



DARK HORSE RUNNING

Bell and Martin-Bell's Cold War Orbital Glide Bombers, Part II

By Dave Stern

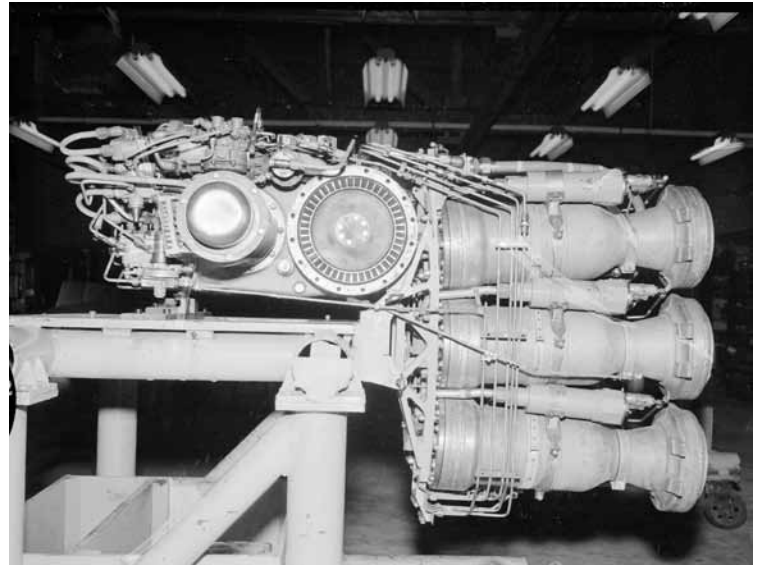
EAST COAST ROCKETS ROAR

Dr. Dornberger joined Bell Aircraft while the Soviet Union was constructing its initial RDS-1 series of A-bombs, and its *Dal'naya aviatsiya* was operating reverse-engineered B-29s given the NATO designation TU-4 Bull. A long range rocket program plus heightened tensions during the Korean War, with Soviet involvement inflamed the Cold War nightmare. Dornberger was briefed on Bell missile and rocket engine contracts but was perhaps unaware of Bell's mid-1930s flirtation with rockets. Bell engineers consulted with Dr. Robert Goddard about installing two non-existent liquid oxygen-gasoline rocket engines (350 pounds thrust each), on their Model-3, "super performance" fighter.¹ A Top Secret project issued directly to Larry Bell and Harland Poyer by General of the Army Air Force, Hap Arnold resulted in the Bell YP-59A Airacomet, America's first jet fighter.

On December 4, 1944, Bell chief designer Robert Woods and Bob Stanley swore a secrecy oath and received a contract for a rocket powered aircraft designated MX-524 a.k.a. MX-653, Bell Model 44 and XS-1.² A November 13, 1945, USAAF ATSC (Air Technical Services Command) specifications letter, won Bell a contract for a supersonic air to ground missile,³ MX-776, XSAM-A-2 re-designated GAM-63 *Rascal*.⁴

In late 1946 the Navy Bureau of Ordnance awarded Bell Aircraft a contract to develop Project METEOR's rocket engine – an Air-to-Air missile, under MIT guidance.⁵

They also contracted Bell to construct 42 800-pound thrust, lox-alcohol fueled rocket engines for Project Kingfisher.⁶ In 1949 Bell engineers designed an acid-aniline rocket engine for MX-776A (RTV-A-4) the X-9 *Shrike* concept test missile for *Rascal*. Bell also constructed the X-1A, X-1B, a modified X-1 identified as X-1E and MX-743 or X-2, a swept-wing supersonic rocket research aircraft. In 1951 at the Niagara



A Bell three-chamber XLR67-BA-1 rocket engine powering their GAM-63 Rascal missile-one of numerous rocket engines developed at Bell. It burned white fuming nitric-acid and JP-4. Their X-planes and dismantling piece by piece an AMC loaned Me-163 Komet rocket interceptor, propelled Bell Aircraft into the rocket engine business. (Photo from the L.D. Bell Museum, Mentone, Ind.).

Frontier Division offices, Larry Bell, Dr. Dornberger and an engineering team initiated discussions about his rocket bomber concept around a huge wood table shaped like a large aircraft wing.⁷

Meanwhile, Hugh L. Dryden, Director of the NACA, contacted Larry Bell informing him that the NACA Industry Consulting Committee compiled a four volume set of accumulated NACA aeronautical data.⁸ It contained the latest data on aerodynamics, aircraft propulsion, aircraft construction methods and operating problems. Classified *Secret* due to National Security issues and restricted to selective distribution, the NACA forwarded a complete set to Roy J. Sandstrom, Bell's Vice President of Engineering.

BELL AIRCRAFT'S GERMANS

The firm's rocket engine and missile contracts described above required Larry Bell to hire experts in rocketry, with Dr. Dornberger now their chief guided missile consultant.

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TOP of PAGE: The original logo of Bell Aircraft Corp. The American aviation community quickly tagged Bell as the most unorthodox U.S. aviation company since its inception in 1935. The firm created the most challenging and unusual aircraft, VTOL/STOL and missile projects; the firm accepted multiple small meat and potatoes research contracts, other firms outright rejected. However, such contracts created numerous amazing innovations injected into the aviation industry. (Bell photo)



Larry Bell poses in his private rest quarters at the Bell factory in N.Y. Calming his ulcers, Larry relaxed while gazing at the models his firm created as seen in this photo; some are in protective custody of the Niagara Aerospace Museum, and the Lawrence D. Bell Museum, Mentone, Indiana. (Bell photo)



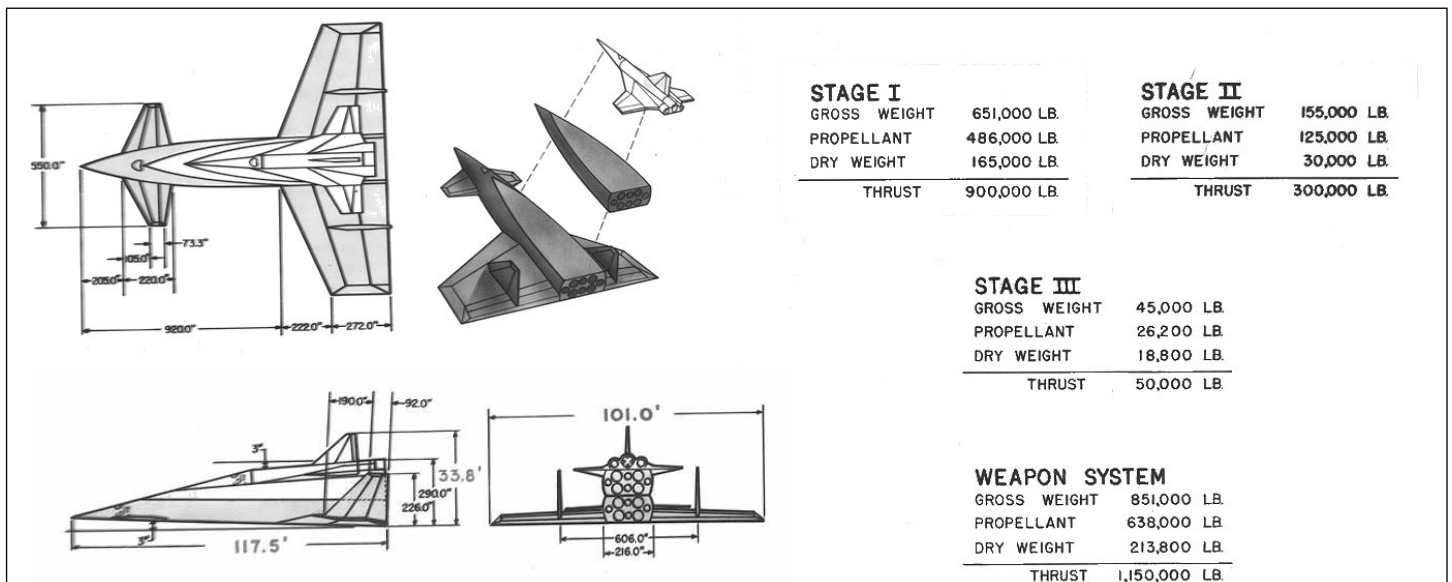
Bell drawing of the rocket motors projected for installation on their Army Air Corps Model 3 interceptor. The Model 3 morphed through redesign with the cockpit moved forward and a liquid-cooled Allison engine behind it, to become the P-39 Airacobra fighter. (From the AAHS collection)



The Bell air-to-air Meteor missile project. The missile was air launched from a Douglas F3D Skynight test aircraft but also ground launched with a booster rocket shown here. Other than their XS-1 rocket research aircraft, the Meteor was their first post war rocket powered missile project. (Bell photo)



The Bell air-to-air Meteor missile project. The missile was air launched from a Douglas F3D Skynight test aircraft but also ground launched with a booster rocket shown here. Other than their XS-1 rocket research aircraft, the Meteor was their first post war rocket powered missile project. (Bell photo)



Bell MX-2276 BoMi initially presented to the USAF with dimensions and weights. Photo: USAF.

