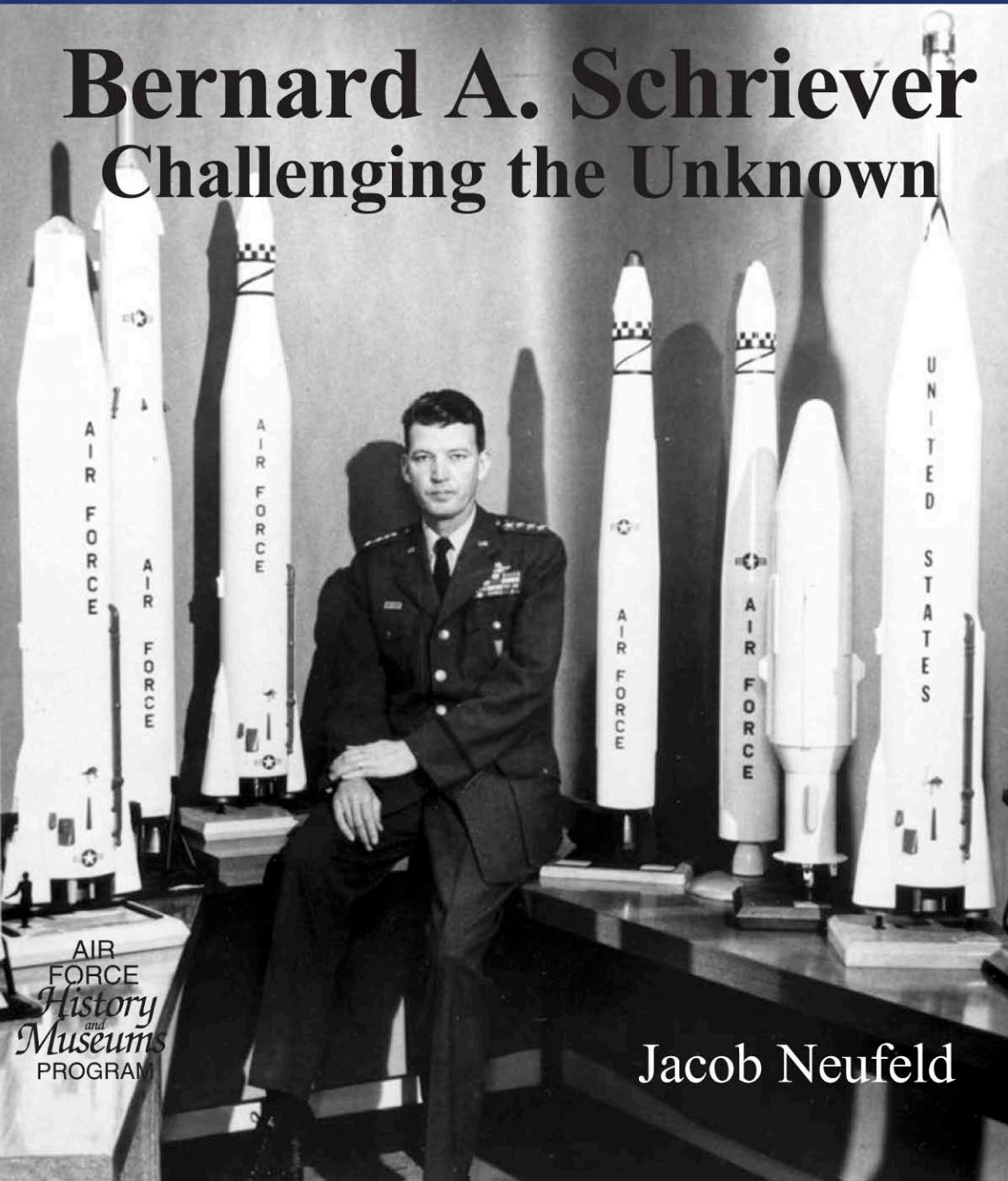


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Commemorative Edition

Bernard A. Schriever

Challenging the Unknown



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On June 5, 1998, Falcon Air Force Base, Colorado, was renamed Schriever AFB in honor of the still-living “father of Air Force missiles and space.”

Bernard A. Schriever

Challenging the Unknown

Jacob Neufeld

When, on June 5, 1998, Falcon Air Force Base, ten miles east of Colorado Springs, Colorado, was renamed in honor of General Bernard A. Schriever, USAF (Ret.), it marked a singular event. Normally, such an honor is bestowed posthumously, but in this case, the renaming ceremony proved the exception.

Although World War II had sparked an effusion of scientific and technical developments, among them radar, electronic warfare, jet engines, air-to-air and air-to-ground missiles, and data-processing technology, the two innovations of unprecedented character that had the greatest affect on the Air Force and the world balance of power were nuclear weapons and ballistic missiles. Gen. Henry H. "Hap" Arnold, who led the Army Air Forces in World War II, believed correctly that the Air Forces' future lay in adapting scientific and engineering advances to air warfare. He was determined to continue in peacetime the cooperation between the Air Force, university scientists, and industry that had paid such handsome dividends during the war. One of the men selected to help fashion the technology of the postwar Air Force was a young colonel named Bernard Schriever, who combined some uncommon personal attributes with engineering training and combat experience. Schriever was to become the officer most closely associated with the development of ballistic missiles. Ultimately, he would be responsible for research, development, and acquisition of all new weapons used by the United States Air Force.

Recognized as an unusually intelligent man, Bennie Schriever had a strong character and a precise, disciplined, but creative mind, determined to master any task he undertook, and willing to make hard decisions. These characteristics were at least in part a result of an extraordinary background. Born

in Bremen, Germany, on September 14, 1910, he was the son of an engineer for the North German Lloyd Steamship Line. His earliest childhood recollections are of German Zeppelins flying over his home on their way to bomb Great Britain during the First World War.

In 1916, the ship on which Bennie's father, Adolph, served was seized in New York and its crew interned. Early the following year, Elizabeth Schriever took her sons, Bernard and his younger brother Gerhard, to join their father in New York. After his release, Adolph found employment as a quality control engineer in a large engine plant in San Antonio, Texas. He settled his family there, where they had relatives. In September 1918 an industrial accident took his life, and his wife, unskilled and not fluent in English, suddenly became the sole support of herself and two young sons.

Some very difficult months followed when the boys had to be placed in a foster home until their mother found work as housekeeper for a wealthy San Antonio family. Her employers later built a small house for the family at the



Commissioned in the Field Artillery, in 1932 Schriever transferred to the Air Corps.

edge of the Breckinridge Park municipal golf course. The energetic Mrs. Schriever put up a small refreshment stand near the twelfth green and sold homemade sandwiches and cold drinks to the golfers. The Schriever boys contributed to the family finances by doing chores and caddying.

Even with the security of a home and steady employment, life was not easy for the boys, especially Bennie, who was expected to look after his

Schriever won the San Antonio City junior amateur championship in 1931. An outstanding golfer throughout his life, Schriever had at one time considered becoming a professional.

younger brother. At a tender age, the boys had been cast from a stable, middle-class, North German environment into completely different geographic and social surroundings. Added to that was the strong current of anti-German sentiment in the United States during the 1920s. Bennie Schriever accepted his situation and, in a true-life Horatio Alger story, determined to excel in everything he did. He graduated with honors from San Antonio High School, and as well was an outstanding golfer. Matriculating at Texas A&M, he graduated in 1931 with a degree in architectural engineering.

