by NASA and the CRA under this Memorandum of Understanding and subsequent launch services contracts.

6. Consider and take action as appropriate on other items as mutually agreed to by the SMROWG Co-Chairmen.

B. NASA and the CRA will designate a Launch Services Coordinator for each launch project, who will be responsible for coordinating the agreed functions and responsibilities of each party with the other, pursuant to the detailed arrangements established under the launch services contracts.

C. The CRA will have operational authority over the assembly, checkout and launching of the Scout vehicles. NASA will have operational authority over the spacecraft.

D. In accordance with normal practice, a NASA-designated Mission Director will determine when the space flight system is ready for flight and can place a " hold " on the launching operation at any time.

E. In carrying out their respective responsibilities, NASA and the CRA will be subject to the safety and other operational regulations and procedures of the San Marco range.

Article III

FINANCIAL PRINCIPLES

NASA agrees in principle to reimburse the CRA for those costs incurred in connection with the launching of NASA satellites which are in excess of costs ssociated with the maintenance and operation of the range during non-launch periods.

The types of costs which will be reimbursed by NASA, and payment procedures, will be agreed upon in any launch services contract.

Article IV

LIABILITY

The CRA and NASA shall bear full responsibility for any damage to their respective nationals in the course of this cooperative project.

In the event of damage to nationals of countries which are not parties to this

cooperative agreement, under the principles of the Treaty Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies,[1] and international law, the CRA and NASA agree to consult promptly on an equitable sharing of the payments for any settlement required. If agreement is not reached within 180 days, the two agencies will act promptly to arrange for early arbitration to settle the sharing of such claims following the 1958 model rules on arbitral procedure of the International Law Commission.

Article V

PUBLIC INFORMATION

Release of public information regarding this Memorandum of Understanding may be made by each agency for its own portion of the project. Insofar as the participation of the other party is involved, release of public information may be made after suitable coordination.

Article VI

TERMINATION

This Memorandum of Understanding shall remain in force until the Università degli Studi di Roma and NASA mutually determine that it should be terminated.

Article VII

CONFIRMATION

This Memorandum of Understanding shall be subject to confirmation by the Government of Italy and the Government of the United States of America through an exchange of diplomatic notes.

P. A. D'AVACK,
Il Rettore
For the Università
degli Studi di Roma

T. O. PAINE
For the National Aeronautics
and Space Administration

February 18, 1969

[1] United Nations, *Treaty Series*, vol. 610, p. 205.

II

The Director General of Economic Affairs, Ministry for Foreign Affairs of Italy, to the American Ambassador

MINISTERO DEGLI AFFARI ESTERI[1]

Rome, June 12th 1969

Excellency :

I have the honor to refer to Your Excellency's note No. 257 of April 30, 1969, concerning the proposed arrangements for the launching of experimental satellites from the San Marco range, the text of which reads as follows:

[*See note I*]

I have the honor to inform you that the proposals set forth in Your Excellency's note are acceptable to the Government of Italy, and, therefore, agree that Your Excellency's note together with this reply shall constitute an agreement between our two Governments regarding the matter.

Accept, Excellency, the renewed assurance of my highest consideration.

G. V. SORO

His Excellency Ambassador Gardner Ackley
Embassy of the United States of America
Roma

[1] Ministry for Foreign Affairs.

INTERVIEWS

- ITALIAN REPUBBLIC MINISTRY OF DEFENSE – DEFENCE STAFF
  Maj. Gen. Alberto Rosso, Chief of IV Department (Logisic), member of ASI Board of Directors (dated 15 April 2015)

- "LA SAPIENZA" UNIVERSITY ROME – ENGINEERING DEPARTMENT
  Professor Paolo Gaudenzi (dated 30 April 2015).

- THALES ALENIA SPACE - ITALIA
  Professor Engineer Roberto Somma, Project Manager Cassini Antemna (retired), (dated 14 July 2015)

- "LA SAPIENZA" UNIVERSITY ROME" – SAN MARCO PROJECT RESEARCH CENTRE
  Professor Paolo Teofilatto, Director of the Centre (dated 16 September 2015)

- Giorgio di Bernardo Nicolai, Freelance Journalist, Luigi Broglio biografer (dated 25 September 2015)

WEBSITES

- ITALIAN REPUBBLIC MINISTRY OF DEFENSE – AIR FORCE STAFF
  Articols from "Rivista Aeronautica"
  www.aeronautica.difesa.it/rivistaaeronautica

- UNITED NATION
  http://www.un.org

- U.S. DEPARTMENT OF STATE
  http://www.state.gov

- U.S. DEPARTMENT OF DEFENCE
  UNITED STATES ARMY – REDSTONE ARSENAL, ALABAMA
  http://www.garrison.redstone.army.mil

- U.S. DEPARTMENT OF DEFENCE
  UNITED STATES NAVY – NAVAL RESEARC LABORATORY
  http://www.nrl.navy.mil

- U.S. CENTRAL INTELLIGENCE AGENCY (CIA)
  https://www.cia.gov

- U.S. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)
  https://www.nasa.gov

- U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
  http://www.archives.gov

  "LA SAPIENZA" UNIVERSITY ROME" – SAN MARCO PROJECT RESEARCH CENTRE
  http://www.psm.uniroma1.it last login 2.10.15

- CONSIGLIO NAZIONALE DI RICERCA (CNR)
  http://www.cnr.it last login 2.10.15

- THALES ALENIA SPACE - ITALIA
  www.thalesgroup.com/en/space last login 2.10.15

- AVIO SPACE INDUSTRY – COLLEFERRO, ITALIA
  http://www.avio.com

- EUROPEAN SPACE AGENCY (ESA)
  http://www.esa.int

- AGENZIA SPAZIALE ITALIANA (ASI)
  http://www.asi.it

- DEUTSCHEN ZENTRUM fur LUFT und RAUMFAHRT (DLR)
  http://www.dlr.de

- CENTRE NATIONAL D'ESTUDIES SPATIALES (CNES)
  https://cnes.fr

- RUSSIAN FEDERAL SPACE AGENCY (RKA)
  (Федеральное космическое агентство)
  http://en.federalspace.ru

- INTERNATIONAL TELECOMMUNICATIONS SATELLITE
- CONSORTIUM (INTELSAT)
  http://www.intelsat.com

- FEDERATION AERONAUTIQUE INTERNATIONALE (FAI)
  http://www.fai.org

- INTERNATIONAL ASTRONAUTICAL FEDERATION (IAF)
  http://www.iafastro.org

- FEDERATION OF AMERICAN SCIENTISTS (FAS)
  https://fas.org

- ASSOCIATION OF RETIRED ESA STAFF (ARES)
  http://www.ares.esa.int

- RUSSIAN SPACE WEB – INDIPENDENT WEBSITE
  http://www.russianspaceweb.com

- PROFESSOR PAUL S. CUTTER PERSONAL WEBSITE
  http://www.profpaulcutter.com

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