He then recommended hiring other former Peenemunde rocket engineers and technicians. They were Dr. Krafft A. Ehrlicke (engineer-physicist), Heinz Mueller rocket engines and “thrust chambers” (miniature reaction motors) and Ing. Rudolph H. Reicher (rocket engines). Further *Paperclip* Germans joining Bell were Dipl. Daus Chamburg-Harburg (specialist in rocket transportation), Dipl. Wilhelm Emil Schlitt (inertial guidance systems).

Also joining Bell was Dipl. Martin Haas,⁹ Kurt Stehling rocket engineer and R.D. Rinehart, Chief rocket engine engineer, later appointed manager of Bell’s Rocket Development Laboratory.¹⁰ An expert on automatic flight control equipment, Heinz Fornoff joined later, eventually becoming Chief Engineer of the Space Systems Department. Dr. Ehrlicke was paired up with Dornberger to initially focus upon the rocket bomber project.

A CONCEPT BIRTHED

Once hired, Dornberger requested a personal meeting with Bell. An employee dragged a heavy foot locker into his office as Dornberger entered, with both arms wrapped around three jam-packed briefcases.¹¹ Dornberger is quoted as saying to Larry Bell, “I didn’t show them everything,” meaning his material was neither located nor seized by the Air Technical Intelligence teams, still searching Germany long after the war for more hidden documents. Dornberger squirreled it away inside Germany prior to the British capturing him, who were unaware of his actions. Dornberger’s cache reportedly included data, imagery and films relating to the Peenemunde team’s A-4b and A-9/A-10 Projects. This was the material presented to Larry Bell.¹²

The Peenemunde projects briefing piqued Bell’s daring non-conservative and exotic approach to advanced but often unorthodox aviation concepts. Bell was both fascinated and enthusiastic with the project and approved Dornberger’s “inhabited missiles,” concept.¹³ Bell stated that his engineers were the best in the world and there was no problem they couldn’t solve.¹⁴ He committed the company to engage in a high stakes gamble to initiate the most advanced manned aircraft project of that period. While Bell X-series rocket planes generated advanced aerodynamics data, a select engineering team established the design parameters for a hypersonic rocket-bomber operating in a region they knew as the “thermal barrier.”

In 1951 Bell approved \$200,000 in company funds to kick-start studies,¹⁵ while encouraging Dornberger’s visit with friendly USAF officers to propose his long range *Project Vulcan* rocket. Vulcan would be designed and constructed by an entity he called the “Amalgamated Aircraft Corporation.”¹⁶ The USAF politely acknowledged Vulcan and the concept of a special firm to construct ballistic missiles, but rejected them.¹⁷ He then sprung an alternative proposal in 1952 - a piloted long range very high altitude rocket powered bomber-reconnaissance vehicle.

Between 1952 and 1953 Bell paper records that \$285,885 dollars were expended for rocket-bomber studies with USAF P-600 funds of \$246,000 towards an “Optimum Evaluation Study.”¹⁸ Robert J. Woods had already forwarded a letter to the



The BoMi project’s supervising team of Drs. Dornberger (left) and Krafft Ehrlicke (right), holding a model of BoMi’s spinoff...a globe spanning Rocket Transport circa, 1955. This original display model and the initial BoMi models were constructed in the Bell Aircraft Corp.’s model shops during the early to mid-1950s and survive today. (Photo from the-Dave Stern collection.)

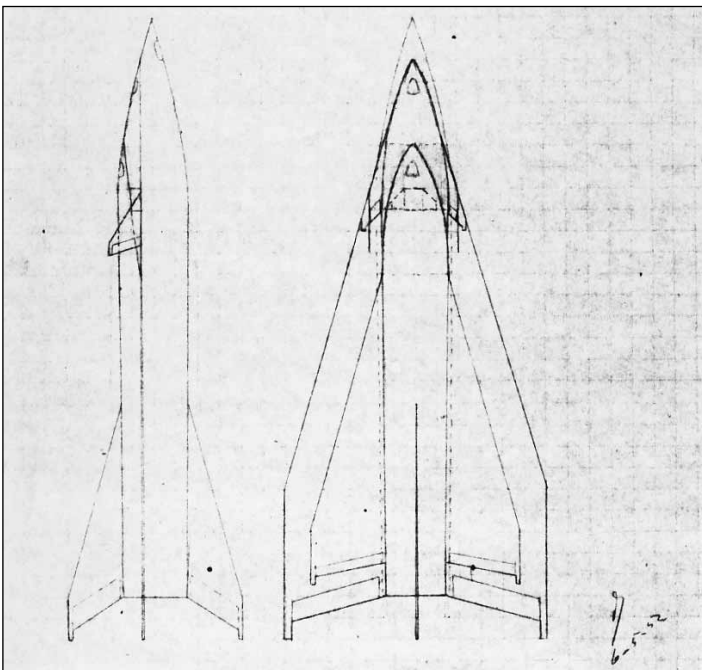
NACA with Dornberger’s rocket-bomber outline, requesting them to fund a hypersonic research program far beyond Mach 7, a speed regime where the proposed rocket-bomber would operate.¹⁹ In June 1952 the NACA Aerodynamics Committee requested that Ames and Langley research centers initiate a hypersonic research program.²⁰

THE STUDY

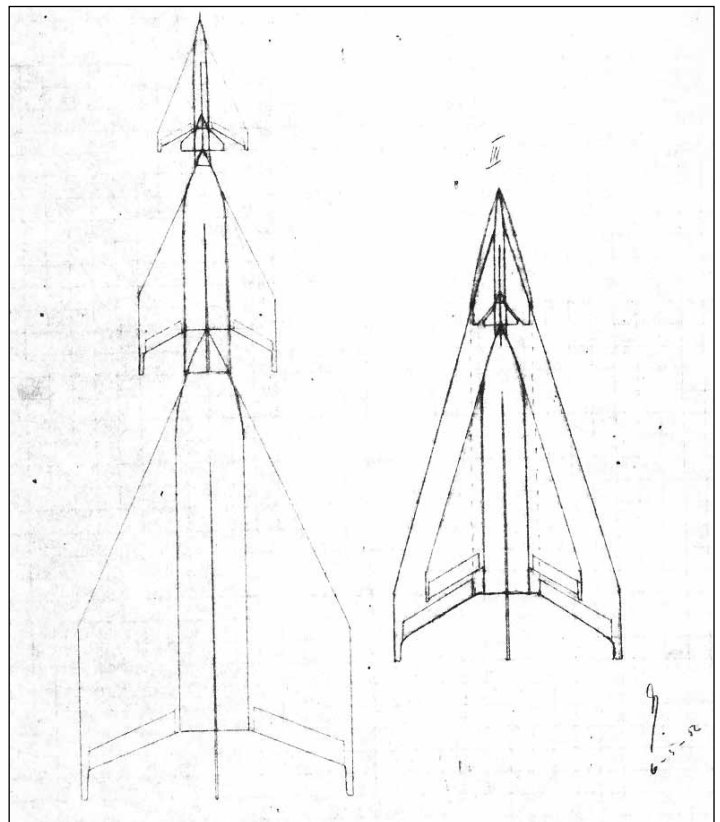
In July 1953, Bell Aircraft submitted a completed “introductory study” for their **ASWS** (Advanced Strategic Weapon System), officially identified as MX-2276 or BoMi, short for **Bomber Missile**.²¹ Dornberger was offering the USAF Strategic Air Command an offensive triad - air breathing bombers, upcoming ballistic missiles, plus Bell’s pilot controlled and callable **Bomber Missile**. He audaciously proclaimed that BoMi was immune from interception by aircraft or missiles. During the January 19, 1953, Air War College lecture Dornberger described a generic piloted Mach 14 “Rocket Glide Bomber” moving at 100,000 plus feet, without mentioning a Bell contract.²²

It would deliver an unspecified weapon (read nuclear) 3,000 miles distant, maneuver along its flight-path under pilot control, execute a 180 degree turn and glide back to a designated base.²³ USAF trained aeronautical engineer Capt. William Walter based at the WPAFB New Bombardment Office monitored this project. He described BoMi to the author as a souped up version of the A-9/A-10 project combining input from Sanger’s Silverbird proposal.

