THE MANNED ORBITING LABORATORY

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ABSTRACT

The development of the Air Force's Manned Orbiting Laboratory (MOL) in the 1960's represented the last in the long chain of unsuccessful programs to achieve a manned military space role. With a raging space race and ever increasing cold war tensions as a backdrop, this major technical program serves as a valuable study in the management of government funded programs. The successes and ultimate failure of the MOL is an attribute the technical and political complexity of modern day democratic government, international relations, inter-organizational rivalry, and public perception. In this paper, I will explore the events leading up to the initial conception of the MOL, program history and background, as well as the people and events that ultimately led to its cancellation.

QUALIFICATIONS TO RESEARCH THIS SUBJECT

As systems engineering technical assistant to the USAF Space & Missile Systems Center, I have three years of experience working in Air Force Space Acquisition fields. My experience in the military has also spurred an interest in the politics behind large scale military systems acquisitions. Combined with my interest in the MOL program, I feel I am duly qualified to research the subject.

INTRODUCTION

There were five major manned space programs undertaken during the twelve years that would later be referred to as the great "Space Race": Mercury, Gemini, Apollo, DynaSoar and the Manned Orbiting Laboratory (MOL). However, most of us are only familiar with the first three programs since their accomplishments would establish national prestige regarding the United States (US) presence in space, immortalize men, and solidify a nation in technical superiority. The first of these efforts was the National Aeronautics and Space Administration (NASA) Mercury program, which was the first to successfully place an American in space, and eventually in low earth orbit. Following Mercury was the Gemini program, which was conceived as a needed step before an effective Moon mission could be executed. The Gemini Program validated the science, docking maneuvers, and technologies that would be needed in the later Apollo Moon missions. Finally, there were two additional major manned space programs during this time period – programs also composed of great space ambitions and novel technical challenges. Most people would never learn of the US Air Force's DynaSoar Program or the MOL for one of two reasons: (1) the programs were shrouded in secrecy; or (2) neither of these programs were ever completed. However, it should be noted that both programs garnered hundreds of millions (if not billions) of dollars in defense funding, produced full-scale prototypes, and launched sub-orbital test missions. Much of the technologies for and planned uses of both DynaSoar and MOL would indeed be utilized by later unmanned systems, or incorporated in the development of subsequent space programs.

While the DynaSoar and MOL programs could not be considered successes like their NASA counterparts, they do offer an important piece of historical analysis when evaluating the history of large, national engineering programs. While the engineering details and facets of these two would-be space systems could easily fill volumes, this paper seeks only to explore the political issues associated with the formation, existence, and eventual demise of these programs. It should be noted, however, that the political analysis of any major component of the American space race can be extremely intricate in its own right – even without a mathematical understanding of Tsiolkovsky's rocket equations or Kepler's orbital parameters.

While the focus of this research paper will be on the MOL, a proper analysis cannot be performed without taking into account other concepts that predated the MOL and originated the idea of a military man in space. For example, the original military space plane, aptly named the DynaSoar (shorthand for Dynamic Soaring) was viewed as the culmination of a series of X planes that pushed the altitudes and speeds of manned flight further and further. The DynaSoar (later renamed the X-20) would be the pinnacle of all military aircraft to date – flying faster, higher, and longer than anything ever demonstrated – achieving orbital flight. But sadly, the X-20 DynaSoar would never come to be, and its successor, the MOL, would eventually suffer a similar fate. These two ill begotten programs spanned three presidential administrations and shifted public and political sentiment on space, its potential uses, and the successes of the Mercury, Gemini, and Apollo NASA programs.

The overarching goal of this paper is an analysis of the political, financial, and social issues impacting the cancellation of the MOL program. Multiple factors significantly influenced the course of the MOL including a war, a federal budget crisis, technology revolutions, and international space treaties. Since a unitary factor cannot be attributed as the sole cause of the MOL program's cancellation – each factor will be examined individually and the complex interaction amongst them will be explored. A history of events impacting the cancellation of the MOL program will be also presented including the competition from the Soviet space program, the development of a relationship between NASA and the United States Air Force (USAF), and the death of DynaSoar. Finally, the cancellation of the MOL program will be analyzed in light of the political facts of life as follows: (1) politics not technology, allows what technology is allowed to achieve; (2) cost rules; (3) a strong coherent constituency is essential; (4) technical problems become political problems; (5) the best technical solution is not necessarily the best political solution; and (6) perception is often more important than the truth.

THE BEGINNING OF THE SPACE RACE

Following the close of World War II, the men and women involved in the war effort eventually returned to their civilian places and began reconstruction or a "return to normalcy". Life was different, however, if you were a German rocket scientist. In Peenemunde, Germany, the end of World War II meant your relocation and a total surrender of intellectual property developed under the Third Reich's rocket program. The successful A-4 program (later renamed the V-2) was created with the sole purpose of wreaking havoc against London –with a spiral development path to reach the Eastern United States. However, the development of this vengeance weapon had much more far reaching implications than warhead delivery to an enemy target. The V-2 was the world's first operational rocket – produced in mass, and operated reliably enough to prove that rocket technology, a key enabler to space travel, was indeed within grasp. Both the US and the Union of Soviet Socialist Republics (USSR) found ways to import German rocket scientists. Operation Paperclip transferred German scientific assets like Dr. Werner Von Braun to Texas, and ultimately advanced the American starting position for the new space age. Similarly, the USSR brought their share of German war intellect to the motherland and began the development of their ambitious space programs.

The military implications of these new launch systems were clear. Just as William Congreve demonstrated the tactical utility of rocket carried munitions during the Napoleonic Wars in 1813, the Third Reich displayed the incredible strategic potential of striking an enemy from a greater standoff distance, without warning, and without any hope of defense. However, Nazi Germany had not been able to change the outcome of the war with the creation of the V-2. Nonetheless, their achievement represented the beginnings a new era of Intercontinental Ballistic Missiles (ICBM), Intermediate Range Ballistic Missiles (IRBM), and space exploration simultaneously. With the marriage of more effective conventional (and nuclear) weapons, coupled with improved guidance systems, the ICBM and IRBM would change the face of warfare forever.