Engineering jobs were scarce during the Great Depression. The six-foot, four-inch Schriever had two alternatives. He could become a professional golfer (he had been featured in Ripley's *Believe It or Not* for three times driving more than 300 yards to the same green and one-putting for an eagle), or, having been an ROTC cadet at A&M, he could accept an Army Reserve commission as a second lieutenant in the Field Artillery. The former alternative meant an easy and pleasant life, but then he caught the flying bug. Transferring from the Artillery to the Air Corps, he now had the chance to become an Army flyer, though with no guarantee of active duty for more than three years. (At the time, only West Point graduates could receive Regular Army commissions.) He began flying training in 1932 at Randolph Field and completed his pilot training at the Army Air Corps Flying School at Kelly Field, Texas, in June 1933.



Schriever won his wings in June 1933 after completing flying training at Kelly Field, Texas.

His first duty assignment was at March Field, California, where he served as a bomber pilot and engineering maintenance officer under Lt. Col. Hap Arnold. One of his most memorable experiences was flying the air mail when the Air Corps took on that operation in early 1934. Schriever would remember the deaths of Army pilots who flew the mail in ill-equipped aircraft and with little training in instrument flying. He was determined to use his engineering skills to improve the flyers' lot.

Schriever's active duty ended in April 1935. His application for a job with the airlines was unsuccessful, so in June 1935 he accepted employment with the Civilian Conservation Corps (CCC), a New Deal agency that provided work for unemployed young men, as a camp commander in New Mexico. He remained until October 1936, when he was able to return to active duty with the Air Corps. In December, he was assigned to Albrook Field in Panama,

where he met and later married Dora Brett, the daughter of Brig. Gen. George H. Brett.

Schriever's industrious, efficient nature concealed a private, somewhat puckish, sense of humor. General George Brett's son, retired Lt. Gen. Devol Brett, recalls how his father used to call on Schriever and another young lieutenant to fly formation with him in open cockpit P-12 fighters. General Brett insisted on a very tight formation. When they came in for a formation landing, however, the two young wingmen were to drop back slightly, but they stuck tight to the general's wing and, approaching the end of the field, chopped their throttles and landed, forcing General Brett to go around for another turn.

In August 1937, Schriever was accepted as a pilot by Northwest Airlines, flying the route from Seattle, his new base, to Billings, Montana. The following January, he and Dora Brett were married in Hap Arnold's Washington, D.C., home. The Arnolds and the Bretts had been friends for many years, and since General and Mrs. Brett could not leave Panama for the wedding, the Arnolds volunteered to serve in loco parentis.



Lt. Col. Henry H. "Hap" Arnold

On one of Hap Arnold's visits to the Boeing plant in Seattle, he and Schriever managed to get together for a golf game. Arnold told Schriever that some two hundred Regular commissions were to be awarded. Schriever liked commercial flying, but military life appealed to him more since it offered broader opportunities than the airlines did. It was a tough decision because he was about to become a Reserve captain and, if called to active duty, would be paid about \$500 a month. If he won a Regular commission, he would be a second lieutenant

and draw much lower active duty pay. Nevertheless, Schriever took the Air Corps examination and on October 1, 1938, received his commission as a Regular second lieutenant and an immediate assignment to the 7th Bombardment Group at Hamilton Field, California, as a B-18 instrument flying instructor.

After a year at Hamilton, Schriever was assigned to Wright Field, Ohio, as an engineering officer and test pilot. While there, he was selected as one of six officers to attend the Air Corps Engineering School—the forerunner of today's Air Force Institute of Technology. After Schriever completed the one-year course, in July 1941, the Army Air Forces (which the Air Corps had become the previous month) sent him to Stanford University to earn a master's degree in aeronautical engineering. By the time he graduated in June 1942, six



In September 1944, General Hap Arnold asked Dr. Theodore von Kármán, head of the AAF Scientific Advisory Group (predecessor of the SAB), to project ahead twenty years the expected scientific advancements. Both men believed fervently in the promise of science and technology.

months after Pearl Harbor, Schriever had been promoted to major and was assigned to the 19th Bombardment Group in the Southwest Pacific. He flew thirty-three combat missions in B-17s while serving as the 19th's chief of maintenance, before being removed from operations because he had experience and training as an aeronautical engineer.

By war's end, Bennie Schriever had become a colonel and the Commander, Advanced Headquarters, Far East Air Service Command. His organization was responsible for building and operating all maintenance, repair, and supply depots that supported the Far East Air Forces. He was one of the few air officers to witness the Japanese surrender aboard the USS *Missouri* in Tokyo Bay.

Col. Bernard Schriever's experience, education, and reputation as a thinker and a doer destined him to remain associated with technical activities of the Air Force. After the convulsive demobilization following World War II, the Air Forces had few officers with his qualifications. In January 1946, he was assigned to the Army Air Forces headquarters in the Pentagon as Chief, Scientific Liaison Branch in the office of the Deputy Chief of Staff for Materiel. He was fortunate to be working closely with Dr. Theodore von Kármán, head of the Air Force Scientific Advisory Board (SAB). Von Kármán took the young colonel under his wing and introduced him to many leading scientists, helping Schriever reforge the connection between the scientific community and the Air Force that had existed during the war.

Schriever soon found himself at the center of a select group of young officers who believed the Air Force had slighted scientific research and development since Arnold's retirement in February 1946. The group included Maj. Theodore Walkowicz, Peter Schenck, James Dempsey, Vincent Ford, and Ralph Nunziato. Maj. Gen. Donald L. Putt, Air Staff Director of Research and Development, was the senior member of this group which campaigned for a separate research and development command and the establishment of a deputy chief of staff for development on the Air Staff. Aiding the group was

retired Lt. Gen. James H. Doolittle, a close friend of Gen. Hoyt S. Vandenberg, who succeeded Gen. "Tooe" Spaatz as Air Force Chief of Staff in April 1948.

This group prevailed upon the Air Force leadership to commission an SAB study of research and development. Dr. Louis Ridenour headed a committee of scientists that reviewed the status of R&D in the Air Force. The Ridenour Committee agreed with Schriever and his colleagues that Air Force R&D would be vastly improved by creating a research and development command. A parallel study conducted by a military committee led by Maj. Gen. Orvil Anderson of the Air University and completed in November 1949 concurred. The Anderson Committee also recommended that a deputy chief of staff for development be added to the Air Staff.

Following a one-year break from Pentagon duty to attend the National War College in Washington, Schriever was again assigned to the Air Staff. He wanted to become Vice Commander of the Air Proving Grounds, Eglin AFB, Florida, but he was named instead to be Deputy Assistant for Evaluation under the newly created Deputy Chief of Staff for Development. In January 1951, Schriever's office, which performed or contracted for analytical work, was renamed the Development Planning Office. In addition to its planning function, his office oversaw the work of the Rand Corporation which had an eight-to twelve-person contingent assigned to the Development Planning Office in the Pentagon.

