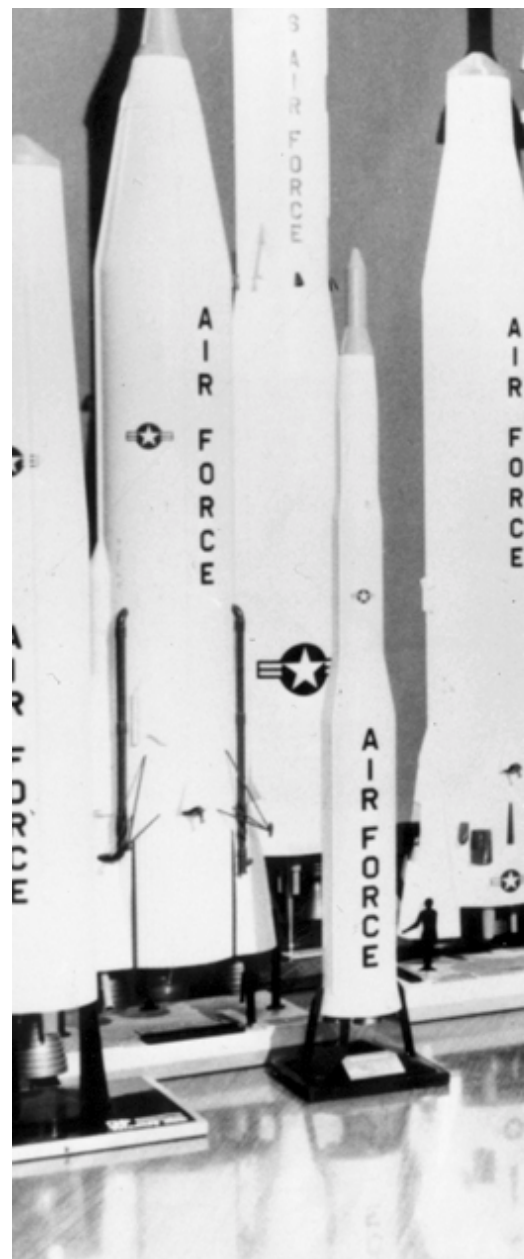


Gen. Bernard Schriever not only produced an ICBM force in record time but also led the way to American dominance in space.

By Walter J. Boyne

The Man Who Built the Missiles



GEN. Bernard A. “Bennie” Schriever, unquestionably one of the most important officers in Air Force history, ranks alongside the legendary Hap Arnold and Curtis LeMay in terms of long-term effect upon the service and the nation. Foremost among his many achievements was the development and acquisition in the 1950s and early 1960s of a reliable and operational ICBM force. It was a towering accomplishment—one that helped propel the United States to military dominance in space, as well.

No one doubts Schriever’s pivotal role in these two stupendous achievements. In April 1957, his image appeared on the cover of *Time* magazine, which called him “America’s Missileman.” His official USAF biography flatly proclaims that Schriever is “the architect of the Air Force’s ballistic missile and military space program.”



Schriever himself is quick to point to the critical contributions of other members of his team, but the fact remains that he was the man in charge. Had the ICBM program failed or fallen short, Schriever would have been held responsible. The program succeeded beyond all expectations, however.

That Schriever reached the pinnacle of American aerospace technology is an unlikely but very American story. Born Sept. 14, 1910, in Bremen, Germany, Bernard Adolph Schriever was the son of an engineering officer on a German ship line. His mother, Elizabeth, spent 10 years living in the New York area. It was there that she met her future husband. The couple were married

in New Jersey but returned to Germany, settling in Bremerhaven just as a world war was set to explode. Schriever, now 90, vividly recalls how, as a child, he would watch the enormous German zeppelins pass overhead on their way to bomb England.

When the war eventually soured German-American relations, numerous German ships were interned in New York Harbor—including his father's. Faced with indefinite separation from her husband, Elizabeth Schriever managed to get herself and her two young sons aboard a Dutch freighter bound for New York. It was a very rough voyage. They arrived in January 1917. About three months later, Washington declared

war on Germany and joined the Allies.

The Schrievers, marooned in the US, were forced to make the best of it. They journeyed to Texas, settling in New Braunfels (a town with a large German-speaking population) and later moving to San Antonio. In fall 1918, after his father died in an industrial accident, young Bennie and his brother lived in a foster home for eight months until their grandmother came from Germany to care for them while their mother worked.