While both the Soviets and Americans rushed to mature the V-2 technology into usable military weapons as well as space test platforms, it was the Soviets who achieved the most notable "first" in space. On October 4th, 1957, Sputnik (as shown in **Figure 1**) circled the globe from space. Not surprisingly, Sputnik was placed into orbit using a converted Soviet ICBM named the R-7. The US space effort was demoralized again on November 3rd, 1957, when the Soviets launched Sputnik II, containing the first living creature to orbit the earth – a dog, named Laika. Based on the Soviet successes with Sputnik and Sputnik II, the implications to the state of modern warfare were clear. With orbiting platforms high above the continent, the USSR could shower munitions down upon America at any time, and without warning. Detecting the onset of a new military space era, President Eisenhower took proactive steps to prevent a rapid space arms race by pursuing a "space for peace" policy. President Eisenhower proposed to the Soviet Premier Bulganin in January of 1958, that both the US and USSR mutually agree to use space only for "peaceful purposes". The term "peaceful purposes", as Eisenhower defined it, would allow for military support missions, but forbid actual on-orbit weapons (such as nuclear or conventional warheads). While the Soviets didn't immediately consent to the proposition, this agreement (which lasted for nearly twenty six years before being ratified) would have significant impacts on military space programs down the road.

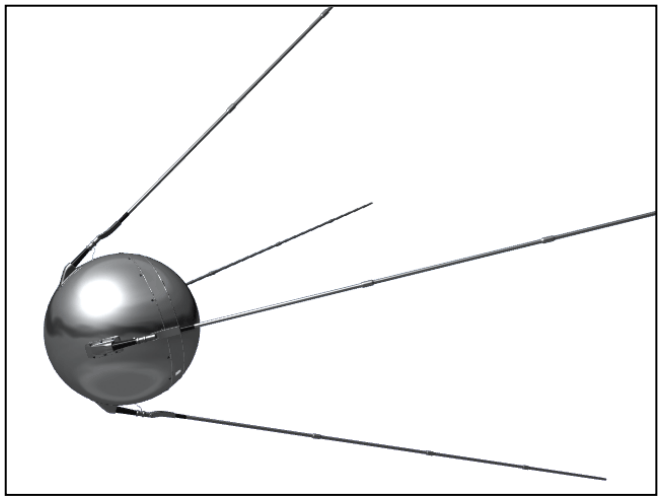

Figure 1: Sputnik Satellite

Determined not to let the Soviets surpass them in space prowess, the Americans rushed to catch up, and began several parallel programs aimed at launching a satellite into orbit. Until now, the USAF and Navy had pursued an evolutionary process of reaching space through the ever-increasing flight envelopes of the X-1 through X-15 rocket planes. In addition, the USAF and National Institute of Health launched mice and live monkeys into the fringes of space to determine the effects of space travel on a human body. The conclusion of these pilot studies was that humans could withstand and operate a vehicle in space (at least for a short period of time). However, the need to beat the Soviets became increasingly important – ultimately trumping slow, methodical and calculated research efforts, and favoring crash programs that utilized existing rockets and modified aeronautical elements. Working in parallel, the US Navy began Project Pilot – which attempted to launch a NOTS rocket after air dropping it from the wing of an F4-D fighter. Unfortunately, all ten launchers were failures, and other US organizations suffered similar setbacks including the Air Force's Atlas program and the civilian Vanguard program. It was the Army Ballistic Missile Agency (ABMA) that finally succeeded in

placing the first US satellite, Explorer 1, atop a modified Redstone IRBM (renamed as a Jupiter–C), into orbit on February 1st, 1958. The Space Race was now off and running – the next important steps would include the development of political legislation and organizations that shaped the development of the US space program.

THE BEGINNING OF NASA – AND THE START OF USAF/NASA RELATIONS

President Dwight Eisenhower initially established the Advanced Research Projects Agency (ARPA) as the governing body to oversee each military branch's space programs. However, it became increasingly clear to political leaders that a new organization in charge of manned space flight would need to be created. At the nucleus of this organization would be the venerable National Advisory Commission on Aeronautics (NACA). The new organization, NASA, was founded through the National Aeronautics and Space Act on July 16th, 1958. This important piece of legislation ultimately transferred control of all existing manned space flight programs (along with associated facilities) to NASA. These programs included the efforts being conducted by the Army, Air Force, Jet Propulsion Laboratory (JPL), and Naval Research Laboratory. Military and ARPA officials howled – they were convinced a civilian organization was unfit to ensure the future of national survival by conducting the necessary research and technological activities needed to field "the manned and unmanned orbiting weapon systems and space flight vehicles to permit military operations in space". This massive redirection of spaceflight programs and corresponding funding to NASA struck a defining note for all future collaborations between the Department of Defense (DoD) and NASA. Reaching space was no longer a national goal that all parties strived and yearned to achieve together. All future NASA-DoD collaborations would forever be tempered with the struggle between these two parties to retain funding and primary ownership of the mission at hand. Unfortunately, this destructive tendency will be observed in subsequent programs and future eras.

The Air Force renewed its argument for a greater role in the US space arena following the historic flight of Cosmonaut Yuri A. Gagarin in a Soviet Vostok Capsule on April 12th, 1961. Once again, the Soviet Union succeeded in demonstrating superior space technology by successfully orbiting the earth and landing intact. The Soviets achieved the second manned flight by Gherman S. Titov on August 6th of that same year. This ultimately drove American politicians to declare a critical situation regarding the lack of US presence in space. The Air Force began promoting the position that a "space for peace" policy would best be achieved through a robust military space capability that would match Soviet strengths and deter any preemptive strikes. Politicians were easily swayed by this argument – Overton Brooks, Chairman of the House Committee on Science and Astronautics summarized the American sentiment when he said the Soviets "obviously now have the capability of sending up manned satellites carrying bombs and other equipment for destroying other nations." Based on the multiple Soviet victories in manned space flight, the earlier decision to segregate civilian and military space activities now seemed inappropriate. Several important political leaders expressed these sentiments. First, Senator John Stennis promised to examine "whether the present

division of responsibility between the military and NASA is proper in light of international developments". Second, General Bernard Schiever capitalized on this renewed sense of doubt in a speech to the American Rocket Society on October 12th, 1961, where he reminded the audience of the artificial constraints on the Air Force's space programs and the growing threat of Russian rockets equally as capable of carrying 100 megaton warheads (as compared to launching cosmonauts). Finally, General Curtis E. LeMay likened the new era of space superiority, to the concept of air superiority during World War I.