As Assistant for Development Planning, Schriever devised a method of analysis called Development Planning Objectives (DPOs). The purpose of DPOs was to identify promising advances in technology and coordinate them to meet future operational requirements of the Air Force. Separate DPOs were created for the major Air Force mission areas: strategic, tactical, airlift, air defense, and intelligence and reconnaissance. The intelligence and reconnaissance DPO was among Schriever's most important early achievements.

DPO methodology clashed with the Air Staff's traditional procedure for establishing weapons and equipment requirements. While Schriever sought to *push* technology forward to meet applications envisioned for future developments, the traditionalists were content to merely *pull* it along to meet the needs of the present. As a relative newcomer among policymakers, Schriever's approach produced some internal friction in the Air Staff. Though he did not always succeed, he enjoyed the confidence of the top Air Force leaders: Gen. Nathan Twining, who became Chief of Staff in June 1953, and Gen. Thomas White, Vice Chief of Staff.

Once convinced of the correctness of a position, Schriever never shrank from confronting such formidable opponents as the Commander in Chief of the Strategic Air Command (SAC), Gen. Curtis E. LeMay, who wanted, among other things, a nuclear-powered aircraft able to fly at supersonic speeds. Analysis showed that only a *subsonic* nuclear-powered bomber was feasible. Colonel Schriever, called to General LeMay's office to defend his position against the SAC staff, held his ground. Expert scientific opinion supported Schriever's position, which ultimately prevailed.

LeMay and Schriever were destined to disagree frequently. Although the two men respected one another, their views quite often diverged. LeMay, the operator, usually looked for solutions to near-term problems; Schriever's vision was more attuned to the future. Among the major issues between the two were disagreements over the best method of inflight refueling, whether or not tactical aircraft should carry nuclear weapons, and whether strategic bombers should be designed as large aircraft to attack from high-altitude or as small aircraft able to attack from low-altitude. An advocate of the latter, Schriever was instrumental in developing the B-58 and pushing for low-altitude bombing capability.

Life in the Pentagon during the formative years of the postwar Air Force gave some foretaste of the pressure under which Schriever would operate in a few years. A seven-day work week was common, affording little opportunity for family life, let alone golf. By this time, the Schriever family included three children: a son, Brett, and two daughters, Dodie and Barbara. An occasional trip to Florida allowed for a family gathering with General and Mrs. Brett, who were living in retirement in Orlando. While Bennie was at work at the Pentagon, Mrs. Schriever would pack for the trip. At the end of the day, he would load the family into the car and drive nonstop to Florida. Mental and physical stamina were trademarks of Schriever operations. Years later an officer who worked for Schriever said, "Anyone not in good physical condition, who doesn't have a trigger-quick mind, had better not work for this general."

Undoubtedly Bernard Schriever left his most prominent mark on the development of Air Force intercontinental ballistic missiles (ICBMs). When he became manager of the ICBM program in mid-1954, it had suffered through a checkered history marked by stop-and-go development, unrealistic requirements, divided authority, low priorities, and indecision whether the emphasis should be on ballistic missiles or winged missiles like the Snark and Navaho, essentially unpiloted aircraft.



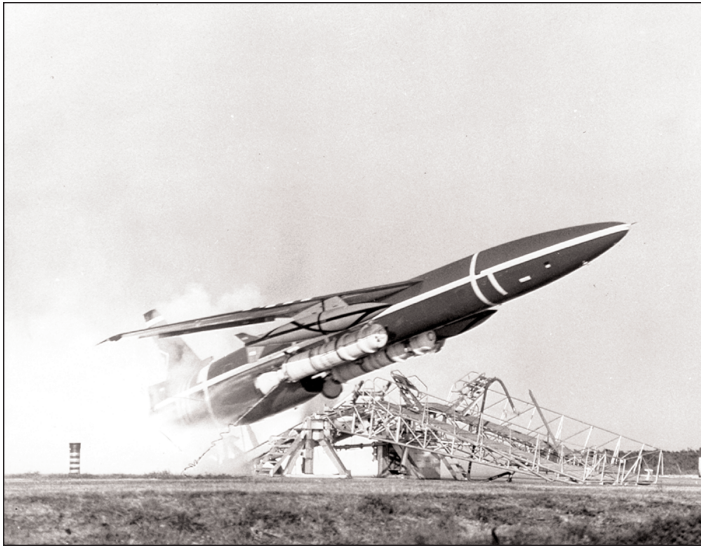
General Curtis E. LeMay and Schriever did not see eye-to-eye when it came to the B-58 Hustler. LeMay stands next to the controversial plane.



The Air Force's expensive, ten-year-long Navaho program did not produce an operational missile. However, the builder, North American developed the rocket engines that propelled not only military missiles, but space launchers as well.

Research in the ballistic missile field had begun immediately after World War II but soon fell victim to budgetary cuts that reduced it to dormancy. The program was resurrected in January 1951 as Project MX-1593, which led ultimately to the Atlas ICBM. In December 1952, a committee of the Air Force SAB headed by Dr. Clark B. Millikan recommended a phased approach that would not produce an operational missile until 1965.

In March 1953, Schriever learned of a scientific breakthrough that appeared to make intercontinental missiles technically feasible much sooner than the Millikan Committee thought possible. At a meeting of the SAB, Dr. Edward Teller, a leading advocate for the development of hydrogen weapons, reported on the successful test of a hydrogen bomb device in November 1952—the “Mike” shot. Dr. John von Neumann, head of the Institute for Advanced Study at Princeton, New Jersey, confirmed Teller’s report and predicted that hydrogen warheads would be extremely light, with a high explosive yield. This news captured the attention of Schriever and Theodore Walkowicz, a retired Air Force officer. The two visited von Neumann and were convinced that the predicted new weapon, lighter and much more powerful than atomic warheads, promised to dispel one of the major obstacles in ICBM development. The missile could require less thrust because of its lighter warhead, and



The Snark long-range missile is boosted into the air during a test launch. At long last, it became operational in February 1961. By June, however, the Kennedy administration declared it obsolete.

its trajectory could be less accurate because of the warhead's greater destructive power. Von Neumann believed a thermonuclear warhead weighing 1,500 pounds and yielding one megaton could be achieved by 1960. Schriever urged the SAB to formalize these findings and prevailed upon von Neumann, Teller, and other leading scientists to issue a report in June 1953 that confirmed the feasibility of such a lightweight, high-yield warhead.

By this time Dwight Eisenhower had been inaugurated as President, and the leadership at the Department of Defense had changed. Harold Talbott was the new Secretary of the Air Force, and Trevor Gardner was his special assistant for research and development. Schriever and Gardner saw eye-to-eye on the significance of the thermonuclear warhead, or H-bomb, to ICBM development. In October 1953, Gardner formed a Strategic Missile Evaluation Committee, informally known as the Teapot Committee, whose distinguished scientists and engineers served under the chairmanship of Dr. von Neumann. Schriever's office provided Air Staff support for the committee.