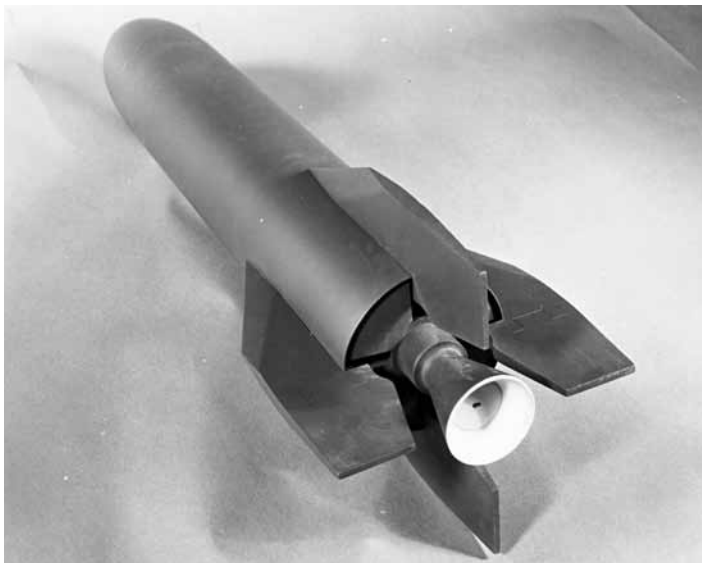
On April 1, 1954, the New Bombardment Development Office, Bombardment Aircraft Branch, WADC (Wright



This sketch appears to be a refinement of the right hand BoMi design in (upper right) photo with both delta-winged boosters piloted for re-use. The refined BoMi glider exhibits a flat bottom design that contributes some lift. The design separates it from the 1960s "lifting-body" (bathtub) concepts with glide-ratios similar to cinder blocks catapulted off a high-rise building roof. (Bell drawings)

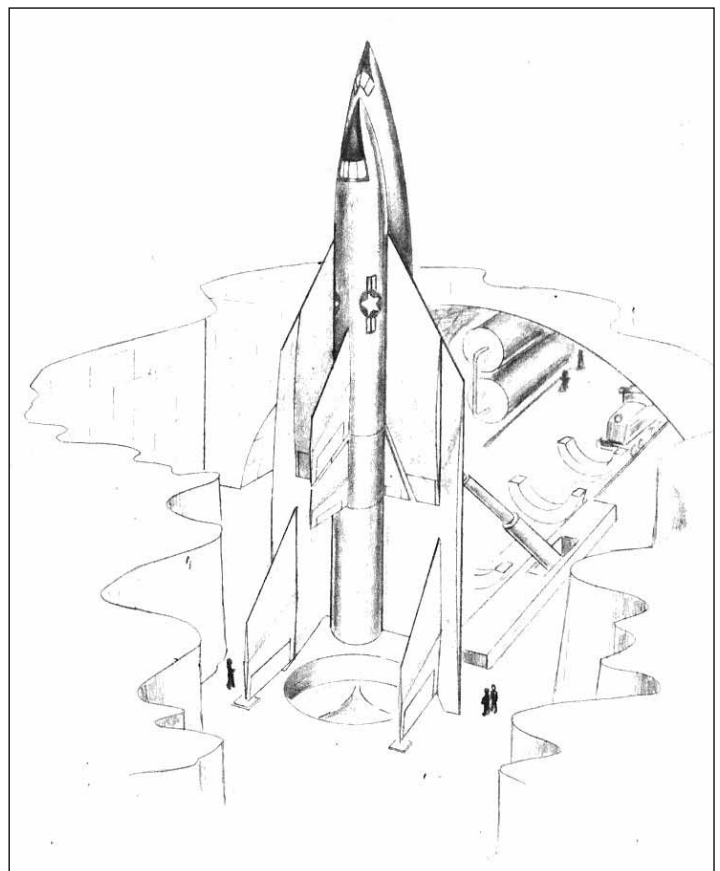


Early concept drawings of a three-stage BoMi rocket-bomber. The left version displays a single stack booster system and glider, while the right hand drawing is a three-stage pick-a-back system, utilizing two fly-back stages. Notice both gliders utilizing various styles of the basic delta-wing-a more efficient and aerodynamically correct wing planform for hypersonic boost-gliders. (Bell drawings)



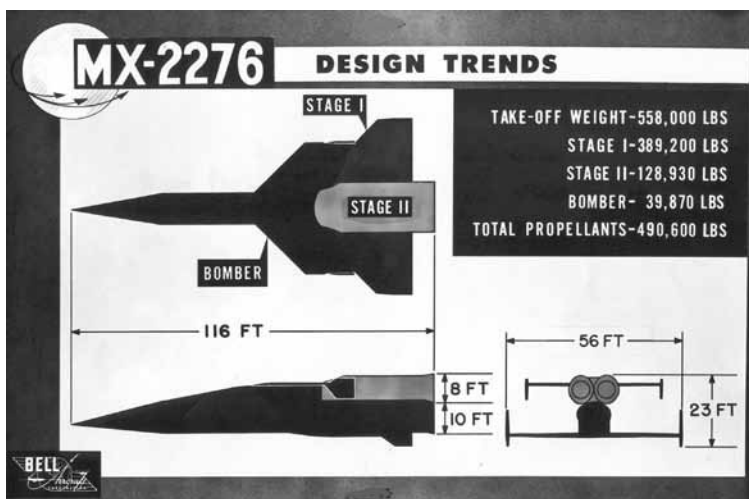
This is suspected of being a display model of Dornberger's Vulcan ballistic missile, proposed to the USAF. No information attached to the photograph, but a Dornberger letter briefly touches on a ballistic rocket-this appears to be Vulcan. (Photo from the Niagara Aerospace Museum)

RIGHT: This handsome drawing appears to present a two-stage BoMi system and a large winged booster piloted for return and re-use. The segmented plate-glass windshields reflect X-1 influence, while smoothly blending into the fuselage to reduce drag. It was both sensible and inexpensive in lieu of raised cockpits creating a formidable challenge in advanced engineering solutions and expense. This BoMi design displays an underground basing system. (Drawing from the Niagara Aerospace Museum)

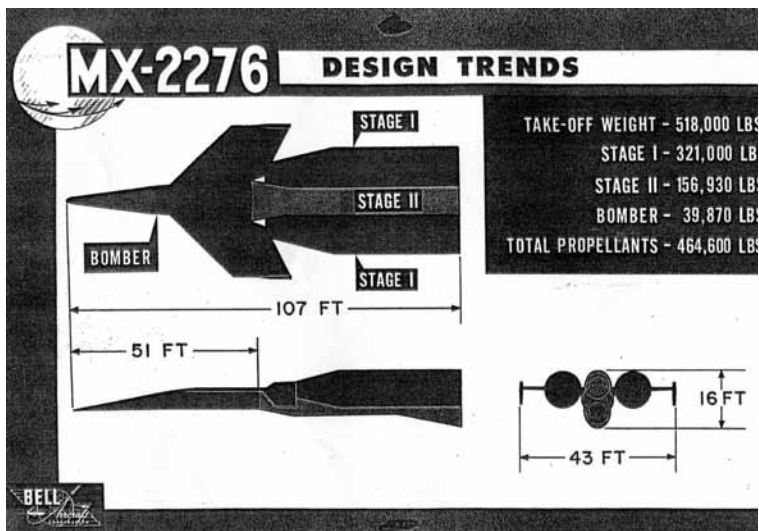




A Bell presentation art drawing of MX-2276 BoMi after liftoff. (USAF photo)