Enjoying renewed support from both the public and political sector, USAF planners moved forward with existing space programs such as Corona, Samos, and Blue Scout. In addition, the USAF decided to fast track the offensive space missions including in-space inspection, orbiting weapons, and anti-ballistic missile systems. Military manned spaceflight was now receiving special attention. In February of 1962, General Ferguson appeared before the House Armed Services Committee and lobbied for the expansion of a military space role. He argued that a strong offensive space capability was the best way to achieve a "space for peace" policy. More importantly, General Ferguson argued that while NASA held the reigns of bioastronautics and space research, there were unique military requirements that should be developed by the DoD. Specific examples include the following: (1) foreign satellite inspection and neutralization, (2) non-cooperative target docking maneuvers, and (3) development of space hardware that could perform quick reaction, cost effective space missions that met military standards of survivability. Finally, General Ferguson also railed against the restrictions placed over the Defense Department's space program pursuits – "we must not be restricted from exploratory developments merely because a clear application is not yet evident." This speech was aimed directly at abolishing the Eisenhower space policy, and opening a new chapter of military space preeminence. General Ferguson's speech achieved its desired effect – Secretary of Defense Robert McNamara approved an increase in funds and accelerated the USAF's primary space project – the DynaSoar.

THE DYNASOAR, THE BEGINNINGS OF MOL

When Eisenhower formed NASA, almost all military space programs transferred ownership and left the services entirely. However, there were a few exceptions. For example, the Air Force's premier manned space plane program, DynaSoar, succeeded in escaping from NASA's purview. This was accomplished by convincing both ARPA and NASA that the true goal of DynaSoar was merely suborbital spaceflight, despite numerous printed statements illustrating the true intent to achieve orbital velocity. The DynaSoar program was seen as the first logical step towards conducting military operations in space. DynaSoar was the Air Force's single-pilot, premier manned reusable space-plane that represented an amalgamation of several earlier conceived space aircraft concepts. Reminiscent of the early Silver Bird concept envisioned by German rocket scientist Saenger Bredt, the DynaSoar was the only military space plane ever to enjoy a period of full-scale development. The DynaSoar's intended purpose was to give the Air Force the military edge in space including the bombing of enemy targets from orbit, non-

US satellite inspection and neutralization, as well as surveillance and reconnaissance of foreign space activities.

The engineering concepts behind the DynaSoar program included launching into space atop an expendable Titan booster, separating the DynaSoar vehicle at orbital altitude, and skipping off the atmosphere to extend its flight path. Once the DynaSoar vehicle completed its specified mission (most likely bombing the Soviet Union), it would reenter the Earth's atmosphere and glide to make an un-powered landing at a designated Air Force base. Following refurbishment and rearming, the vehicle could be fitted with another expendable booster, and flown again. The initial drawing board included several versions of the DynaSoar (D.S.) vehicle. First, D.S.1 represented a hypersonic research vehicle. Initially intended to launch in 1963, the D.S.1 would lay the groundwork for future versions of the DynaSoar vehicle. Second, D.S.2 would be the first manned hypersonic reconnaissance vehicle, ranging over 10,000 km, and carrying high resolution optical, ELINT (Electrical Signals Intelligence) and side-looking radar payloads. Regarding nuclear capabilities, the D.S. 2 also had the potential to carry a nuclear weapon if needed. Finally, the D.S.3 system would represent a full-fledged, global reach space bomber. The first DynaSoar launch was initially planned for 1970, but following a renewed interest in offensive military space capabilities as discussed above, the DynaSoar program was accelerated and the first launch of D.S.1 was planned for 1962. It should also be noted that parallel to the plans of constructing this military space plane were lower fidelity plans to construct a military space station.

Unfortunately, the DynaSoar program would slowly lose its constituency for several reasons including erosion of the reasons for having a military glider in space, and competing priorities that demanded larger shares of available funding. As this new philosophy on the use of space took hold, the DynaSoar program would see its proponents gradually downgrade the importance of the vehicle. The entire effort of the DynaSoar program was eventually reclassified as a research and test platform rather than the premier Air Force space bomber. Along with the reclassification came a renaming of the DynaSoar program as the "X-20" (as shown in **Figure 2**), which officially branded the DynaSoar as the follow on to the X-15 research vehicle. As the budget waned for the X-20, several technical problems cropped up. For example, the original orbital space bomber version was too difficult to keep cool on reentry without a heavy active cooling system. This and other technical realities added to a serious weight growth problem that required a larger and larger (and therefore more expensive) launch vehicle. As the budget for the program grew, and the available payload to conduct non-bombing missions shrank, support for the program waned even further.

In January of 1963, Secretary of Defense Robert McNamara directed a review of the DynaSoar program as well as a review of NASA's Gemini program. Two months later, the Secretary of Defense directed the Air Force to compare the military potentials of both the DynaSoar and Gemini. Believing that the Pentagon had no real reason for a military manned space plane, he began to bury the program by proposing a "Blue Gemini" spacecraft. To be run by NASA, the Blue Gemini would be identical to the NASA capsule, yet with specific modifications to conduct all proposed experiments scheduled

for DynaSoar. The Blue Gemini program was clearly a threat to the future of the DynaSoar program, and the Air Force was initially opposed to the idea. General Curtis LeMay retorted by claiming the Air Force needed both the DynaSoar and the Blue Gemini programs. However, Secretary of Defense McNamara threatened to cancel the program should a clear and cogent military mission not be made apparent in the near future. This political threat to the DynaSoar program ultimately provided the impetus for development of the MOL framework.

THE NEED FOR MULTI-MANNED ORBITING FLIGHTS OF LONG DURATION

The death of President John Kennedy and swearing in of Lyndon B. Johnson as the new President meant regime change – the administration that had so boldly answered the Soviet space challenge and declared that an American moon landing would be a national priority, was over. An article published on the front page of the *New York Times* on June 11th, 1962, described how the US Defense Department was embarking on a military man in space program to prevent military control of space as well as its exploitation. The article detailed Air Force efforts to create a manned satellite to destroy hostile space vehicles, which generated a public outcry from critics who thought a man-in-space program was in direct competition with NASA. In addition, the public sentiment was that the anti-satellite mission was in violation of the nation's declared use of "space for peace". It was becoming clear that public sentiment for a strong military control of space during the Sputnik mania had waned – and was replaced with a desire to eliminate government duplicity in order to shift funding to other competing projects. For example, in 1961, South Vietnam signed an economic aid treaty with the US, leading to the formation of the US Military Assistance Command in 1962. This economic aid treaty would further sway President Johnson to trim non-essential military endeavors and wasteful duplication of effort within the Federal Government. In addition, Secretary McNamara, who had lobbied for US engagement in the first place, was also on the hook to free up funding for the war effort. Unfortunately, the space program would be a natural target for downsizing and cutting of funds. Turning a more critical eye to the expensive space development programs under his purview, McNamara began to take a dim view of Air Force space programs that reeked of NASA duplication and re-work.