In its report of February 1954, the Teapot Committee made several important recommendations. It confirmed the feasibility of building an operational ICBM by 1960, but it believed the project would succeed only if a "radical reorganization" was effected, including creation of a new agency that would be "relieved of excessive detailed regulation." It believed that missile accuracy could be reduced to three miles and that warhead weight could be reduced to 1,500 pounds. Intelligence reports that the Soviets were ahead of the Americans in developing long-range ballistic missiles added urgency to the committee's recommendations.



Western Development Division, a former parochial school in Inglewood, California, a suburb of Los Angeles, housed Schriever and his handpicked staff.

At the time, the Air Force used a single prime contractor to develop a new weapon system. When relatively minor technological advances were involved, the single-prime approach worked reasonably well. However, when applied to major technological developments, this approach proved less effective because constantly changing design, components, performance specifications, and inventory planning resulted in program slippages and cost overruns. Clearly, if the ICBM program was to succeed, a new management philosophy was needed.

Trevor Gardner, the principal architect of ICBM acceleration, believed that Soviet achievements in missile development made the Atlas as urgent a project as had been the World War II atomic bomb. He convinced Air Force Chief of Staff Nathan Twining and Secretary Talbott of the ICBM's importance. In March 1954, the Air Research and Development Command (ARDC) was directed to establish a military-civilian group to "redirect, expand and accelerate" Atlas on a crash basis. In May, the Air Force assigned the Atlas top priority and directed that the speed of its development be limited only by technology concerns.

Although he had succeeded in gaining Air Force priority for ICBM development, Gardner believed it essential to dramatize the program to obtain *national* priority. Gardner asked Bernard Schriever, now a brigadier general, to manage the ICBM program. Schriever agreed, but only on condition that he be granted sweeping authority to get the job done.

The Western Development Division (WDD) was created as a new agency under Air Research and Development Command to manage the ICBM program outside the traditional Air Force bureaucracy. In August 1954, Schriever

assumed command of the division located in California at Inglewood, near Los Angeles. He also held the title, Assistant to the Commander, ARDC, which meant he could bypass much of the cumbersome bureaucracy.

General Schriever had two personal attributes invaluable in his new position. First was his calm, unflappable nature. The director of a top-priority project is subject to extreme pressure from multiple sources. In this case, inevitable competition for resources within his own service was exacerbated by the Army's and the Navy's desire to be included in, if not in charge of, the decision-making process. Demonstration of spectacular Soviet progress in missile development also raised the stakes to a level intolerable for a person less disciplined than Schriever.

Another valuable attribute was Schriever's ability to persuade very senior and sometimes irascible officials to accept his views. Retired Gen. Bryce Poe, who had served as Schriever's aide and assistant executive officer at Western Development Division, recalled once accompanying Schriever and members of his staff to brief the redoubtable Gen. Thomas S. Power on a new organization plan. Power, head of the Air Research and Development Command, was in a particularly bellicose mood. He summarily rejected the proposal. As they left Power's office, Major Poe commented to Schriever that the rejection left them in a spot, since time was running out. "Don't worry," replied Schriever, "I'll go back and talk to him alone this afternoon." He did, and the organization plan was accepted.

General Power was an operator, more interested in getting the job done than in knowing *how* it got done. That left Schriever considerable latitude in running the ballistic missile program. He rarely received direction on how to proceed. Most of the management innovations that characterized WDD and its successor organization were conceived by General Schriever and his staff.

Once the Western Development Division was established, a major unresolved question concerned the locus of responsibility for day-to-day management of missile development. Among the available choices were an aircraft manufacturer, a university laboratory, an



Bomber advocates Gens. Thomas Power (right), commander of ARDC, and Curtis LeMay (left), commander-in-chief of SAC, understood the importance of ICBM development. Here they await a test launch, seeking confirmation the missiles would work as advertised.

Air Force organization with a technical staff, or a special independent contractor who, in effect, would become part of the organization. Schriever recommended the last option and proposed that Ramo-Wooldridge Corporation be given responsibility for systems engineering and technical direction. His recommendation was accepted. The Ramo-Wooldridge element at Inglewood was called the Guided Missiles Research Division, becoming Space Technology Laboratories in December 1957. Ramo-Wooldridge merged with Thompson Products in October 1958 to form TRW.

In charge of a top priority program, Schriever could ask for, and get, anyone he wanted for his own staff. He personally picked a small nucleus of men whom he knew well, people who could get things done even if they themselves were controversial. Such people were not always wanted by other commanders. "I wanted them," Schriever said, "because they were smart and would tell me not what I wanted to hear, but what they really thought." He also valued loyalty, not in the sense of agreeing with him, but the kind that inspired trust. And he believed that loyalty was a two-way street. At one point, General Power thought Officer Effectiveness Reports (OERs), the basis for promotion, were running too high. He directed all commanders under him to lower their reports. Schriever had a study done that showed the OERs of his people were lower than when these individuals had been competing against a typical cross-section of officers in their previous assignments. He wrote General Power that he was not lowering, but was raising the OERs in his organization.

Among the first contingent of people Schriever selected were Cols. Charles H. Terhune and Harold W. Norton; Lt. Cols. Benjamin P. Blasingame, Beryl L. Boatman, Philip C. Calhoun, Otto J. Glasser, Edward N. Hall, and John P. Hudson; Maj. Roger R. Hebner and Paul L. Maret; and Capt. David M. Fleming and Vernol L. Smith. Each was an expert in his field; for instance, Ed Hall was an expert in propulsion systems. All of these men rose to senior rank in the Air Force or to important positions in the civilian world.

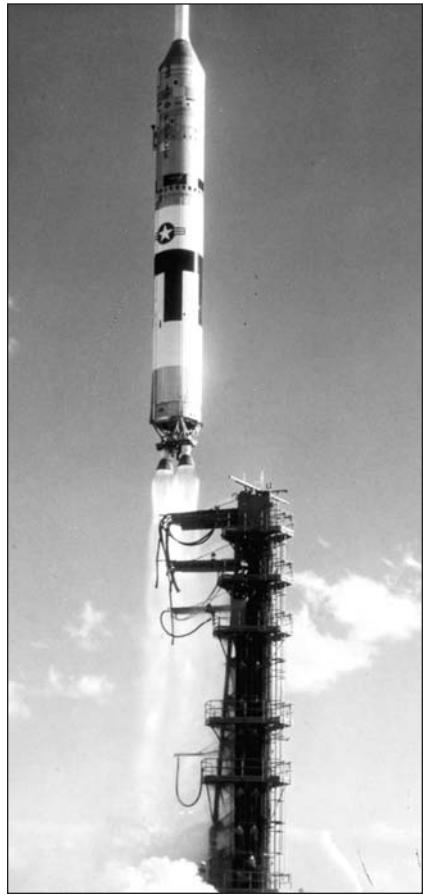
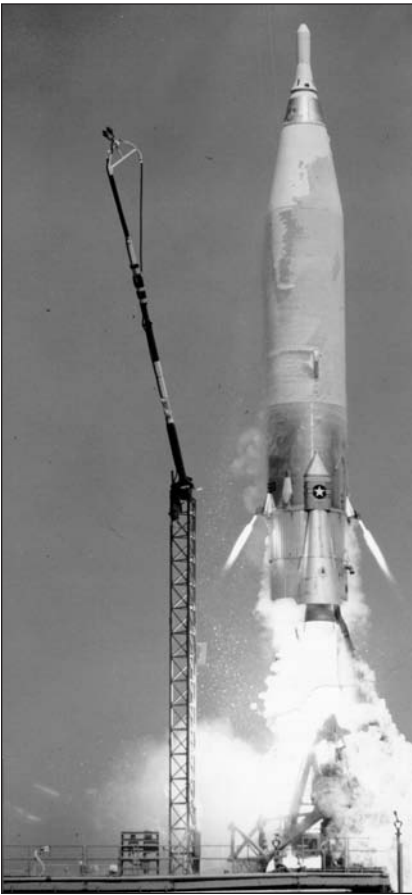
General Schriever took great personal pride that, in many years of dealing with industry, not one official protest was lodged concerning irregularity in selecting contractors for the enormously costly ballistic missile programs. Schriever himself often was singled out by lobbyists seeking favorable treatment for their clients. All failed. Schriever built a record of unquestioned integrity.