Fascination With Aviation

In 1923, Schriever became a naturalized US citizen. He attended Texas A&M, graduating near the top of the class of 1931, and was



First commissioned in field artillery, Schriever later entered flight school and participated in the Air Corp's 1934 program to deliver airmail in aircraft like this one. He flew mail from Salt Lake City to Cheyenne in B-4s and O-38s.

commissioned as a second lieutenant in field artillery. Though an artilleryman, Schriever long had been fascinated with aviation, and he decided to enter flying school at Randolph Field, Tex.

He did so in July 1932, but the move required him to revert from officer status to that of aviation cadet. Flying came easily to Schriever. When he graduated in June 1933 at Kelly Field, Tex., he was commissioned as a second lieutenant for the second time. The Army soon promoted him to first lieutenant and assigned him to March Field, Calif., where he flew B-4 and B-10 bombers under the command of Lt. Col. Henry H. "Hap" Arnold. Arnold was impressed with Schriever's abilities and would later remember the young Texan when he needed an airman to whom scientists could relate.

Schriever soon became caught up in the Army's 1934 misadventure in carrying domestic airmail. He flew ill-equipped Army Air Corps O-38 and B-4 aircraft on the hazardous Salt Lake City-to-Cheyenne, Wyo., route. Neither aircraft was equipped for instrument flying. He survived, but many of his colleagues were killed. For Schriever, the "airmail fiasco," as it was called, showed the high price a military force and a nation would pay because of inferior or inadequate technology.

Schriever went on to spend a six-month tour at Hamilton Field, Calif. However, the tight military budgets

of the day forced him to go off active duty and onto the inactive reserve list.

In the Great Depression, commercial flying billets were scarce, and Schriever in 1935 ran a Civilian Conservation Corps camp of 200 boys in New Mexico. When that job ended in October 1936, he was able to return to active status. He was assigned in December to Panama, where he was stationed at Albrook Field as a P-12 pilot. In August 1937, he accepted a position as a pilot with Northwest Airlines.

A year later Schriever learned that the Air Corps had 200 regular commissions available. He passed the exam for regular officer and, on Oct. 1, 1938, was sworn in once again as a second lieutenant. Schriever served with the 7th Bomb Group at Hamilton Field and then moved on to test pilot duties at Wright Field, Ohio. He flew almost every type of Army aircraft, working with Stanley Umstead and some of the finest pilots in the world. He attended Air Corps Engineering School and graduated in July 1941.

Stuck in Stanford

Schriever gave stellar academic and flying performances while at Wright Field, so much so that he gained admission to Stanford University's graduate program—a rare privilege for a military officer. He was hitting the books in Palo Alto, Calif., when, on Dec. 7, 1941, Imperial Japanese forces attacked the

United States fleet in Pearl Harbor.

Schriever requested immediate assignment to a combat unit. The Air Force denied the request, ordering him instead to stay in California and finish his graduate work at Stanford. He did so, earning a master's degree in mechanical engineering (aeronautical) in June 1942.

Within the month, Schriever joined the 19th Bombardment Group in Australia and quickly jumped into the shooting war with Japan. The Japanese had transformed Rabaul, on the northeast end of New Britain Island in the Bismarck Archipelago, into their most important base. Feroocious opposition by fighters and flak forced the 19th by August 1942 to turn to night bombing.

The newly minted Major Schriever developed a flare-dispensing system for use in night attacks and tested it in two raids with an old Hamilton Field comrade, then Maj. Jack Dougherty, who had survived being shot down over the jungles of Java. They flew in a formation of about a dozen B-17s in a night raid on Rabaul. Their airplane carried the flares and half the regular bomb load. The flare system worked well, but Schriever wanted to check on the bombing results, so they made another circuit over the target area. Flak was heavy but ineffective at the 10,000-foot altitude from which they were bombing.

As they turned, the No. 3 engine burst into a ball of flames. Dougherty, in the left seat, feathered the prop and shut the engine down. They still had bombs on board but did not want to set up another bombing approach. A quick conference on the intercom led to a decision: They would dive-bomb the ships in the harbor. Schriever laughs ruefully today at the thought of dive-bombing in a three-engine B-17 from a relatively safe altitude down into the flak over Rabaul, but they pulled it off, sinking a ship and returning to base.

Kenney's Command

Schriever flew 38 combat missions in B-17s, B-25s, and C-47s, but his truly important contribution to the war effort lay in managing the Air Corps engineering effort for Gen. George C. Kenney, commander of Fifth Air Force and ultimately commanding general of Allied Air Forces in the Southwest Pacific. When 19th BG was told it was being returned to

the States, Kenney called Schriever in to his office. "I'm not letting you go home," he said. "I need as much engineering help as I can get out here."