This BoMi configuration was also presented to the USAF as an alternate design. There are no art drawings to present a more reasonable view of this vehicle, thus they are simply presented as "Design Trends." (USAF photo)



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Aeronautical Development Center), issued Contract AF33(616)-2419 satisfying a GOR-92 (General Operational Requirement).²⁴ The USAF provided \$174,000 and Bell contributed \$420,000 for the initial 12 month study.²⁵ Its objective was to study the technical problems involved in designing a piloted rocket-propelled strategic bomber-reconnaissance weapon system. In closed military circles BoMi was described as a rocket-boostered manned glider thrust into a steady equilibrium gliding flight—that is, where gravity, lift, drag and centrifugal force are in equilibrium. The term "equilibrium glide," thus became a sparkling new aerospace lexicon.²⁶ BoMi executed (if boosted to exact speeds and altitudes tailored to a specific mission), gliding flight whereby kinetic energy and potential energy offered speed, range and altitude.

The equilibrium glide-flight concept replaced Sanger's skip-glide method because Silverbird slowed with each dip into the atmosphere thereby accumulating airframe heat rather than dissipating it. It also heavily stressed the airframe, and the NACA engineers agreed with Bell engineers on this point.²⁷

BoMi's CREATORS

The BoMi project team occupied a modified factory building in downtown Buffalo, N.Y., on Kenmore Avenue - 20 miles from the main Bell Niagara Falls plant. Drs. Dornberger and Ehricke were the engineering team's mentors and guided the project. Casey L. Forrest a sharp young Bell aerodynamics engineer was chosen as project leader with nine others;²⁸ He was also project engineer for MX-2147, the Bell Model 67 *Bald Eagle* high altitude reconnaissance aircraft. Model 67 utilized innovative lightweight structural features that won Bell a short-lived production run of 27 aircraft – but the USAF suddenly cancelled it.²⁹ Other known BoMi aerodynamics engineers joining Forrest were Benson Hamlin (principle X-1 engineer), Joel Eisenberg, Dick Passman, Robert Postle and Vincent Paxhia.³⁰

The structures engineering group consisted of Wilfred H. Dukes (structures team leader), Howard Wolko, Frank A. Anthony, Joseph Padlog and Dr. Maury Brull, supervising the Analytical Methods Group.³¹ Others joining them were Ivan Rattinger, Herbert Mund, Richard Gallagher, and Harry A. Pearl, chief materials engineer.³² Mr. Dukes informed the author that both teams worked in consort, shared data and never competed or withheld information from each other.³³ He stated that "the structures problem was almost entirely associated with aerodynamic heating, specifically the critical areas of the wing, tail leading edges, nose and lower belly area."³⁴

Solving frictional or kinetic heating during hypersonic flight was his team's main focus. Their severe handicaps were high thermal temperatures (ranging from 1,700 to 3,000 degrees F), demanding non-existent heat resistant metals and yet to be created structural design and production techniques.³⁵

Bell engineers and progress reports refer to BoMi as an aircraft or "the airplane" and indeed, it was, but with performance far in advance of 1950s aerodynamics and metals technology.

STRANGE DAYS

The title above is applicable for good reason. From 1945 onward, huge amounts of German technology, specifically rocketry was shipped to the U.S. and absorbed. Between 1946 and 1948, the USAAF-USAF and Navy initiated efforts to launch an early space program. Excluding the RAND world circling spacecraft study, a plethora of magazine articles presented manned rockets traveling to the moon. It included establishing lunar military bases with excellent supporting artwork for that time period.

News and magazine revelations concerning the German V-2, A-9/A-10 and the Sanger's projects generated a sudden deep interest in the moon, but other less apparent reasons could support this conclusion. Immediately upon cessation of WWII, space travel and rocketry was exciting and newsworthy for a nation exhausted from war. The subject also entered daily and Sunday edition newspapers throughout the late 1940s. One startling news item actually reported the Army contracting for enough "fuel" to launch an unidentified rocket to the moon, as though one actually existed. An early 1947 Army Air Force recruiting advertisement featured a military astronaut in a space suit with a very tall and large finned rocket behind him-in living color no less. This less than subtle Ad invited men to join up and explore new frontiers.

The above seemingly hints of activity and hardware not openly publicized, or it was simply rhetoric generated by individuals within the USAAF including Willy Ley, the American Rocket Society, upcoming Si-Fi authors and some aviation reporter-writers. However, the news report concerning enough fuel to launch a rocket to the moon is both unusual and suspect.

Nevertheless, there was powerful opposition to all military space plans emanating from unidentified individuals in Washington, D.C. They emanated from the Departments of Defense and State, including the White House. Whoever they are, blocked funding and refused to support space research including robotic or manned space flight. The inane term "world image," was invoked to justify and prevent any efforts to enter low-earth orbit, let alone travel to the moon, and whoever generated this term remains unknown.

In 1954, USAF Lt. William C. Walter was earning a Masters Degree in Aeronautical Engineering at the USAF Institute of Technology (USAFIT), WPAFB. He took a short leave to attend a symposium at Hayden Planetarium - but, in uniform. Only one other man was in uniform - a brigadier general. He saw no women but lots of "old guys" in suits and ties. A USAF colonel in mufti grabbed Walter and demanded to know if he was a Pentagon spy and why he was in uniform.

He practically dragged Walter to the entrance and asked what he saw. Walter said, "I see a bunch of old guys in civilian clothes." The colonel stated that those "old guys" were high ranking officers from all the military services and that Walter had better keep his mouth shut because reporters wanted to interview anybody in uniform, or else Walter's career would quickly end.

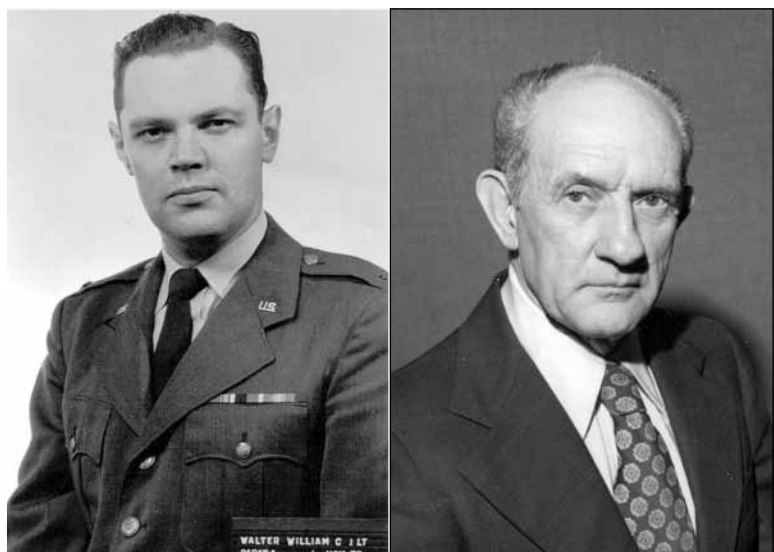
He told Walter that the uniformed general was a plant for the Press to pounce upon. So, why the big deal? Some of the lectures concerned that dirty forbidden word, SPACE! Well ... ok, meteorites probably contain some dirt to concede that point. The speakers included Dr. Walter Dornberger, USN Commander R.C. Truax, BuAer, Guided Missiles Division and Dr. Fred Singer, Professor of Physics, University of Maryland (proposing his MOUSE, a **Minimum Orbital Unmanned Satellite Earth**). Dr. Claud E. Shannon, mathematician and expert on communications theory, Arthur C. Clarke and Joseph M. Camberlain, general manager of the Planetarium also gave talks.