In July 1954 the Scientific Advisory Board had recommended developing an alternative missile to the Atlas. This recommendation was motivated by fear that the pressurization required to maintain the Atlas's structural integrity might collapse under stress—an unfounded fear, as it turned out. The more conventional alternative, the XSM-68 Titan, offered greater prospects for "growth" and would create a secondary source for subsystems as a hedge against failure in the Atlas program. From the start, General Schriever recognized that the ICBM program warranted an exceptional approach. He borrowed a page from the Manhattan Project of World War II and contracted with the ablest firms available for production of the major subsystems. Each major

subsystem of the Atlas and the Titan had a separate associate contractor as insurance against any one of the contractors' failing. Major subsystems included guidance, propulsion, nose cone, and airframe.

Planning for the Titan appeared sound, although it intensified budgetary pressure on the Air Force. With the addition of still another missile, the intermediate range (IRBM) Thor, this pressure grew. Soon the 1,500-mile range IRBM became a bone of contention between the Air Force and the Army over roles and missions. At first the Air Force intended that Wright Air Development Center would develop the IRBM. However, General Schriever, fearing this would drain scarce resources from the Atlas, proposed that the IRBM be built as "fallout" from the ICBM project. In May 1955, Thor was assigned to the Western Development Division.

Although Schriever's division amassed a variety of projects, ICBM development remained paramount. In October, separate teams were organized to



To ensure the United States did not lose the ICBM race, the two-stage Titan was added in case the Atlas program encountered difficulties.

develop the Atlas and Titan and were given instructions to maintain as much interchangeability between the subsystems as possible. Comprising the Atlas team were Convair (airframe, assembly, and test), North American (propulsion), General Electric (nose cone), Sperry Rand (radio-inertial guidance), and AMF (accessory power); comprising the Titan team were the Martin Company (airframe), Aerojet-General (propulsion and accessory power), AVCO (nose cone), Bell Telephone (radio-inertial guidance), and American Bosch (all-inertial guidance). Schriever developed the computer capacity to automate management information on a nearly instantaneous basis, permitting him and his managers to track progress in the various programs and concentrate on performance.

Meanwhile, Ramo-Wooldridge had formulated a novel test program for the Atlas. The original plan for building special test vehicles was abandoned to speed up the testing process, and the basic Atlas was used instead. Initial tests were conducted on the simplest flyable missile, the Atlas A, which consisted of only the airframe, booster engine, and autopilot. Flight testing continued by building progressively more complex missiles that included, incrementally, the sustainer engine, missile staging, full guidance, and a separable nose cone. Finally, the refined operational version, the Atlas E, was tested.

Early in the test program General Schriever recognized that primary dependence on flight testing was inadequate and very expensive. Because a missile's time of flight was extremely short and the projectile could be used only once, a great number of flights would be required to accumulate the necessary data. A ground, or static, program for testing components offered an



The Ramo-Wooldridge Corporation provided systems engineering and technical direction to the Air Force's missile program. Schriever and Ramo dedicate the entrance to WDD.

alternative to flight tests. Western Development Division devised a test “pyramid,” which emphasized a thorough checkout at all levels before committing to either static or flight testing. Although this test philosophy appeared logical, it depended on the availability of specialized missile facilities. In fact, the ballistic missile programs created an entirely new class of support systems which included test facilities, launchers, training, and a host of other equipment not yet available. All elements had to be ready on time if the system was to be completed quickly. Schriever’s prescription—developing the various elements in such a sequence that they would be completed when needed—was called concurrency. Needless to say, this approach involved considerable risk, but risk was unavoidable if the Americans hoped to win their race with the Soviets.



Lt. Gen. Schriever and Kendrick R. Wilson, Jr., AVCO Corporation president, inspect a Thor-Able (Thor) nosecone after its recovery from a test vehicle.

Schriever began to identify his facilities’ needs in December 1954. Approval was deferred for some time because an existing administration policy forbade the concentration of missile facilities along U.S. seacoasts. A master development plan was released in April 1955, but facilities and funding approval were not granted until July when Lt. Gen. Donald L. Putt, Deputy Chief of Staff for Development, approved the plan and reiterated the program’s highest Air Force priority.

Trevor Gardner continued to campaign for top *national* priority for the ICBM program. However, the Air Force’s sense of urgency was not completely shared within the Eisenhower administration. In February 1955, the President’s Technological Capabilities Panel did, however, issue a report warning of progress in Soviet missile capabilities. The Killian Report (named for its chairman, Dr. James R. Killian), cited the vulnerability of North America to surprise attack. It recommended making the ICBM program “a nationally supported effort of the highest priority” and urged as an expedient measure the rapid development and deployment of the shorter range IRBMs. Gardner urged Congress, especially Senators Clinton P. Anderson of New Mexico and Henry M. Jackson of Washington, to emphasize the urgency of the ICBM program to the President. Throughout the summer, Gardner, Schriever, and von Neumann briefed the various levels of government up through the National Security



In the foreground, Schriever and James R. Dempsey, Convair Corporation's Atlas project director, lead a congressional delegation on a tour of an Atlas production line.

Council. In July the trio made a presentation to President Eisenhower. Finally, in September, the President made the long-awaited decision. ICBM development was to have top national priority and proceed at all possible speed.

Success depended, in large measure, on being free of unnecessary bureaucratic procedures. Schriever assigned an aide to chart the typical administrative chain of approval within the Departments of Defense and the Air Force. The resultant chart was said to resemble a bowl of spaghetti. Schriever and Gardner asked for simplified management procedures that would bypass many superfluous layers of review in the Office of the Secretary of Defense (OSD) and in the Air Force. Hyde Gillette, Air Force Deputy Assistant Secretary for Budget and Program Management, headed a committee that recommended a streamlined chain of approval. The Gillette Procedures, issued in November 1955, established a committee in the Air Force and another in the OSD to serve as the ultimate review and decision authorities. These Ballistic Missile Committees were chaired initially at their respective secretarial levels by Air Force Secretary Donald A. Quarles and Defense Secretary Charles E. Wilson. Each committee included assistant secretaries of their respective departments, and each had formal authority over the entire program. The committees delegated program approval and implementation to the lowest possible echelon and bypassed many of the regular reviewing agencies.