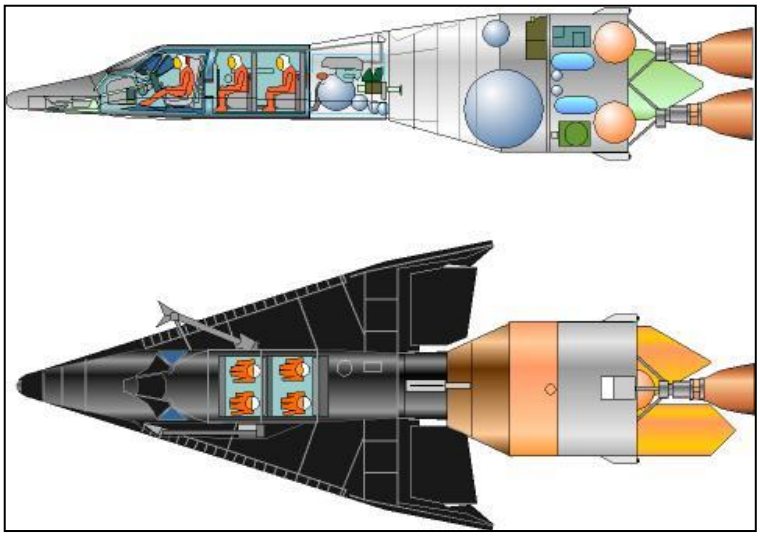

Figure 2: DynaSoar (X-20) courtesy M. Wade

Shortly after McNamara's previously discussed threat to cancel the X-20, then Vice President Lyndon Johnson requested a statement be prepared on the importance of a space station to national security. In McNamara's reply, he stressed the importance of a multi-manned long duration facility in orbit. This would be an important component to the beginning of the space station debate, and the initial origins of the MOL. The space station would be capable of performing all science experiments envisioned for the DynaSoar, as well as providing the larger cargo spaces/masses needed to conduct advanced reconnaissance, communications, biomedical and technical development. Although with less vigor, the Air Force had been simultaneously exploring the possibility of fielding a military space station entitled the Military Orbital Development Station (MODS). Initial plans called for MODS to be serviced and accessed by an X-20 – or Gemini-type vehicle. While the Air Force was less excited about the laboratory at the time, its position quickly became more defensible than the seemingly pointless space glider. A Director Defense Research & Engineering (DDR&E) report to Secretary McNamara in February of 1962 stated the following:

> *"In the near future, it may become necessary to perform optical surveillance from high altitude orbits. Very large optics will be required if high resolution is desired. Use of such optics may be quite feasible… However the practicality of a system would almost certainly depend on use of man for system adjustment and continued operation of equipment."*

Another potential use of the orbital platform would be the inspection and potential destruction of hostile satellites. While skeptical at first, policy makers were eventually swayed by such a concept – a military space station for the purpose of passive reconnaissance and inspection. While not as sexy as the X-20 space plane, a military space station had its merits and enjoyed initial support from the Office of the Secretary of Defense (OSD).

Secretary McNamara however was not about to give up his fight against other military space projects, and stated "space technologies primarily related to military applications must be advanced concurrently with those being exploited primarily for scientific applications." McNamara further emphasized deeper cooperation between NASA and the Air Force with regard to its Gemini platform, and insisted reuse of the Gemini hardware would be a valuable cost-saving measure. Secretary McNamara instructed Air Force secretary Zuckert as follows:

> *"It is recognized that a space laboratory to conduct sustained tests of military man and equipment under actual environmental conditions impossible to duplicate fully on earth would be most useful… Ultimate realization of the full potential of such a facility, however, is dependent on the attainment of other capabilities (e.g. space rendezvous, docking and transfer) yet to be developed. For that reason, work in this area should be in the nature of a study to identify basic building blocks which might be needed were such a facility to prove economically and technically feasible and warranted. The possible adaptation of Gemini and DynaSoar*

technology and hardware to meet initial military experimental requirements for preliminary experimentation with a manned orbital test station is also worthy of study."

The political changes and budget downsizing during this time ultimately redefined the space program agenda. The realization of a need for multi-manned orbiting flights of long duration provided the appropriate backdrop for the development of the MOL concept.

THE DEATH OF DYNASOAR AND THE BIRTH OF THE MOL

Many independent studies found that the DynaSoar platform was ill equipped and had little weight budget to perform the space missions that truly needed to be accomplished. On December 10th, 1963, McNamara cancelled the DynaSoar for lack of a clearly defined military mission:

"We don't have any clear military requirement, or any known military requirement [for DynaSoar] per se. But, I think we do have a requirement for environmental testing and experimentation in near-earth orbit… I guess that we will find that Gemini has a greater military potential for us…than does DynaSoar… and DynaSoar will cost something on the order of $800 million to a billion dollars. The question is, do we meet a rather ill defined military requirement… better by modifying a Gemini in some joint project with NASA…?"

Secretary McNamara had effectively used project Gemini as a "stalking horse" to kill the DynaSoar program. NASA made matters worse by actively supporting the Blue Gemini concept, with the underlying motive that this support may mean more DoD dollars to the NASA program. The shrinking capability and rising cost of the space plan project eventually looked entirely ridiculous when compared to the practical alternative of executing the same missions on NASA developed launchers and capsules. However, death of the DynaSoar would not be the end of Air Force manned space as previously thought. During the year or two leading up to the death of the DynaSoar, Manned Orbiting Research Laboratory (MORL) and MODS concepts continued to survive. In 1963, Secretary McNamara attempted to cancel all funding for Blue Gemini and MODS, but simultaneously agreed to examine a similar concept known as the National Orbiting Space Station (NOSS). The NOSS concept largely arose from the fact that post-Apollo plans were forming at NASA for the research and development of a space station that could have joint DoD and civilian purposes. On December 14th, 1963, NASA and the Air Force signed an agreement to jointly explore a "possible new manned earth orbital research and development project." The goal of this project would be to achieve a national design of an orbital platform that could meet the needs of both agencies. Following this agreement, the DoD embarked on its own mission to study the usefulness of a manned orbiting platform. A majority of the study would be devoted towards space stations that utilized (in some form) the Gemini hardware.