Walter was told that those military officers actually came to hear Dr. Dornberger speak about his Peenemunde experiences and long range liquid fueled rockets, due to the increasingly funded ballistic missile projects underway. Adjunct to ballistic missiles was the subject of space flight - also included in the symposium agenda.

The trick for Bell Aircraft pitching their rocket-bomber project to the USAF during this time was for Dornberger to carefully speak in terms of hypersonic global circling manned rocket-bombers gliding at extreme altitudes but, never uttering the word space.

The point is that the attitude of those in power maintaining their form of "status quo," specifically warned, even ordered ranking generals to exclude the word "space," in their presentations. Only Willy Ley, Dr. Werner von Braun (employed by the Army's Ballistic Missile Agency no less), and perhaps Dr. Fred Singer got away with presentations on space travel when *Collier's Magazine* published his and von Braun's lavishly illustrated series during the early 1950s.

The above situation reminds one of the early 1950s Si-Fi film entitled *Destination Moon*. A rather successful and entertaining movie with great early special effects, the story line indicates the moon rocket project is a private venture. However, a rather creepy Cold War flavored situation occurs when an unknown (read unidentified) entity attempts to stop the manned rocket from being launched. The movie apparently reflected the mentality of the late 1940s and is roughly similar to Bill Walter's Hayden Planetarium encounter.



LEFT: USAF Captain William Walter was associated with the Bell's initial rocket-bomber projects and created the original specifications for R464L Dyna Soar (RS-620A). He later resigned and worked for Avro Aircraft of Canada during their development of the Avro VZ-9 Aerocar. (Photo from Kathy Walter) **RIGHT:** British born engineer Wilfred H. Dukes in later life and a leading structures engineer who was heavily engaged in the BoMi, Brass Bell, RoBo, and the Bell, Martin-Bell Dyna Soar projects. Also a member of the American Rocket Society, he traveled widely giving excellent presentations on Bell Aircraft's hypersonic structures research work. He received dozens of complementary letters praising Bell's work and his presentations. (Photo from the W.H. Dukes Estate).

A CONCEPT DEFINED

The aerodynamics and structures engineers held multiple convicts during the initial six months, discussing hypersonic design concepts fitted to BoMi specifications, including its re-entry weapon. Realistically, BoMi engineers faced three basic criteria: Heat (thermal expansion and contraction), control (aerodynamic flight stability) and maneuverability during endo and exo-atmospheric flight. They occurred simultaneously while coasting on a "once around" (one circumnavigation of earth) mission. The single most amazing and audacious component of BoMi was that its internal structure was that of a traditional aluminum aircraft.

The caveat was that Bell's structural engineers proposed enveloping the glider's aluminum airframe with a layer of low-conductivity insulation.³⁶ Materials researched were vermiculite - an exploded mica, thermoflex and fiberfrax both fibrous insulants, covered by an outer heat resistant metal exo-skin, basically, an outer plate jacket.³⁷ Different hypersonic configurations also required varying methods of construction including new engineering heat protection methods previously unheard of, untried and untested.³⁸ Studies included possible applications of transpiration cooling - a liquid coolant exiting as vapor through a porous outer skin into the boundary layer, but the team questioned its overall weight and rejected it.³⁹

Mr. Dukes indicated that BoMi structural research was

heavily supported by Wright Aeronautical Development Center's (WADC), Structures Division.⁴⁰ Available 1950s era heat resistant metal samples were tested for possible application as outer skin panels. The available metals were Inconel X series,⁴¹ Haynes Alloy 25, Molybdenum (Westinghouse) and various graphites (U.S. Graphite Co. and others).⁴² Ceramics were other possible choices researched at Westinghouse and Battelle Memorial Institute's Thermodynamics Division.⁴³

After launch, BoMi and future gliders transitioned through sonic, transonic and supersonic regimes into sustained hypersonic glide at Mach 10 to Mach 20 speeds for the majority of its flight. This speed regime was the engineer's primary hurdle in constructing a survivable hypersonic glider. The aerodynamics team grappled with a spectrum of problems including wing planforms, L/D (Lift-Drag) ratios for optimum glide angles via aerodynamic design compromises. Included were control, maneuverability, heat transfer, cockpit cooling and layout plus pilot egress choices.⁴⁴ Meanwhile the structures engineers were deeply engaged in researching creep, thermal shock, heat transfer, gust loads and advanced materials evaluation and fabricating samples for thermal tests.⁴⁵

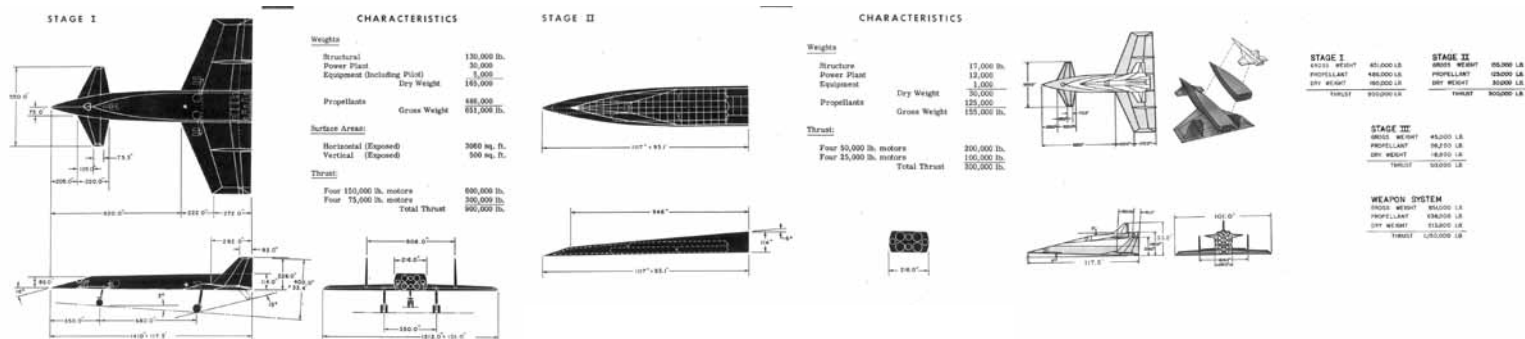
HERE'S...BoMi

Initial BoMi was introduced to the USAF as a vertical launched three-stage pick-a-back vehicle that was quite the monster - its total gross weight topping 851,000 pounds. BoMi was thrust aloft into hypersonic flight between 100,000 and 250,000 feet. Stage I was a 117.5 foot piloted 651,000-pound recoverable canard aircraft with four 150,000-pound thrust regenerative-cooled and gimbaled rocket engines.⁴⁶ Four smaller 75,000-pound thrust rocket engines provided a total of 900,000-pounds thrust. Initial Reports for Stage I and II suggested a mix of 50% oxygen, 50% fluorine with JP-4.⁴⁷ However, an alternate fuel listed for Stage I and II was a hydrazine-ammonia mixture with oxygen.⁴⁸ Stage III's two regenerative-cooled engines would burn oxygen-flourine with JP-4 and nitric acid was also suggested.⁴⁹

Stage two was a 117 foot long "flat iron" style expendable booster with four 50,000-pound thrust rocket engines and four 25,000-pound thrust engines. All eight engines generated 300,000-pounds thrust, burning the same fuel as Stage I.⁵⁰ Stage III, the piloted glider, was 74.6 feet long and weighed 45,000 pounds with two onboard rocket engines generating 50,000-pounds thrust.