Schriever welcomed the news, for the title "engineering officer" also encompassed supply and what later became known as logistics. It was absolutely vital to the war effort in the Pacific. He became chief of the Maintenance and Engineering Division, 5th Air Force Service Command, in January 1943. Thereafter, his duties expanded as the war progressed. He became chief of staff, 5th Air Force Service Command, and then commander of the advance headquarters, Far East Air Service Command, where he was responsible for maintenance in 5th, 7th, and 13th Air Forces.

His rank rose swiftly as he moved his headquarters from New Guinea to Leyte to Manila to Okinawa. Promoted to colonel at age 33 in December 1943, he kept in the forefront of the war, moving his headquarters into the battle zone before the firing ceased, sometimes landing on the nearest highway. He took over the Manila airport while the shooting was still going on and landed his C-47 on Naha strip on Okinawa the day the Marines captured it.

After spending 42 months overseas, Schriever returned home to an assignment in the Pentagon. The Army Air Forces were in the midst of a precipitous demobilization and



Schriever flew 38 combat missions in World War II and developed a flare-dispensing system for night attacks and tested it from B-17s in night raids on Rabaul. Here, bombers are on a mission to Rabaul.

at the same time were fighting for independent status. At the end of his career, ailing physically and beset with all the problems implicit in his job as Commanding General of the Army Air Forces, Hap Arnold still had the vision to continue the emphasis on Research and Development fostered by the Scientific Advisory Group he formed in 1944.

Schriever's engineering and management skills were by that time well-known in AAF. He was made chief, Scientific Liaison Section, Deputy Chief of Staff, Materiel. For Schriever, it was the perfect job, for

it gave him the opportunity to mix with the brilliant scientists Arnold brought on to the Scientific Advisory Board (as it became known when it convened in June 1946). It was in this post that Schriever introduced development planning objectives—a series of planning documents that linked ongoing R&D efforts with long-range military requirements.

Over the next 10 years, Schriever became well-regarded for his technical expertise and willingness to buck senior leadership when he thought it necessary. In one of his less successful efforts, Schriever opposed the bid by Gen. Curtis E. LeMay, then commander in chief of Strategic Air Command, to procure the B-52 bomber. Schriever maintained that USAF could carry out the mission at less cost by using a re-engined B-47. LeMay was not amused and eventually won out. Despite this dustup, LeMay recognized Schriever's value, as did other top leaders such as Gen. Nathan F. Twining and Gen. Thomas D. White.

Heavyweights All

The degree of Schriever's effectiveness as a leader can be ascertained by looking at the high caliber of the men who became his closest associates in what would become his most important technological effort—the creation of a reliable Intercontinental Ballistic Missile. Numbered among them were such luminaries as



Schriever talks with Simon Ramo (shown here at far right), co-founder of Ramo-Wooldridge, a key contractor in the ICBM programs, and J.D. Wright, of the newly formed Thompson-Ramo-Wooldridge—TRW.



At a 1958 House committee hearing, Schriever speaks with (l-r) Reps. John McCormack, James Fulton, and Kenneth Keating. The October 1957 launch of Sputnik spurred a funding boost for ICBM programs.

Trevor Gardner, Simon Ramo, and John von Neumann, all heavyweight scientists and technologists. These were all men of the highest intellect, leaders in their field, and capable administrators. They recognized Schriever as one of their own, a distinction not bestowed lightly to anyone and even more rarely to a military officer. They regarded Schriever as “born for the job.”

The importance of the ICBM had been clear ever since the existence of the first German V-2 rocket was made known to the world. However, actually fielding an ICBM was difficult for political and technical reasons. The services engaged in a fierce rivalry for control over missile programs in general and any potential ICBM programs in particular. Divisions also opened in the ranks of the Air Force itself. Most of its leaders were bomber veterans who did not find it easy to assign priority to a new type of weapon system.

The first problem was resolved for the most part when Washington granted USAF the charter to develop both the ICBM and intermediate-range ballistic missile. The second problem was not completely resolved for many years.

The technical difficulties proved to be far more serious. Nobody had ever built an intercontinental-range missile. Problems were major and totally new, comprising missile guidance, en route navigation, warhead re-entry, and provision of

rocket engines large enough to lift projected gross weights of 440,000 pounds.