On the same day that the X-20 DynaSoar was cancelled, Secretary McNamara formally announced the start of the MOL program. The cancellation of the DynaSoar meant the end of the first approved military man in space project – one that had already contributed significantly to the advancement of space technology that would later serve other programs and endeavors. The Air Force now turned its attention towards fulfilling their man in space dream through the operation of a manned space laboratory. However, this would be a significant departure from previous military man-in-space endeavors that sought to bomb something or fly around shooting satellites. With these missions no longer on the table, the Air Force had been relegated to piggy-backing military missions onboard NASA Gemini flights. Ultimately, OSD skepticism on the value of a military presence in space would keep X-20 like programs from ever coming to fruition. Instead, military planners had to channel their future platforms as an exploratory method towards finding an appropriate military role in space. Only through this avenue would the services be permitted to continue spending valuable dollars on man-in-space projects. Secretary McNamara reinforced his philosophy from the start by declaring the following:

> *"This is an experimental program not relating to a military mission. I have said many times in the past that the potential requirements for manned operations in space for military purposes are not clear. But that, despite the fact that they are not clear, we will undertake a carefully controlled program of developing the techniques that would be required were we ever suddenly confronted with … a military mission in space."*

The Secretary was able to rationalize this purpose, and defend it from those who accused it of duplicating NASA involvement. Furthermore, the Secretary provided that the MOL would be an Air Force managed program, one that would not require specific authorization from the President since it was not considered a separate spacecraft that was significantly larger than previous Apollo and Gemini models. The fact that McNamara allowed the start of MOL and its commissioning as an Air Force led program hinted that he was sympathetic towards the services desire to place a man in space. The MOL also promised to make good use of the Gemini hardware, as well as preserve the industrial launch base (by stimulating launches aboard the Titan III rather than NASA's Saturn IV).

When Secretary McNamara announced the beginning of the MOL, he only authorized several studies – the Air Force would have to clearly illustrate what important military missions the MOL enabled should it have any chance of being taken forth to development. It is important to realize that the proposed MOL platform would have to identify and establish both unique and critical roles to eventually carry forward. The two year project definition period (lasting from December 1963 to August 1965) hinted that military missions for this orbiting station did not jump right out or were not readily apparent to military planners. It was clear that many potential projects could be accomplished in orbit by MOL astronauts, however they couldn't always be argued as the most cost effective methods when compared to the unmanned missions/technologies. A total of seventeen contractors were selected to research potential missions for the MOL, which

included the topics of navigation, biomedicine, communication, and observation. However, these potential research missions alone were not sufficient to supply the Secretary of Defense with enough justification to carry the MOL through to full scale development. Regardless, in 1964, the Defense Department added the missions of camera assembly, and radar operation in space. The launch site for the Titan III/MOL was moved from Cape Canaveral to Vandenberg AFB to allow for high inclination orbits that would pass over the Soviet Union. Furthermore, the MOL would also image and assess foreign satellites when they were in range, and conduct some form of ocean surveillance to satisfy naval missions. In summary, the MOL would have not offensive capability (like the envisioned DynaSoar), but instead would passively collect information through onboard instrumentation in accordance with national security concerns. The addition of these defensive capabilities provided the necessary framework for further development of the MOL with respect to the engineering concepts of Gemini modification, and plans for full-scale production.

THE MOL BEGINS TO TAKE SHAPE

Modification of the Gemini Capsule

The new MOL (as shown in **Figures 3 and 4**) would be launched by the newly developed Titan III (the development of which can be traced directly from the DynaSoar program), and included a Gemini capsule as well as an attached laboratory module. Approximately the size of a typical bus, the Gemini capsule would contain all the equipment required for space surveillance of both ground and satellite targets. In addition, the attached Gemini capsule (affixed to the top of the MOL) is where DoD astronauts would launch and ride to their appropriate orbit. Once safely in orbit, astronauts would then climb through a specially engineered hatch in the base of the Gemini heat shield, through an access tunnel, and "down" to the laboratory module. The two-story pressurized laboratory module would allow the astronauts to conduct their operations in a shirt-sleeve environment (meaning without space suits or specialty breathing apparatus) with enough supplies for a typical 30 day mission. Most importantly, the attached Gemini capsule meant that no approach and docking maneuvers were required to place the crew aboard the station – a major departure from previous space station concepts. Once supplies ran dry and mission objectives were completed, both astronauts (an envisioned crew of two people) would re-enter the Gemini capsule, separate from the laboratory, re-enter the Earth's atmosphere, and splash down in the ocean. The remaining

Figure 3: MOL w/ detachable Gemini Capsule

laboratory module was expendable, and would be burned up following re-entry. Although the Gemini capsule used for the MOL had its roots in the original NASA development program, for all intents and purposes it could be considered an entirely new space craft. The "Gemini B RM", as the capsule was later named, would not fly as a separate spacecraft, and therefore have no need for an elaborate Reaction Control Systems (RCS). However, it should be noted that most onboard systems had to be redesigned, or at the least containerized to permit long-term orbital storage. By far the most significant change to the capsule was the addition of the hatch penetrating the heat shield, which allowed for pressurized transfer of the astronauts to the aft sections of the MOL. This represented a serious engineering challenge, and would later require a separate unmanned sub-orbital launch to test the integrity of the seal (which would become the only launch associated with the MOL prior to its eventual cancellation).

MOL Components and Special Equipment

The MOL itself consisted of four separate components that were pressurized and un-pressurized. The most forward portion (approximately 2.43m in length) housed the crew transfer tunnel (which was pressurized) along with cryogenic storage tanks of helium, hydrogen, and oxygen for onboard power generation (fuel cells) and crew atmosphere. The next two portions of the MOL were the pressurized working/living quarters – these were separated into two "stories" and were a total of 3.37m in length. Each of these stories were divided into eight "bays" that made up the modular functions of the MOL and provided life support functions for the astronauts. The bottom bulkhead contained a hatch leading to a tunnel through the aft un-pressurized section that contained a docking collar. This "mission specific" aft module would be modified depending on the purpose of each mission and could contain special airlock equipment for multi-MOL docking or EVA (Extra Vehicular Activity –"Space Walk") satellite inspection operations.

Figure 4: MOL during takeoff

It was believed that most missions would carry the KH-10 optical surveillance system (consisting of a telescope and 1.8m mirror). The undeveloped film would be delivered through four separate smaller re-entry vehicles to be ejected during the mission. These capsules were essentially the forerunner of the Corona satellite RVs, and would rendezvous with an aircraft equipped with special parachute snatching cables. There were also plans for equipping the MOL with special side-looking radar and ELINT payloads. The entire MOL assembly would weigh 25,000 total pounds - 5,000 of which would be devoted to surveillance payloads. Once the engineering challenges were

addressed with respect to the modification of the Gemini capsule, as well as the nature of the optical surveillance system, the MOL would be ready for full scale production.