The 4,000-pound "glide-bomb" housing a 2,800-pound warhead was placed between the engines and ejected rearwards.⁵¹ The piloted glider's wing utilized a half diamond airfoil and landed on X-2 style landing gear - a standard nose wheel and two retractable landing skids. BoMi would naturally be equipped with small reaction control motors, as tested on the X-1A. Cockpit pressure was set at five PSI of inert nitrogen gas with the pilot wearing an oxygen mask.⁵² Engineers chose four cockpit thermal control approaches - coolant circulating through the walls, additional insulation, gases circulating around the pilot or a special pilot ventilating suit.⁵³

Sudden cabin pressure failures were still an issue, thus both pilot and navigator-bombardier wore full pressure suits. Their



LEFT: Drawing of Stage I, the winged, piloted fly-back booster that was inspected, serviced and RTS (Return to Service). CENTER: Stage II the flat-iron intermediate booster was described as an expendable booster, although it could have been recovered via parachute return, but this was not mentioned as an option. RIGHT: A three-view plan of the piloted Stage III BoMi glider-again, given in inches rather than feet. (All USAF photos)

development was initiated in 1940 as MX-117, as a secret War Department funded WADC Aero-Medical Research Laboratory project, and continued after WWII.⁵⁴ Six firms engineered variations subjected to high altitudes in a B-17D and B-17E. Other heavily encumbered pilots squeezed into P-39 and P-47 fighters, flying to their aircraft's maximum altitude. Pressure chamber tests simulated 105,000 feet plus altitudes, indicating that several designs might conceivably function in a space environment, albeit under very short, highly uncomfortable and heavy energy depleting conditions.⁵⁵

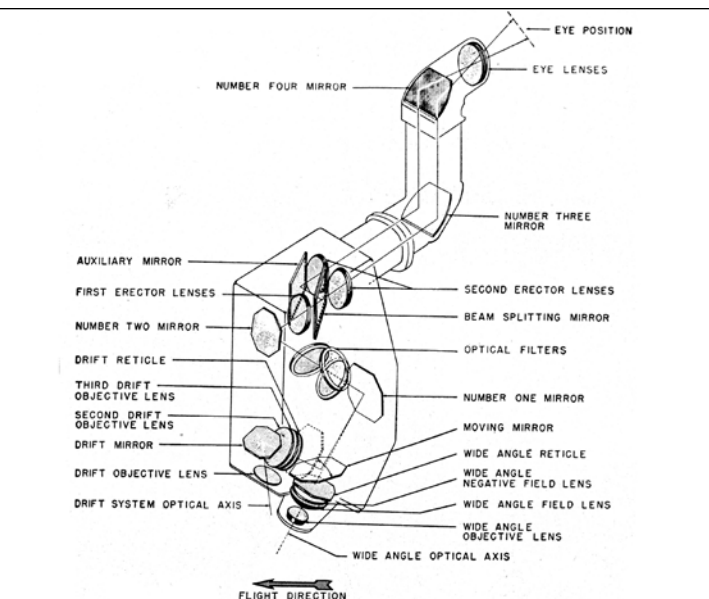
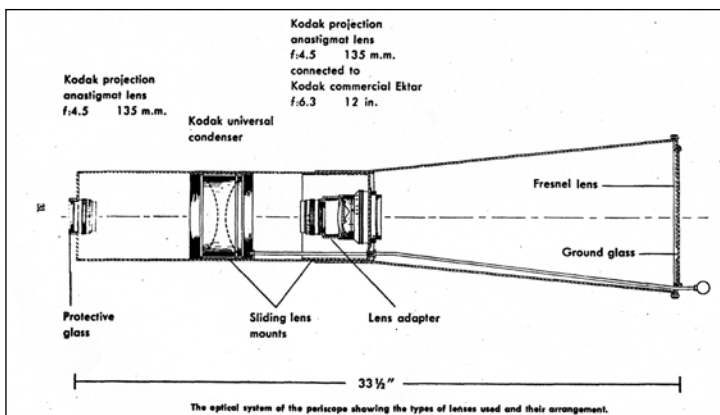
The BoMi Stage III glider drawing displays a poor visibility plate windshield. Early 1950s plastic and glass technology did not produce heat resistant glass windshields so they were omitted to reduce drag, thermal problems and heavy development expenses. Instead, BoMi engineers opted for an early 1950s ocular type periscope presenting 76 degrees field of view, with advanced models promising 180 degrees of view from the vehicle's belly.⁵⁶

From 1949 into the late 1950s the USAF Aero Medical Laboratory's "vision section" at WPAFB, were testing optical periscopes to improve pilot vision.⁵⁷ Republic Aircraft flew an F-84F for their experiments while Farrand Optical Company, Inc. of New York, University of Illinois, Perkins-Elmer and the Aero Medical lab flew a B-17 on their periscope tests. Tests

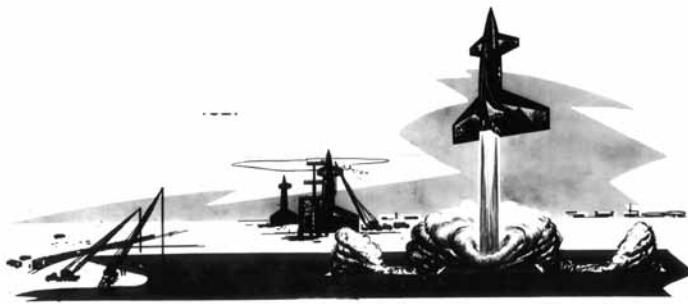
with low-time and experienced pilots indicated that certain optical devices provided a pilot with the necessary vision to approach and land a supersonic or hypersonic aircraft.⁵⁸

The Bell series of boost-glider designs, Dyna Soar included, utilized slightly angled side port windows located on the forward tapering nose cone. The pilot viewed his flight path through a forward aimed viewfinder (periscopes) for approach and landings. Raised heat-resistant cockpit frames, a cooling system and heavily insulated multi-plate glass protected by a reentry heat shield increased drag. They were very expensive to engineer and construct as displayed in Boeing's 814 and 844 series Dyna Soar gliders. Consequently, the Bell gliders were easier to engineer (a smooth unbroken low-drag fuselage) and featured crew ingress-egress via a top hatch above the cockpit. Boeing followed suit on their late Dyna Soar gliders.

Initial BoMi glider had no separating escape unit ala the Douglas Skystreak, Skyrocket and Bell X-2, the whole glider was the proposed method of escape. This meant that should



LEFT: A representative drawing of 1950s era optical periscope engineered at the University of Illinois for the USAF. This one of numerous types that could be applied to aircraft with poor forward visibility. (Drawing from the Maxwell AFB Archives) RIGHT: This drawing presents the type of optical periscope Bell Aircraft contracted for the Bell Model 67, X-16 high altitude reconnaissance aircraft, and for installation in BoMi and R459L Brass Bell Reconnaissance gliders. USAF and contractor research increased the field of view during the late 1950s. (Drawing from the Dave Stern collection)



A Bell art drawing of MX-2276 BoMi lifting off a surface ready launch stand; three other assembled BoMi vehicles are ready to launch. Had any version of BoMi been manufactured, Strategic Air Command would operate it, since it was a strategic weapon system. (Bell drawing)

the pilot find himself in an outrageous and dangerous situation, he must let the vehicle tumble to a lower altitude where, if still alive, he ejected up and out of the cockpit - hah! Bell engineers then redesigned later gliders with explosively detached nose-cabin capsule units.⁵⁹

Two other initial BoMi configurations were also presented to the Air Force. A 107-foot two-stage tailless bomber weighing 518,000 pounds with propellants making up the bulk of that weight. The 51-foot long piloted glide bomber was attached to parallel booster rockets. Another variant was a 5,000 mile range reconnaissance airplane with twin-tails and a booster grossing 297,000 pounds. The aerodynamics team deriving estimates from airframe creep and thermal airframe predictions concluded that economic Bomi airframe life might span 10 to 15 flights at approximately 80 minutes per flight. This allowed a reasonable and estimated margin of 100 total airframe hours for the initial BoMi, before retirement to the Davis-Monthan AFB, boneyard.⁶⁰

BoMi engineers generated calculations with slide rules and delivered the results to the mathematics department. Their data was processed with a rather dated card program calculator (CPC) performing 100 computations a minute.⁶¹ A small army of women also worked mechanical calculators to crunch numbers and provide answers. In 1955, Bell's Niagara Frontier office received one spanking new IBM *electronic engineer*.⁶² The IBM 650 Magnetic Drum Data Processing Machine (a.k.a *Defense Calculator* IBM 701) digested and stored an amazing 20,000 digits,⁶³ becoming an advanced tool throughout the U.S. aeronautical community.