Committees have a bad reputation, but it was a series of committees that guided the Air Force in its selection of people and methods to produce the ICBM. The Teapot, Killian, and Gillette committees were almost entirely composed of the brightest leaders in academia, industry, and the military. Schriever, who was either a member or advisor to each panel, usually managed to push them in a direction that produced the results he needed.

Although an early advocate of missiles, Schriever, now a brigadier general, was well aware of the technical difficulties involved. He was attending a briefing of the Scientific Advisory Board at Patrick AFB, Fla., in 1953 when von Neumann and Edward Teller gave independent presentations indicating the practical possibility of building a nuclear bomb weighing no more than 1,500 pounds.

Schriever recalls, “I almost came out of my seat in excitement, realizing what this meant for the ICBM.”

The breakthrough solved one of Schriever’s most pressing problems—the weight of the nuclear warhead. The proposed ICBM—the Atlas—could now weigh in at as “little” as 220,000 pounds. The weight difference was enormous. It reduced the rocket-engine challenge to manageable proportions. Almost equally important, Teller and von

Neumann estimated that the 1,500-pound bomb would yield explosive power of one megaton of TNT, greatly easing the ICBM’s accuracy requirements.

The very limited yields of previously designed warheads generated the requirement for extreme accuracy; the ICBM guidance system would have to produce a Circular Error Probable of about 1,500 feet. With the one-megaton yield, however, accuracy requirements could be relaxed to a CEP of two to three nautical miles. In consultation with others, Schriever increased the estimate of the warhead weight to 3,000 pounds, just to be conservative.

Into Overdrive

Things began to move rapidly. In May 1954, then Vice Chief of Staff Gen. Thomas White assigned the Air Force’s highest priority to the Atlas. In July, Schriever, Gardner, and von Neumann briefed the Atlas program to President Eisenhower, convincing him to give top national priority to the development of the ICBM. On Aug. 2, Schriever officially took command of the newly created Western Development Division, which had its quarters in a former schoolhouse on Manchester Avenue in Inglewood, Calif. Schriever had the privilege and the luxury of picking his top staff and most of the original party. They were a talented crew.

The project was backed by Secretary of the Air Force Harold E. Talbott, whose deputy for budget and program management, Hyde Gillette, created (with Schriever’s guidance) a streamlined set of procedures that made WDD solely responsible for planning, programming, and developing the ICBM. The stage was set.

In size and funding, WDD’s ICBM effort dwarfed that of Manhattan Project. It also faced a different kind of challenge. The Soviet Union had already demonstrated its scientific prowess by producing nuclear and thermonuclear bombs. It was producing new, highly capable bombers even as it mounted an aggressive rocket technology program (which, in fact, led to the shock of Sputnik and then a workable ICBM). Schriever and his team could not afford to fail.

The successful October 1957 launch and orbit of Sputnik dealt a blow to US pride and morale. Ironically,

however, it was a piece of incredibly good fortune for Schriever and his team. For years, the Eisenhower Administration had been cutting back severely on R&D and defense spending. At a stroke, Sputnik ended the cutbacks and ushered in a period of rich funding for the American ICBM program.

Schriever's nominal task was to create an ICBM. His actual task was to create an organization that managed all the elements of the high-technology endeavor while, at the same time, coming up with practical means for using the ICBM. This included planning and building the complex facilities for production and testing. The missile systems, themselves infinitely complex and almost bereft of computer power at the time, had to be integrated with the nuclear warhead. To prove that a nuclear warhead could re-enter the atmosphere without self-destructing, Lockheed opened a secondary program, the X-17, to test experimental nosecones. The Air Force needed new launch sites, meaning land had to be acquired and designated for use, and facilities planned and built, and the operating personnel trained. All this had to be done before the Soviets did it.

Schriever contends that the program succeeded in large measure because the Eisenhower Administration backed it fully and because he chose a risky path of development. With his top aides, Schriever



Schriever inspects a payload similar to one ejected by a Discoverer satellite in 1960 and recovered in the Pacific Ocean. E.A. Miller, General Electric program manager, is at his right and Brig. Gen. Richard Curtin, at his left.

created a system based on technical feasibility and concurrency—conducting simultaneously certain development tasks that normally would be conducted sequentially. It was a revolutionary change in management and administration of a military program.

Schriever also demanded, and got, from the Administration:

- Clear and vertical decision-making channels on overall program and policy matters.
- Assignment of priority high enough to ensure adequate funds.
- Complete responsibility and au-

thority for program direction at the operating management level.