In February 1956, Trevor Gardner, who harbored serious doubts about the administration's commitment to research and development, resigned his position. He launched a public campaign to warn the President and the American people of the urgent need to overtake Soviet technological progress.

In July 1956, the ICBM operational plan underwent sharp scrutiny by the Air Force Ballistic Missile Committee when Secretary Quarles applied his “Poor Man’s Approach” to missile development. This meant austerity and reductions in program objectives. More important, Quarles’s decision changed the program’s goal from achieving the earliest *possible* operational deployment to achieving the earliest *practicable* one. His aim was to save money by stretching out the program. While the ICBM program did not suffer from serious funding shortages, the sense of urgency began to wane. Ironically, the funding crisis seems not to have caused any perceptible harm and may even have had beneficial effects because it resulted in lengthier and more detailed facilities planning.

In April 1957, the 1st Missile Division was activated at Camp Cooke, California (the name later became Vandenberg AFB) to supervise the training and operational phases of the budding missile program. The following month work began on “soft,” aboveground missile sites at Vandenberg. By August, the Air Force had selected the first Atlas and Titan operational bases: Warren AFB in Wyoming, and Lowry AFB in Colorado. The outline of an operational ICBM force began to emerge.

By January 1957, only thirteen months after Western Development Division had contracted with Douglas Aircraft for the Thor IRBM, Thor was ready to flight-test, a record achievement. Four failures preceded Thor’s first successful flight from Cape Canaveral, Florida, on September 20. The Atlas met with two failures before its first successful flight on December 17, 1957, the fifty-fourth anniversary of the Wright brothers’ flight.

Meanwhile, the Soviets had delivered a stunning blow to America’s pride by launching the world’s first artificial satellite, Sputnik, on October 4, 1957. Although the administration tried to minimize the military significance of the Soviet feat, Sputnik had been placed in orbit by a Soviet ICBM. The event immediately impacted Air Force ballistic missile programs: the so-called “Poor Man’s Approach” and the recently imposed restrictions quickly evaporated, funding was increased, plans were revised, and the urgency of the program was restored. In the months that followed Sputnik, the Ballistic Missile Division (WDD had changed its name to BMD in June 1957) undoubtedly



A hands-on manager, General Schriever inspects the construction site at Vandenberg AFB, accompanied by Col. Nether-ton.



Less than one month after the first successful Thor flight, the Soviet Union launched the world's first artificial satellite, Sputnik.

experienced the most sustained high pressure in the history of Air Force weapons development.

During those hectic months, Schriever spent much time commuting between Inglewood and Washington. He would work all day on the west coast, spend most of the night flying to Washington (in those days it was a six- to eight-hour flight, depending on the weather), meet with Defense officials, and fly back to Inglewood, often immediately.

Despite a seemingly impossible schedule and an undemonstrative nature, Schriever never lacked concern for his people. One trip to Washington was made when Bryce Poe and his wife were expecting their first child. While they were in Washington, Poe was notified that his wife had gone to the hospital. He



A Thor Intermediate Range Ballistic Missile blasts off on a successful test launch.

told General Schriever that he would return home immediately by commercial air. "No," General Schriever said, "we'll both go." Arriving at Bolling AFB to board for the return trip, General Schriever, who, unlike most VIPs, always walked out to his parked aircraft, told Poe to bring the plane to them. As Poe was getting on the airplane, Schriever called the hospital in California and, climbing aboard the aircraft, matter of factly told Poe, "Your wife just had a little girl." With that, Schriever went to the rear of the cabin and attacked the mountain of work awaiting him.

By the end of 1959, the first Thor IRBMs were already in the United Kingdom, and a token force of Atlas ICBMs became operational at Vandenberg AFB. Schriever's division could rightfully boast of having won the race against time. Thor development, from program approval to the initial operational squadron, had taken only three and one-half years; Atlas's development took a little more than five years, better than the six to eight years predicted by the Teapot Committee in 1954. By contrast, development of conventional aircraft or aerodynamic missiles required much more time. The B-47 took nearly eight years; the B-52, almost nine and one-half years; and the B-58, more than eleven years. Among the aerodynamic missiles, the Navaho was canceled in July 1957 after nine and one-half years of development; the Rascal was canceled after eleven and one-half years; and nearly fourteen years were required before the Snark became operational.

The alternative ICBM, the Titan, proceeded at a slower pace, taking nearly six years to achieve operational status. However, even as the first Titan lifted off from the Cape in February 1959, development of the more advanced Titan II was underway. The Titan II, a second-generation ICBM, could be launched from an underground silo, storable liquid propellants powered it, and it featured an all-inertial guidance system.

True to his reputation as a visionary, Bernard Schriever was not content merely to preside over development of the Atlas, Titan, and Thor. Important as these missiles were, he continued to search for new and better weapons. As early as 1955, the Western Development Division explored the feasibility of using a solid, rather than a liquid, propellant for ballistic missiles. Affecting the solids were several technical problems related to burn rate, propulsive efficiency, and weight. If these problems could be solved, the solid-fueled missiles would be storable underground, quick to react, easy to maintain, flexible, and cheaper to produce. When the Navy approached General Schriever for help in developing a shipboard IRBM, he encouraged them to experiment with solid fuels. In the summer of 1955 the Air Force SAB convened a study group, chaired by Dr. von Kármán, to address the problems that needed to be solved to make solid-fueled rockets feasible. Schriever approached several industrial companies competent in this work to ask their cooperation.

By 1957 Ramo-Wooldridge began preliminary design efforts, convinced that solid-fueled ICBMs were feasible. Schriever assigned Col. Edward Hall, the former director of the Thor program, to head the solid-fueled missile project. First known as Weapons System "Q," it evolved into the three-stage Min-

uteman. In February 1958, Schriever presented the Minuteman proposal to the Air Staff. Everyone, including Vice Chief of Staff Gen. Curtis E. LeMay, was enthusiastic. The Secretaries of the Air Force and Defense approved the Minuteman in a period of seventy-two hours and provided \$50 million to start the program. Later, in 1959, when Gen. Thomas S. Power, then Commander in Chief of Strategic Air Command, asked that the Minuteman program be accelerated, Schriever accepted the challenge. In February 1961—only three years after program approval—Minuteman successfully completed its first flight from Cape Canaveral. More remarkable, the Minuteman was in an “all-up” configuration; that is, the three stages, the guidance system, and the nose cone separation were all tested together, a first in missile development history. By the end of October 1962, at the time of the Cuban Missile Crisis, the first ten Minuteman weapons were poised on combat alert inside their underground silos, just four years and eight months after program go-ahead.