According to an IBM news release, Bell applied it to process X-plane, *Rascal*, and rocket engine data.⁶⁴ Bell also acquired an IBM-704, a 717 printer and 714 card reader that equipped a new computer processing department. Mr. Dukes stated that numerous boost-glider software programs were created for the 704. They included leading-edge geometries, temperatures, gradients and stresses, angle of attack, wing sweep angles and evaluating new metals and coatings.⁶⁵

A FOREIGNER PUBLICIZES BoMi

In 1954, MI-5's Kenneth W. Gatland gained information on some aspects of BoMi thus publicly letting the "cat out of bag"

by writing *The Dornberger-Ehrlicke Project*, minus its official project number and nickname. His article was featured in *RAF Flying Review*, December, 1954. BoMi was officially classified secret meaning that neither Bell nor the USAF publicly released any MX-2276 data to American aviation magazines. Where he obtained his information and the two-stage pick-a-back vehicle illustrations is unknown.⁶⁶ Doubtless, copies of this issue reached Moscow in Russian diplomatic pouches, alerting several Russian specialty OKBs also engaged in Sanger-style bomber-vehicle studies.⁶⁷

The 1957 Soviet response to Bell's boost glide projects is the highly suspect T-4A, a piloted straight wing *Kosmolyots* (Space-Airplane) they coined "ICBM rocket-bomber." No photographs or details of T-4A have ever been published, thus one may treat it as an attempted disinformation project to demonstrate Russian contemporary engineering prowess. Concurrent with this revelation was the audacious statement that the T-4A's engine and the vehicle (no pilot was mentioned) were supposedly flown between 1958 and 1959.⁶⁸ It was initially revealed by American aviation-space researcher and author, Lloyd Mallan, during a successful 1958 "information gathering" tour throughout the Soviet Union. He returned with interviews, detailed information, and 6,000 amazing photographs of Soviet aerospace progress after Sputnik was launched.⁶⁹

SYSTEM-118P, THE CLASSIFIED CATYLIST

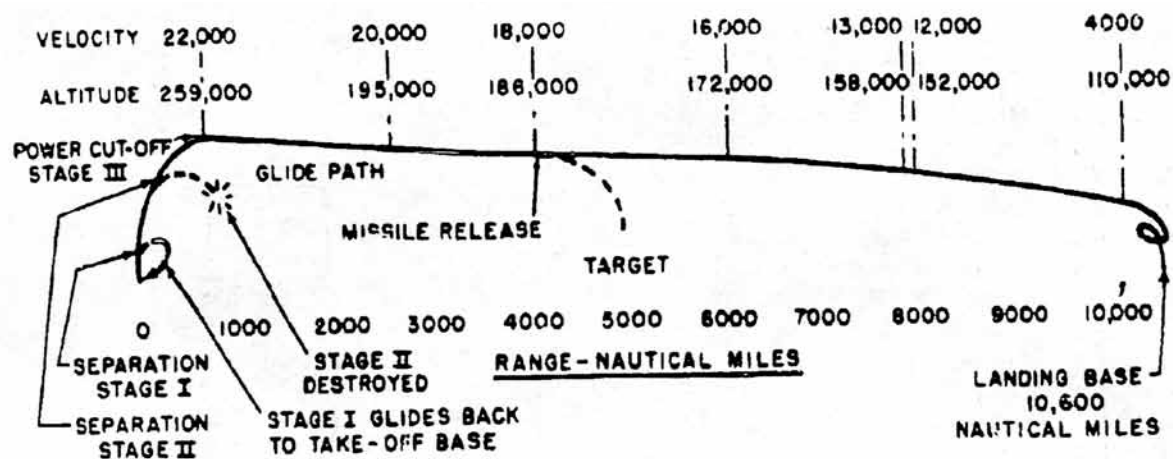
In early 1955, the USAF ASD (Aeronautical Systems Division) and WADD (Wright Aeronautical Development Division) reviewed and acknowledged BoMi as an advanced and viable strategic weapon system. BoMi thus represented a promising weapon system but required a substantial research and development program.⁷⁰ SAC interest claimed it since the gliders performed strategic missions and promised immunity from aircraft and guided missile interception. While the USAF evaluation of MX-2276 has not been located, an off-handed report recorded the following conclusion: "there is no single or combination of natural geophysical factors that would make the operation of a vehicle of the type described in MX-2276 unfeasible."⁷¹ ARDC thus approved \$125,000 to extend the BoMi contract by creating a "rider" or supplemental agreement 2 (56-284) attached to the original AF 33(616)-2419 BoMi contract. It is identified within SR-12 as Development Requirements System Number-118P.

The 118P rider stipulated that BoMi engineers must apply analytical investigations and design studies to their initial BoMi submission. It would adapt BoMi through refinements to satisfy or exceed the criteria set forth in Phase II (hypersonic) of 118P.⁷² Bell engineers complied and literally transformed the original BoMi concept into a totally different configuration. This transition was accomplished under System 118P requirements between May 2, 1955 and December 1, 1955.⁷³ According to Bell paper, the Air Force approved \$200,000 to cover the advanced studies under the System 118P Supplemental Agreement concerning BoMi.⁷⁴ Genealogically, System 118P provided the catalyst that literally transformed initial BoMi into a more viable advanced hypersonic reconnaissance glider;

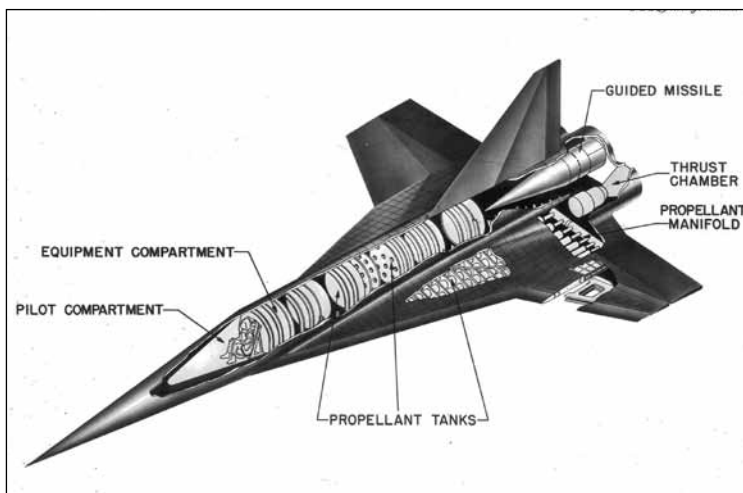
American Aviation Historical Society Journal, Summer 2017



LEFT: The original surviving model of MX-2276 BoMi as presented to the USAF. The model is shown here in its separate stages. Though somewhat ragged due to desktop and manhandling combat damage, the chips and nicks are small price to pay for an original display model that is approximately 60 plus years old. CENTER: BoMi as it would be launched. The white paint of Stage III the piloted glider would have been burned away at hypersonic speeds, but this is a display model—meaning “license, where paint schemes are concerned. RIGHT: As seen from the rear, BoMi carried a total of 18 rocket engines producing various thrust levels to achieve hypersonic speeds and altitudes, according to a specific mission and target range. The handsome model is held at the Niagara Aerospace Museum. (All photos from the Dave Stern collection)