MOL FINALLY REACHES PRODUCTION STAGE

In August of 1965, President Johnson approved the MOL to enter full scale production. The three selected contractors were selected from the many who submitted proposals: (1) McDonnell, (2) Douglas, and (3) General Electric. McDonnell (who was responsible for the earlier Gemini capsules) was selected to design and build the Gemini B. Douglas was selected to construct the laboratory module, while General Electric was chosen to produce the on-board experiments. After 1965, the Air Force enjoyed a period of continued support from both the OSD and NASA. Secretary McNamara and NASA administrator signed an agreement in January of 1966 that transferred a large volume of knowledge, materials, and hardware to the Air Force MOL effort. Included in this transfer agreement were Gemini spacecraft, test capsules, simulators, ground equipment, Apollo ground tracking equipment, as well as NASA engineers and technicians.

In November of 1966, the Air Force achieved the important milestone of launching a simulated MOL atop a Titan IIIC into suborbital space (as shown in **Figure 5**). The simulation allowed for structural tests of the MOL structure (which was simulated by an empty Titan III fuel tank) and the re-entry characteristics of new Gemini B (complete with heat shield penetrating hatch). In addition, weight growth of the baseline MOL had caused some problems – with the total onboard payload inflating to 30,000 pounds. Since the existing Titan IIIC would no longer be appropriate, the Titan IIIM was created to address this issue. Complete with seven-segment solid rocket boosters, the Titan IIIM produced over 12 thousand kilo-Newtons of thrust on liftoff.

Figure 5: MOL Test Flight

By 1967, the MOL program office had nearly finished the modifications to the West Coast launch complex at Vandenberg AFB, and selected the first twelve DoD astronauts to fly the MOL. Things were indeed looking up for the future of Air Force manned space flight – many assumed the first launch would take place in 1969 following the final 600 million dollar budget allocation that would complete the range and purchase the final MOL components. Unfortunately, the external political and financial climate would hold a different fate in store for this project.

THE ULTIMATE CANCELLATION OF THE MOL

By 1968, the growing financial challenges of the Vietnam War, and the quickly escalating social program obligations of the "Great Society" significantly increased the pressure to reduce spending wherever possible. The large research and development budgets that were not directly associated with wining the war against the North Vietnamese became prime targets for reduction or cancellation all together. This pressure was so extensive that even project Apollo suffered budget reductions (before the first landing had taken place!). Increased attention was placed on MOL as a potential budget target given the steady advancement in capability of automated satellites. Opponents to heavy military space spending saw the MOL (which comprised nearly half of the Air Force's astronautics research budget) as an entirely ineffective and expensive way to produce what could easily be accomplished by unmanned satellites. To make matters worse, the MOL had already established a pattern of poor behavior, which included running over budget and slipping behind in schedule. Accusations of duplication with the NASA space station plans were again used against the Air Force planners. Studies also showed that the public was also growing less enthusiastic about space in general. A 1968 poll illustrated that Americans felt the $4 billion price tag for American space operations was too high. As we would see shortly after the Apollo moon landings, an American poll showed a belief that space exploration should be slowed down, or dropped entirely.

As a result of these issues, the MOL received a budget cut. The new Secretary of Defense, Robert Laird, scrapped the fifth scheduled flight of MOL for a savings of $22 million. This decision had a ripple effect, which included the following two events: (1) it caused delays to the first flight, which was now scheduled to occur in 1972; and (2) it inflated the total program cost estimate to over $3 billion (which happened to be twice the initial MOL estimate). In addition, President Nixon also sided with NASA's more visible Skylab program when faced with making a decision between the two programs. In June of 1969, faced with pressure to make even more cost cuts, the Secretary of Defense chose to cancel the MOL program entirely. MOL was now officially dead – however, at the time of cancellation, the program had already spent nearly $1.4 billion.

The decision to cancel the MOL program came after the Secretary of Defense was forced to choose between a slew of automated satellite programs and the MOL. Many of these automated satellites promised to fulfill many of the MOL objectives as stated by Laird:

> *"Since the MOL program was initiated, the Department of Defense has accumulated much experience in unmanned satellite systems for purposes of research, communications, navigation, meteorology …these experiences as far as unmanned satellites are concerned, have given us confidence that the most essential Department of Defense space missions can be accomplished with lower cost unmanned spacecraft."*

The Aerospace Corporation, the leading Air Force federally funded research laboratory for aerospace activities, had nearly 20 percent of its workforce involved with the MOL

program at the time of its demise. The cancellation meant inevitable job cuts both at Aerospace Corporation, as well as in private industry. The cancellation of the MOL marked the effective end of the Air Force's presumed destiny to operate in the manned space arena. General Bernard Schriever had retired – and with him went the service's aspirations of a space-centric Air Force. The evolution of experimental X-planes that pushed harder and harder on the traditional envelope of flight would no longer extend beyond the atmosphere or the starry magnificence of earth orbit. With these hopes dashed, the Air Force returned its attention to the traditional airframe development activities that would benefit the present war environment. It should be noted that of the fourteen MOL astronauts selected to fly the missions, many went on to successful careers – including later astronauts aboard NASA's space shuttle.

POLITICAL FACTS OF LIFE AND THE MOL

The MOL is a fine example of many of the political facts of life. Intertwined with war, changing political offices, emerging technologies, and shifting public sentiment, the history of the MOL offers prime examples of the political facts of life.

Even from the beginning, politics would derail the Air Force plans to place a man in space within an Air Force vehicle. Traveling even further back, the entire desire to establish a military presence in space was brought about by political issues that influenced the way Americans viewed space.

Without question, the arrival of Sputnik in 1957 signaled the beginning of a new political and scientific era in the arena of space. Space was no longer an untouchable expanse of darkness after the Russians demonstrated space was a new frontier to be explored and conquered. The rivalry between the US and Russia would indeed fuel the race to the moon more so than the desire to discover new science – and would also spark the future of space exploitation for military purposes. It would be hard to imagine the pressing Air Force need for an X-20 like space plane in an era without a perceived Soviet space threat. Indeed Air Force efforts to expand the traditional flight envelopes of aircraft into space had been ongoing before Sputnik (i.e. X-15, etc); however these efforts had largely been pursued on a quasi-research basis as evidenced by the heavy participation of NACA. The first military space plane post Sputnik was controlled purely through the Air Force, and had a clearly stated military objective – bombing from space.