- Competent, highly motivated personnel at all levels.

In short order, Schriever was calling on the talents of 18,000 scientists, 17 prime contractors, 200 subcontractors, and 3,500 suppliers, employing about 70,000 people. By June 1, 1957, the WDD had become the Ballistic Missile Division. More than 8,000 individual reporting channels fed back to the master control room at Schriever's BMD.

Today, Schriever says he did not attempt to understand all of the technology involved, because it was too much for any one person to assimilate. However, he did understand the needs of the managers he put in charge, and he understood whether they were obtaining the results he wanted.

Colleagues from the time recall Schriever as being a workhorse, putting in 16-hour days and shuttling around the country to put out—or start—fires. He was known to be tough but fair. He was easy to get along with if you were producing. If not, you could expect to be gone in short order.

When success came, it was on an extraordinary scale. The first Atlas was launched by a Strategic Air Command crew from Vandenberg AFB, Calif., on Sept. 9, 1959. Deployment went ahead at a feverish pace, despite the requirement to put a large part of the Atlas force in huge under-



A Strategic Air Command B-52 flies over an Atlas missile and gantry at Vandenberg AFB, Calif. A SAC crew launched the first Atlas in September 1959. By 1963 SAC had 13 Atlas squadrons.

A Thor lifts off from Vandenberg in April 1959. The Thor IRBM went from contract award to IOC in less than four years and was just one of four complete missile systems Schriever's organization created in eight years. These ballistic missile programs led to the establishment of a USAF presence in space.



ground silos as protection against Soviet ICBM attack. By 1963, SAC had 13 Atlas missile squadrons, with 127 missiles deployed, sufficient to meet the contemporary Soviet threat.

Tale of Four Missiles

This was but one of Schriever's accomplishments. While the Atlas was being conceived, engineered, produced, and developed, he had simultaneously supervised creation of the Thor intermediate-range ballistic missile, which went from contract award in December 1955 to Initial Operational Capability in June 1959—in other words, in less than four years. The far more sophisticated Titan ICBM reached its IOC in April 1962. Most amazing of all, an entirely new concept in ICBMs, the solid-fuel Minuteman, achieved its IOC in December 1962, rendering obsolete all but the Titan II missiles.

In just eight years, Schriever and his brilliant organization had created a missile industry able to provide the US Air Force with four complete missile systems of almost unimaginable complexity and capability. By comparison, it took 10

years to take the contemporary F-102 fighter from concept to completion.

American dominance in space came about in part as a by-product of Schriever's development of missile technologies. In February 1957, he had announced that about 90 percent of the developments in the ballistic missile program could be used to establish a USAF presence in space. However, even Schriever himself would not have predicted that, four decades later, the Atlas design would still be used as a satellite launcher.

Though Schriever's hardware was useful and long-lived, his revolutionary management changes were even more important for the space program. Today's navigational, meteorological, intelligence, and communication satellites owe their existence to the work of Schriever and his team.

As his successes mounted, Schriever exerted greater and greater influence

on USAF's structure and organization. He became commander of Air Research and Development Command in 1959. Two years later, he was promoted and given command of a new organization he had long advocated—Air Force Systems Command. As a four-star general at AFSC, he was able to apply his management rigor to the acquisition of all USAF weapon systems. He insisted on technologically superior performance standards for new weapon systems. At the same time, he demanded that they be produced under tough cost controls to meet the pre-established production schedules.

By 1963, Schriever was overseeing about 40 percent of the Air Force's budget, with AFSC employing 27,000 military and 37,000 civilian personnel.

In that same year, he directed Project Forecast, a visionary look into the future of technology that helped chart the nation's journey to superpower status. It identified key areas that would lead to great improvements in air and space weapons, including computers, advanced composite materials, radical new propulsion systems, and a prodigious expansion in the use of satellites.

Schriever retired as a four-star general in 1966 after 33 years of Air Force service. In retirement, he immediately started a busy second career, serving as chairman of the President's Foreign Intelligence Advisory Board, the Defense Science Board, the Ballistic Missile Defense Organization Advisory Committee, and many more defense-related organizations. His advice is still sought by research organizations and government agencies.

When it comes to technology, Schriever still has strong opinions on what remains to be done. "We are now in a period of history where global engagement with the enemy is right at our fingertips," he asserts. "We can defeat the enemy in his own backyard at the speed of light." It is a bold and penetrating prediction, just the sort of thing you'd expect from the man who built the missiles. ■

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