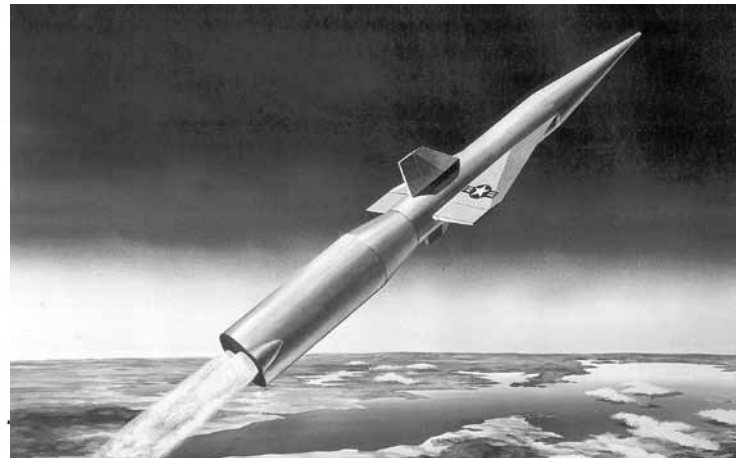
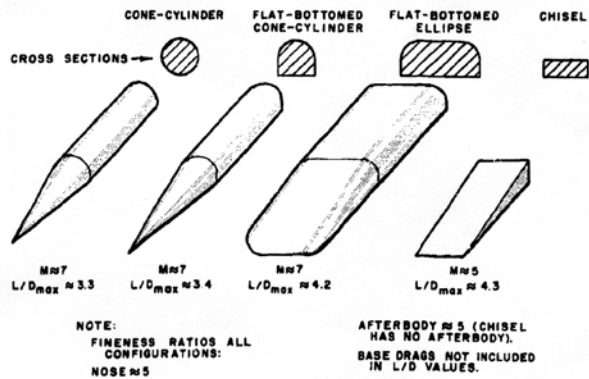
A mission profile for a 10,000 mile range BoMi bomb delivery whereby, the pilot continues along a track that returns to his base. Originally, BoMi would launch the weapon, slow down to negotiate a huge 180 degree turn, double back along its original flight path to reach the U.S. The 180 degree turn reduced speed and range requiring flight profiles be changed to a continuous straight-line global spanning glide flight. (Bell drawing)



A cutaway drawing of Stage III the piloted glider displays rocket engines, fuel tanks and nuclear weapon nestled in the extreme rear fuselage. The pilot wears a full pressure suit—the suit being the prescribed wear for hypersonic rocket-bombers, boost-gliders, lifting body spacecraft and Dyna Soar weapon systems. (USAF photo)



A model of the advanced BoMi after Bell Engineers applied System 118P's analytical studies to redefine the initial BoMi – but still a bomber. The model also represents a very basic configuration style for the Brass Bell, and March, 1958 Bell Dyna Soar I proposal. Variations were two-crew, side by side, tandem and various tail designs with short lower fins jettisoned for landing, and other features are not visible here. (Bell photo).

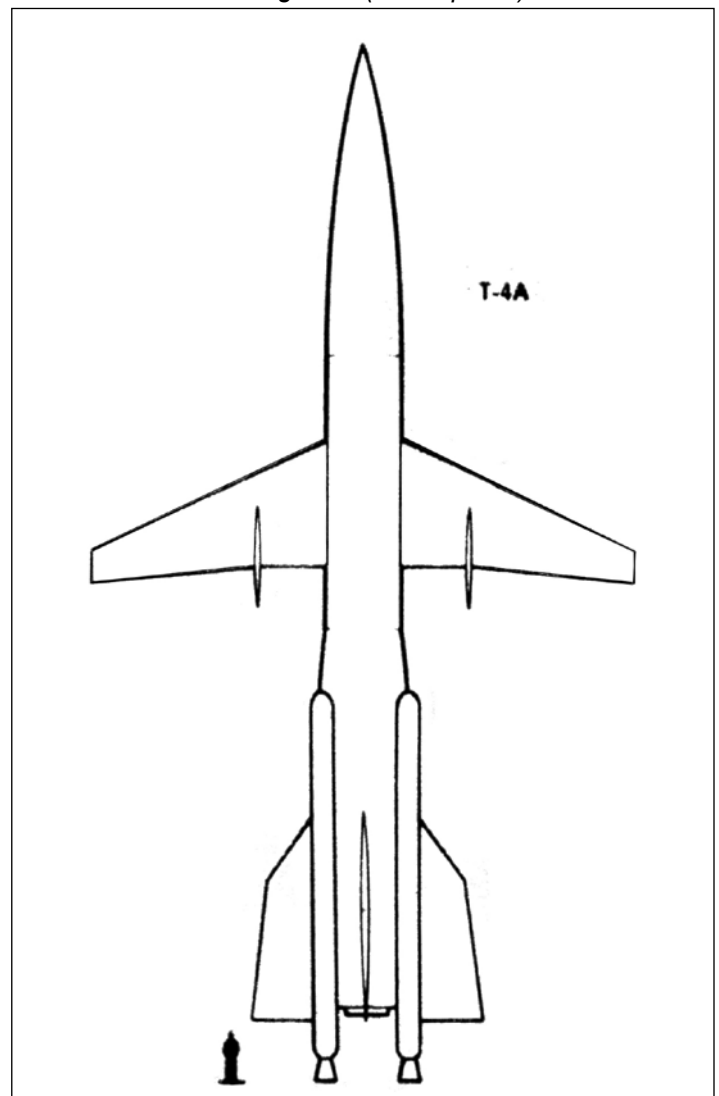


Various hypersonic shapes, including lenticular (saucer) types not illustrated were studied for BoMi and System 118P). System 118P criteria effectively changed the BoMi engineering team's design approach whereby they opted for the cone-cylinder body, and slender nose cone. The sharp needle-nose would not survive re-entry due to exotic heat bearing metals being unavailable, and was later blunted. Today, such a sharp nose is reputed to be survivable with advanced materials absorbing extreme thermal temperatures. (Bell photo)



A Bell display model of the transformed MX-2276 upon completion of the Bell Supplemental study contract System 118P. The parallel booster is not a Martin Titan III design rather a prescient booster type created by BoMi engineers, predating the late Titan III heavy launch booster system! (Bell photo)

The refined solution to USAF Supplemental Study System 118P. Bell project engineers and Dornberger referred to redesigned MX-2276 BoMi as a glide-bomber. The 118P spinoff satisfied USAF requirements for an unarmed hypersonic reconnaissance glider. (USAF photo)



Drawing of the Soviet T-4A "ICBM Rocket-Bomber," a title easily applied to an unpiloted ICBM rocket. No photos of rocket-bomber have ever been released. It is not described in the Russian authored book, "Space Wings." It can only be considered a disinformation project at best. (Drawing from Lloyd Mallan)

however, Bell still retained the initial bomber mission for MX-2276.

In April 1956, USAF funding listed at \$300,000⁷⁵ transformed BoMi into the heavily researched and continually funded System 459L, *Hi-Fi Recce* or *Brass Bell*.⁷⁶

The re-born BoMi now satisfied System 118P of GOR-92, the ARDC requirement for a piloted very high altitude unarmed hypersonic reconnaissance weapon system.⁷⁷ After this transformation Bell Aircraft commissioned a color presentation film introducing the reconfigured MX-2276 BoMi to the USAF. Dr. Dornberger now presented the updated BoMi glider with either a modular camera suite or carrying a “drop-down” (read re-entry) missile. He mentions not, the System 118P reconnaissance variant outlined in USAF R&D Research Form DD-613 formally describing System 459L *Brass Bell*.⁷⁸

After cancellation of the Model 67 *Bald Eagle* reconnaissance aircraft contract, the USAF continued funding Bell Aircraft’s pioneering research into boost-gliders, including a spectrum of structures research. With USAF funds engineers refined BoMi, R459L *Brass Bell* and SR-126 RoBo gliders while advancing and refining their cooling and insulation systems; this included select sub-contractors who created specialized equipment applicable to the Bell gliders. Bell continued to be awarded a series of USAF funded structures research contracts (well into the mid-1970s), that greatly contributed to theirs and other hypersonic glide vehicles-including those Lifting Body creations. →

(Concluded in Part III)

Author’s Note: Would the gentleman who salvaged numerous Bell Aircraft Co. files please contact the author; communications will be kept in strictest confidence.

Acknowledgements

The author thanks AAHS member and retired aeronautical engineer, Gerald Balzer for his advice and critiquing the aerodynamics described herein. Included is Sherry Kelt who graciously agreed to “let’s make a deal,” allowing the author to acquire now deceased Bell Aircraft Structures Engineer, Mr. Wilfred Duke’s collected engineering material, for the Bell boost-glider and Dyna Soar projects.

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