Other involvements in the political arena would serve to reign in Air Force space efforts rather than stoke them. The seeds of Eisenhower's "space for peace" treaty are still alive today in the form of modern international agreements. In the era of the MOL, this philosophy would be hotly debated. Opponents of USAF space programs asserted an arms race with space hardware would be extremely costly to those nations involved, and deprive other vital government programs. When X-20 DynaSoar's initial purpose became politically unfavorable, program advocates were forced to scrounge up other applications. The MOL would have suffered a similar fate had the entire purpose not been shifted towards that of a research and test bed. Were military space programs (on both the Soviet

and American side) allowed to evolve unfettered by this political decree, we would likely have seen the fruition of space bombers like the DynaSoar, along with orbital weapons or refueling platforms resembling that of the MOL. The US could have easily spent itself out of business trying to match Russian space advancements, and ignored entirely more stoic and peaceful space endeavors like a lunar landing.

Despite international treatise, tight war-time budgets, and competing civilian space programs, the MOL did manage to flourish for nearly ten years and enjoy over half a billion dollars of federal funding. What propelled this program forward for so long? The true secret to this obsolete program's longevity consisted of one of the many missions the MOL promised to accomplish: reconnaissance. While the military was less interested in spying than the National Reconnaissance Office (NRO), the MOL offered to perform in space inspection, and man-in-the loop observations of national interests. So valuable was this practice to the United States, President Lyndon Johnson was quoted as follows:

> *"… we've spent 35 or 40 billion dollars on the space program. And if nothing else had come from it except the knowledge we've gained from space photography, it would be worth 10 times what the program cost. Because tonight we know how many missiles the enemy has, and it turned out, our guesses were way off. We were doing things we didn't need to. We were building things we didn't need to build. We were harboring fears we didn't need to harbor".*

President Johnson's comments underscore the political importance placed on any science or technology that allowed better surveillance of activities abroad. The fact that MOL promised to perform, develop and improve space reconnaissance capabilities bought the program much needed funding and federal support.

As NASA personnel and contractors knew, manned space flight was very expensive. NASA astronauts Gus Grissom and Gordon Cooper were quoted as saying "you know what makes this bird go up? Funding! Funding makes this bird go up". "He's right" Grissom said, "no bucks, no Buck Rogers". The final nail in the MOL's coffin was very much the issue of cost. Sending an astronaut into space with a reasonable expectation of retrieving him safely is extremely costly – therefore only the most vital of purposes must be chosen. The MOL hadn't run considerably over budget, but it was expensive from the beginning, and a number of other indirect cost issues would ultimately spell the death of the MOL.

From the start, the MOL was essentially competing with the cost burdens of manned spaceflight. Furthermore, the advancement of unmanned spacecraft would ultimately act as a stalking horse, by offering cost effective solutions to more expensive missions promised by the MOL. The laboratory had the benefit of a man in the loop. The astronaut would be able to observe events and scenes, analyze them, and dictate his finding directly to his control station on the ground. Furthermore, the astronaut would be able to inspect and even disarm potentially hazardous enemy satellites in orbit. While these capabilities initially sounded tantalizing to military planners, they became easier to accomplish

without the use of a man in space. Placing a man in the system meant costly added weight and life support systems to launch and dispose of during each mission. Making matters worse was the limited endurance of the MOL – enough life support for only 30 days of operation. At the outset of the program, this seemed adequate, given the present alternative of having short and risky over-flights of only several hours.

The very first orbital reconnaissance satellites would have low success rates. Early technical problems would be surmounted, but the confines of the technology at that time dictated each satellite physically de-orbit film canisters in order for development and assessment of data. Cloud cover and poor weather could also obscure targets thereby wasting precious film and rendering some missions fruitless. However, this technology would improve with time, which made the significant budget associated with MOL less cost-effective.

It is important to note that the later stages of the 1960's were a fiscally constrained era. The economic consequences of Roosevelt's' New Deal were reaching a point where other budgetary belts would need to be tightened. Further adding to the mess was the ever escalating cost of the Vietnam War. While the MOL promised to make significant contributions to military capability, the current military engagement involved guerilla warfare in a jungle against a technically inferior enemy. The DoD made requests of NASA to transfer space technology gleaned through their 4 billion dollar budget to address pressing military needs – among them were quiet aircraft, acoustic location of mortar attacks, and fire suppressant foam. However, these types of pressing military war-time needs would not be satisfied through any of the MOL's stated objectives. It seems that in an era of vastly increasing scientific and technical capability, a great number of the nation's cost focuses became rather simple and straightforward.

The MOL also suffered from significant constituency problems. Despite having the Air Force's firm backing, the DoD would eventually lose interest in the program and cancel it. A strong USAF support existed from the beginning – the service had no problem devoting over half of its entire space research and development budget to the MOL program after DynaSoar failed. Dedicating this much funding to the program meant a lesser focus on traditional air frame development programs that typically characterized the flying Air Force. However, USAF support alone would not be enough to see the MOL program through to completion. It would take steady executive support and oversight, a willing public, and ample room in the defense discretionary budget. Unfortunately, the MOL program would enjoy none of these components of a strong coherent constituency.

Winning the battle of Secretary of Defense support could easily be called MOL's greatest constituency achievement. Early attempts to put an Air Force officer in space may have led the Pentagon to believe the service had ignored national policy for space weapons and regarded the necessity for a near term practical application as beneath them. Secretary McNamara would only sign on to the MOL program after DynaSoar was cancelled, and when NASA collaboration promised to shave costs and illustrate common sense technical utilization. Indeed, even the early sketches of the MOL program included the use of a

Gemini capsule straight from NASA. To further gain Secretary of Defense approval, the purpose of the MOL would be reclassified as a research and development laboratory, negating concerns that it would be used to orbit weapons. Gaining McNamara's approval, the MOL could proceed – however, retaining the secretary's support would prove difficult as time marched on.

Many factors that led to constituency growth around the MOL program sprung from the considerable amount of development that went along with it. Huge surges in engineering manpower in aerospace arose in both contractor and Federally Funded Research and Development Center (FFRDC) locations. The added requirement of developing a new heavy lift launch vehicle would also add the support of another segment in the Aerospace industry (likely in other congressional districts). The promise of repeatedly using McDonnell's Gemini capsule would also garner support from the existing constituency that formed during NASA's use of the same hardware.