General Schriever recognized that the ICBM program had put the United States on the threshold of space, and he had urged that the Western Development Division assume responsibility for space R&D. He succeeded in having



One solution to the vulnerability of fixed missile sites was a scheme to move the missiles around a track. Shown here is a mockup of the mobile Minuteman concept. Schriever discusses the project with the Boeing Company president, William Allen, and Brig. Gen. Osmond “Ozzie” Ritland.

the office responsible for the development of a satellite system assigned to his division and in 1956 signed a contract with Lockheed for its development. The Eisenhower administration, however, anxious to emphasize the peaceful nature of space exploration, concentrated space work on the International Geophysical Year satellite and restricted its booster rocket to nonmilitary uses. In early 1957, when Schriever gave a speech in San Diego calling for a major space effort, he immediately received word from Washington that it was not appropriate to use the word *space* in future speeches.

Sputnik, of course, provided the impetus for the U.S. space program. The National Aeronautics and Space Administration (NASA), created in October 1958, depended heavily on the Air Force’s Thor, Atlas, and Titan missiles as boosters for its space activities. On February 28, 1959, a Thor-Agena booster combination launched Discoverer I, an Air Force satellite, into polar orbit from Van-

denberg AFB. Shortly after Schriever's success, he received promotion to lieutenant general and became head in April 1959 of the Air Research and Development Command (ARDC). His achievements over a relatively brief time as head of the ballistic missile programs included development of a new class of weapon systems, initiation of a second-generation missile, and a clearly established frontier of space. His philosophy of central management was well enough defined to be emulated in other programs, and his development team in Inglewood was poised to undertake new responsibilities.

Upon assuming command of ARDC, General Schriever introduced concurrency in weapon system development and acquisition, the concept that had served so well in the Ballistic Missiles Division to compress acquisition time and get operational systems into the hands of combat units more quickly. Under this management approach, Air Force headquarters initiated the conceptual phase of a new weapon, systems centers provided acquisition management, and the using commands refined the system during its operational phase. In December 1959, Dudley C. Sharp became Secretary of the Air Force and suggested expanding the concept to all weapon and support systems.

One of Schriever's major priorities in his new command was to have total responsibility for weapon system acquisition transferred to ARDC from the Air Materiel Command. This was not a new problem. When Schriever headed the Western Development Division, he possessed complete authority over all aspects of Atlas development, including engineering decisions, with the exception of contracting and procurement. Air Materiel Command jealously guarded its right to these functions. However, Schriever worked out a solution in which AMC retained its authority through a field office collocated with WDD. This AMC office, called the Special Aircraft Projects Office (later renamed the Ballistic Missile Center), effectively came under Schriever's command. In April 1961, the Center was reassigned to ARDC's Ballistic Missile Division. Now, however, Gen. Samuel E. Anderson, Schriever's predecessor at ARDC and the



A Minuteman leaps out of its underground silo, preceded by the missile's signature smoke ring on the upper right.



Always ready to promote the Air Force position and its efforts in the space program, General Schriever is interviewed by ABC's Jules Bergman in 1964 at the tenth anniversary of the ballistic missile and space program.

current commander at AMC, was adamantly opposed to a broader application of the idea. Anderson argued that ARDC and AMC should be merged under AMC and that development, procurement, and production functions be integrated. A compromise offered by the Air Staff proposed improved management procedures and strengthened weapon system project offices, rather than a reorganization. The issue remained unsettled for two years, with both Schriever and

Anderson sticking to their guns.

With the advent of the Kennedy administration, space programs assumed new urgency. Roswell Gilpatric, Deputy Secretary of Defense, had known Schriever when Gilpatric had been Under Secretary of the Air Force in the Truman administration and through his association with The Aerospace Corporation. Gilpatric proposed assigning the Air Force responsibility for research and development of all military space programs. However, the offer rested on the ability of the Air Force to resolve its split of research, development, and production between ARDC and AMC. Gen. Thomas D. White, the Air Force Chief of Staff, lost no time in deciding the issue in favor of Schriever's position. In April 1961 ARDC became the Air Force Systems Command (AFSC), and AMC became the Air Force Logistics Command (AFLC). At last Schriever had reached the goal sought for more than a decade: transform materiel development and acquisition from a functional to a systems approach. Schriever continued as Commander, AFSC, and was rewarded with a fourth star.

On March 6, 1961, Secretary of Defense Robert S. McNamara issued a directive assigning the responsibility for "research, development, test, and engineering of Department of Defense space development programs or projects which are approved hereafter" to the Department of the Air Force. In April Schriever established the AFSC Space Systems Division at Los Angeles.

Despite this promising start, many Kennedy administration officials, notably those around Secretary McNamara, believed that the Communist threat could be handled best through an accommodation with the Soviet

Union. They believed too much attention had been paid to deterring nuclear war with strategies that favored large missile and bomber forces. Instead, they adopted a policy of Mutual Assured Destruction (MAD) that required only enough weapons to survive an attack and to destroy a high percentage of the Soviet population and industry. Consequently, Schriever saw many of his advanced missile programs, like the railroad-based Minuteman and medium-range ballistic missiles, canceled. McNamara opposed spending too much on advanced technology, reasoning it would provide the impetus to initiate new development programs. Consequently, the Secretary of Defense canceled many promising technology initiatives. Schriever favored pushing advanced technology and believed it was foolish to try to restrain the “technology clock.” The United States would do so at its own peril because the Soviet Union certainly would not hold back. What irked Schriever most was that McNamara made many of these decisions which affected policy with little if any input from Congress, much less any public debate.

Another irritant was that the streamlined Gillette management practices, first instituted for the ICBM program, were discarded and replaced by new management procedures that effectively reestablished the former layers of review. These Schriever facetiously called “paralysis by analysis.”

In 1963, at the suggestion of Air Force Secretary Eugene M. Zuckert, General Schriever established and directed a series of studies known collectively as Project Forecast. The purpose of these studies was to survey technology for the

future needs of air warfare and develop a long-range plan which projected requirements five to fifteen years into the future. All of the functional missions, such as strategic, tactical, air defense, and logistics, were considered. Major technologies were divided into categories of interest to the Air Force, including materials, propulsion, electronic countermeasures, guidance, and navigation. Other panels studied general war, limited war, command and control, and political and economic conditions.



Air Force Secretary Eugene Zuckert asked AFSC Commander General Schriever “to project ahead twenty years the expected scientific advancements.” Like, his mentor, von Kármán, Schriever produced an invaluable report. The latter, called Project Forecast, was published in 1964.

A summary report included recommendations relating to programs needed to improve Air Force capabilities. Its central conclusion was that technology would remain the major determinant for achieving new capabilities. Improved weapons made possible by latent technology were considered more significant to national security than those attainable with existing technology—and sufficiently important to warrant some delay in their operational availability. Finally, it was demonstrated that reaching some policy goals depended on technological advances to counter the threat of continued Soviet progress. Project Forecast, completed in 1964, remains the most comprehensive survey ever conducted by a military service to assess the impact of advancing technology on its future capabilities to support national policy. It was one of General Schriever's most important contributions to national defense.