The MOL also had its host of technical problems. For starters, excessive weight growth led to the engineering of a new launch vehicle – the Titan IIIM. Problems with program funding stretched the MOL timeline out, which ultimately delayed initial launches and also inflated the budget. However, these technical problems are somewhat "run of the mill" as they're not terribly unique. Other technical problems however would be unique, and create political turmoil (such as confusion over duplication with NASA objectives). During the MOL lifespan, the overall estimated program costs rose from $1.5 billion near the end of 1964, to $2.2 billion in the spring of 1967, and to $3 billion just before program cancellation.

While the MOL was essentially a military outpost in space, it had the unfortunate appearance of a space station. Casual analysis showed that the MOL was indeed something other than a space station – it was meant to last for only 30 days, and carry only a crew of two. However, the lines between what the MOL was and wasn't would be blurred in the eyes of the public. For example, the Apollo Applications Program (AAP) had the stated objective of fielding a NASA space station following the lunar landings, which would later take fruition in the form of Skylab. To the general public, the concept of two competing space station programs seemed like Government waste at its finest. Further adding to MOL's problems, detractors suggested that critical military experiments could be performed on later Apollo flights, saving the billions required to field a separate program altogether

Another factor that enshrined the MOL program in political hardship was the classification of the MOL's reconnaissance missions. Deemed as extremely sensitive to national security, portions of the laboratory's surveillance experimentation were largely closed to the public, as well as most lawmakers. As explained earlier, the reconnaissance portion of the MOL was the cornerstone for its survival over such a tumultuous period for manned military space systems. Without a public display of technical wizardry (as performed by NASA on several occasions), the MOL was at a loss to garner public support. Departments with similar classified hardware, like the NRO, which was established in 1961, were making incredible strides in unmanned satellite imagery while

MOL hardware still sat on the drawing board. The classified nature of NRO's satellites makes direct comparison to MOL very difficult; however the nation's reliance on the NRO's hardware is certain. It is said by some estimates that the NRO produced nearly 90% of all intelligence data on the Soviet Union in the 10 year span after its creation. With the NRO's technical achievements growing in popularity among political and military insiders, the popularity of a competing MOL program would slowly fade from political discourse.

The area of space militarization is filled with many examples of technical solutions which prove to be politically unfavorable. At the beginning of the space race era, the leaders of the superpower nations were clearly made uneasy by the range of military capabilities suddenly made possible by mans ability to exploit space. Traditional warfare, complete with borders and lines that divided friend from foe, and safety from danger, now stood redefined. New conflicts could be fought high above the earth's atmosphere an entire hemisphere away, and involve remote delivery of weapons of mass destruction. Smaller nations with inferior armies and navies could now strike a crushing blow to a fortified empire in minutes. In an effort to prevent any one of these doomsday scenarios from being realized, President Eisenhower made political maneuvers to prevent space from becoming overly militarized. President Eisenhower's efforts during the critical birth of space technology would lay the groundwork for a safer future – one where the best military technology application in space may be banned by international treaty or agreement.

The Air Force during the era of MOL and DynaSoar could be accused of being blind to technical solutions and realities that failed to meet their political objectives. Obvious even to the uninitiated reader is the Air Force's unending desire to obtain the capability of independent manned space flight. The USAF illustrated their motivation towards this end through their pursuit of the DynaSoar (and similar programs) despite lacking an approved military purpose. As unmanned satellite technology matured, the Air Force's MOL program slowly crept into obsolescence as well. Unfortunately this writing was on the wall since the early 1960's when NASA had already succeeded in flying computer controlled manned spacecraft (Gemini). As technical means for satellite surveillance and reconnaissance improved, Air Force MOL advocates still lobbied for continual development. It should have been taken as a bad omen that the MOL needed to be classified as a research test-bed (i.e. a platform <u>without</u> a specific military purpose) in order to receive support from the Pentagon in the first place.

The USAF goals of placing a man in space could have arisen from a desire to establish a truly unique military capability when compared to its sister services, or a desire to demonstrate air superiority in all flight regimes. Either way, the NRO's technical capabilities and unmanned satellite accomplishments that eventually destroyed the DynaSoar and MOL were clearly not a part of the Air Force's political desires to field their own manned space system.

The power of people's perception has caused a great deal of influence leading up to and throughout the MOL program. During the beginning of the space race, the American

public perceptions regarding the intent of the Russian space program led to a more aggressive pursuit of our own space goals. The relentless pursuit of comparable, if not superior, space "firsts" was largely driven by a perception of competition with the Russians and a fear of succumbing to their technical supremacy. There is no doubt that military planners played upon this perception in order to elicit funding for important projects. For example, General Schriever casually reminded a civilian audience of the Russian's capability to orbit "100 megaton nuclear warheads".

Another public perception that had great influence over the MOL program was duplication over NASA systems and efforts. While many of the covert surveillance and reconnaissance purposes of the MOL were withheld from the general public, it was perceived that the MOL offered little that NASA hadn't already accomplished or couldn't accomplish if given the appropriate resources. Misperceptions regarding the MOL and the reasons for fielding separate military space vehicles in the first place would significantly hamper the MOL development.

CONCLUSION

The Manned Orbiting Laboratory project represented the Air Force's last serious attempt to achieve a native manned space platform. Reduced to laboratory from a futuristic manned space plane, the service saw even that hope dashed as the tide of cost-effective technology swept away the last hope to extend traditional "scarf and goggles" bravado to the final frontier. Technical, and political problems (both international and domestic) would interface with the Air Force's space plans, and limit them to the unmanned systems for military navigation, weather, surveillance, and communication they have today. The thirty seven years since the cancellation of the MOL have seen comparatively little change in military space posture when compared to the thirteen years post Sputnik I. The development and realization of ICBM missiles, manned space capsules, and early communications satellites all came within a fairly compact period in history. It might be difficult to explain to a person of that era that by 2006, we would have no moon base, daily flights to Mars, or Air Force space planes. Something happened in space around the era of MOL cancellation and Apollo mission truncation – our efforts slowed. Our fascination with the heavens and our newly found ability to break the gravitational binds of this Earth faded, and our interests turned inward as we addressed "more pressing issues". Perhaps the MOL should not be viewed as just a failed program or an unsuccessful space endeavor, but a milestone in military and cultural evolution – where some of our imaginative dreams slowly dissolved, and gave way to a less exciting era of practicality.

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