Under the Kennedy administration, emphasis shifted from strategic to tactical and airlift forces with the aim of deterring all wars, “general or limited, nuclear or conventional, large or small,” as the President put it. Much of Air Force Systems Command's work under General Schriever thus was reoriented toward weapons and ordnance for limited conventional war, an area that had been slighted while the United States was developing its strategic deterrent forces. Among limited war-related developments that had been advocated by Project Forecast were a long-range, high-capacity transport plane that ultimately emerged as the C-5A; a vertical, short takeoff transport for which conceptual studies were begun in August 1964; and the very accurate guided “smart bombs” that proved so effective in the later stages of the Vietnam War. Other developmental work focused on electronic countermeasures, a variety of air-to-air and air-to-ground missiles, navigation systems, communications, and conventional ordnance. With respect to conventional ordnance, a still nuclear-oriented Air Force headquarters opposed Schriever. His fiscal year 1963 request for \$40 million to develop nonnuclear munitions was slashed to \$15 million. He favored developing aircraft specialized for specific operational missions, and he considered Tactical Air Command's support of a single, multipurpose aircraft to be a serious error.

President Kennedy and Secretary of Defense McNamara believed—mistakenly, as events have shown—that the Soviets would accept tacitly a strategy of Mutual Assured Destruction and that their missile buildup would level off at about the same strength as the United States' arsenal. In keeping with that notion, the Air Force missile inventory was limited to 1,054 systems, and the bomber and air defense forces were reduced drastically in size. The search for new technology slackened markedly. This philosophy, and the autocratic manner in which defense policy was conducted, continued under President Johnson, with Robert McNamara remaining as his Secretary of Defense. General Schriever felt that he could no longer support the administration's defense policy. Although mandatory retirement was several years off, he retired voluntarily on August 31, 1966.



Gen. Bruce K. Holloway, Vice Chief of Staff, who later became CINC-SAC, congratulates General Schriever upon his retirement. The event, on August 31, 1966, was held at Andrews AFB, Md.

After devoting thirty-three years of service to his country, Schriever retired from the Air Force. He will be best remembered as the architect of the Air Force's missile and space programs, but his influence went far beyond that. He also introduced systems management and operations research; project management; and systems engineering. Thus, he achieved the mission he had vowed to carry out when he flew the air mail in 1934, ensuring America's aerospace superiority. And he far exceeded his assignment from Hap Arnold in 1945, "to maintain the close ties between the Air Force and the scientific community." So successfully did Schriever merge science and engineering with

military procedures that he created a methodology that became the standard throughout the Defense Department for many years.

Since his retirement, Bennie Schriever has served in numerous consultative roles for the U.S. Government. During the Nixon Administration he chaired the President's Advisory Council on Management Improvement. He also served on the President's Foreign Intelligence Advisory Board during the Reagan and first Bush Administrations. His contributions to the Defense Science Board and the Ballistic Missile Defense Organization Advisory Committee were notable. In great demand as a consultant to think tanks, like the High Frontier, he worked tirelessly to promote advanced technology research by the nation's leading aerospace corporations.

One of General Schriever's closest associates has said that of all of the generals he has known, none was as devoted to this country as Schriever. "Bennie, who came to this country as an immigrant, feels that everything he has achieved he owes to the United States." After his retirement, General Schriever was in great demand as a consultant to civilian organizations and frequently served without fee as an advisor to the Air Force and the Department of Defense.

Before relinquishing his Air Force uniform, General Schriever told a meeting of the Arnold Air Society in Dallas, Texas: "The world has an ample supply of people who can always come up with a dozen good reasons why a new idea will not work and should not be tried, but the people who produce progress are a breed apart. They have the imagination, the courage, and the persistence to find solutions."

No one typifies that breed better than Bernard Schriever himself.

Sources

The primary sources for General Bernard Schriever's military career are his personal papers on file at the USAF Historical Research Agency (AFHRA), Maxwell AFB, Alabama. The papers detail his activities from 1954, when he assumed command of the Western Development Division (WDD) at Los Angeles, through his retirement as Commander of the Air Force Systems Command in September 1966. The Schriever papers contain official studies, minutes of meetings, letters, memoranda, and messages relating to ballistic missile and space activities. Another subdivision consists of congressional hearings and reports, and an extensive file of speeches.

General Schriever's early life was documented primarily through interviews, including a series of six interviews with Schriever conducted by the author from September through December 1982. The author also interviewed many associates of the general, including his executive assistant, Col. Vincent T. Ford, and the WDD historian, Dr. Alfred Rockefeller. Finally, the Air Force Systems Command History Office retired to AFHRA about a dozen relevant interviews with senior officers that were conducted by a former AFSC historian, Dr. Ernest G. Schwiebert.

There is no biography of General Schriever as yet; however, his work is discussed in numerous publications. One of the first books on ballistic missile development is Kenneth R. Gantz (Editor), *The United States Air Force Report on the Ballistic Missile* (Doubleday, 1958). Ernest G. Schwiebert's *A History of the U.S. Air Force Ballistic Missiles* appeared in a special issue of *Air Force Magazine* in May 1964.

A wealth of information is contained in congressional documents, most notably: Senate Subcommittee on the Air Force of the Committee on Armed Services, *Study of Airpower*; 84th Cong., 2d Sess., 1956; Senate Committee on Armed Services, Preparedness Investigating Subcommittee, *Hearings, Inquiry into Satellite and Missile Programs*, 85th Cong., 1st and 2d Sess., 1958; and House of Representatives Committee on Government Operations, Subcommittee on Military Operations, *Hearing, Organization and Management of Missile Programs*, 86th Cong., 1st Sess., 1959 and 2d Sess., 1960.

The most incisive and scholarly investigations of the ballistic missile programs were done by Robert L. Perry. Among his numerous writings are "The Atlas, Thor, Titan, and Minuteman," in Eugene M. Emme (Editor), *The History of Rocket Technology* (Detroit, 1964); *The Ballistic Missile Decisions, P-3686* (The RAND Corporation, 1967); and *System Development Strategies, RM-4853-PR* (The RAND Corporation, 1966). Another important scholarly

study that owes much to Perry's work is Edmund Beard's *Developing the ICBM: A Study in Bureaucratic Politics* (New York, 1976). A more general, but extremely insightful, analysis is Robert Frank Futrell, *Ideas, Concepts, Doctrine. A History of Basic Thinking in the United States Air Force, 1907–1964* (Maxwell AFB, 1971), especially Chapters 9 through 14.

As a visionary on the leading edge of technology, Schriever often was at the center of major controversies. Perhaps the best accounts of these controversies are John B. Medaris and Arthur Gordon, *Countdown for Decision* (New York, 1960); Michael H. Armacost, *The Politics of Weapons Innovation: The Thor-Jupiter Controversy* (New York, 1969); and Edgar M. Bottome, *The Missile Gap: A Study of the Formulation of Military and Political Policy* (Teaneck, N.J., 1971). Also, of value is Eugene E. Evans, *Dispute Settlement and Hierarchy: The Military Guided Missile Controversy, 1955–1960* (unpublished Ph.D. dissertation, University of Illinois, 1963). General Schriever himself is an excellent and prolific writer. The most comprehensive guide to his writing is the annually published *Air University Library Index to Military Periodicals*, Maxwell AFB, Alabama.

This pamphlet is reprinted from the chapter titled “Bernard A. Schriever: Challenging the Unknown,” in *Makers of the United States Air Force*, edited by John L. Frisbee, (Office of Air Force History, 1987).

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