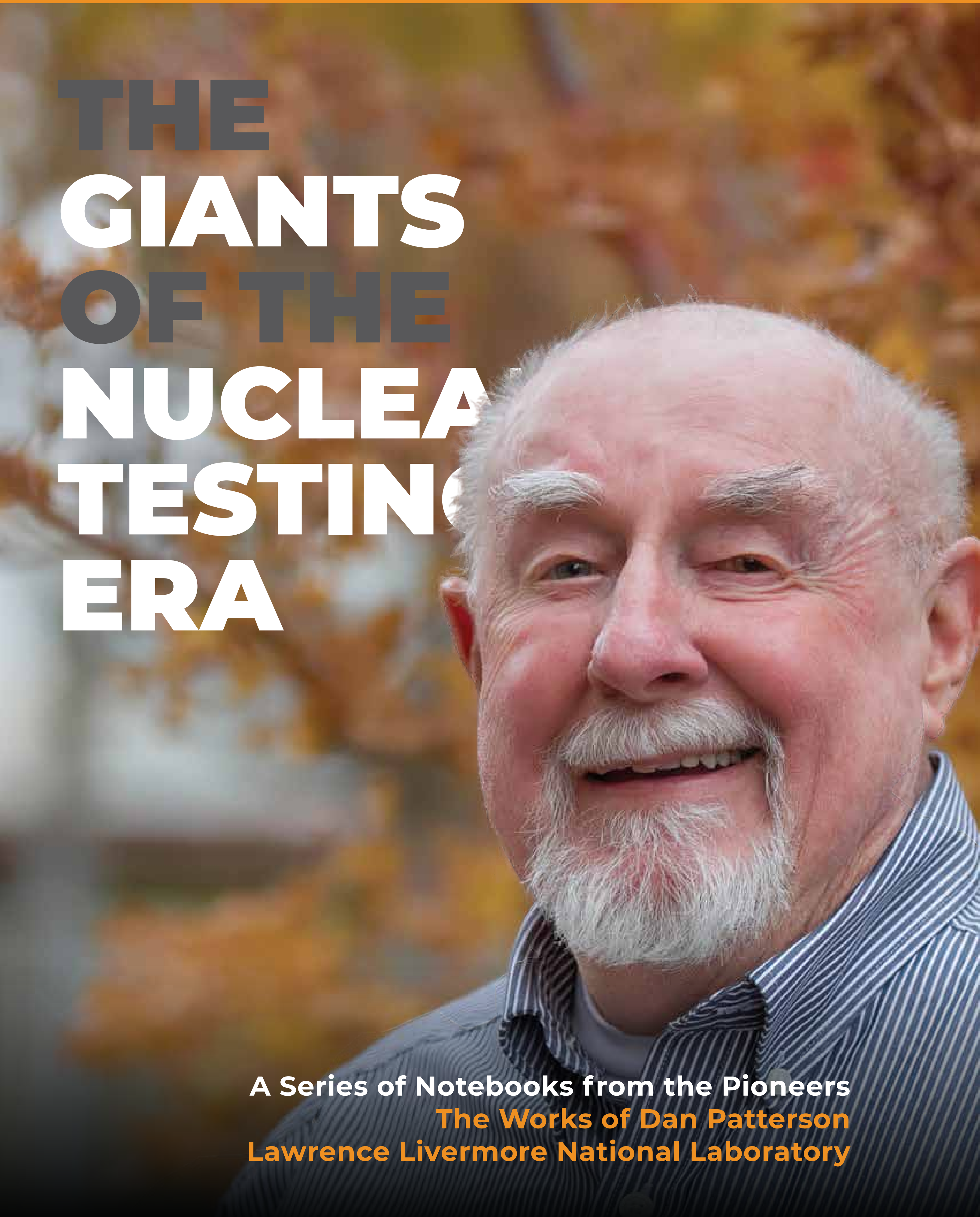
THE GIANTS OF THE NUCLEA TESTIN ERA



A Series of Notebooks from the Pioneers

The Works of Dan Patterson

Lawrence Livermore National Laboratory

This work is part of a series sponsored by the Archiving Data and Management (ADAM) program within the National Nuclear Security Administration's Office of Engineering Stockpile Assessments and Responsiveness (NA-115). The ADAM program is responsible for preserving the data and irreplaceable knowledge from the nuclear weapons testing era. This information continues to be used to support the current and future stockpile and also train the next generation of weapons scientists with no nuclear testing experience.

THE GIANTS OF THE NUCLEAR TESTING ERA

A Series of Notebooks from the Pioneers

The Works of Dan Patterson

> "Dan Patterson refined modern thermonuclear design. Equally importantly, he helped lead the transition from live testing to stockpile stewardship.
>
> ~ George Miller, director emeritus
> Lawrence Livermore National Laboratory

> "The idea is to do design work so well that we don't need to test. With accurate calculations, we can operate in the field of what's been tested before.
>
> ~ Dan Patterson, weapons designer
> Lawrence Livermore National Laboratory

FOREWORD

Most people see Dan Patterson as a craftsman, and he is. Dan is an exquisite craftsman who can combine science, engineering, and computer code to yield an optimized device. What I also see in Dan—what I would ask others to see—is a man with a tremendous understanding of physics. He has incredible depth beyond the craftsmanship.

When I started at Livermore in 1972, I had the opportunity to interview with Dan, and I wound up working down the hall from him. Dan was well established as a group leader in A-Division. He had just tested the W71, the most complicated and sophisticated weapon in the stockpile. Dan went on to develop other advanced weapon designs for the United States military. He and his team worked long hours to perfect modern, integrated devices.

I was awed by Dan's ability to come up with the ideal design, and I confess to spending a late night studying one of Dan's drawings to figure out how he did it. At the same time, Dan was willing to help anyone. His door was, truly, always open.

Another of Dan's masterpieces was a device to advance x-ray laser research. In fact, Dan was asked to do the work specifically because it was anticipated to be so difficult. Incredibly complex nuclear physics research succeeded thanks to Dan and his team.

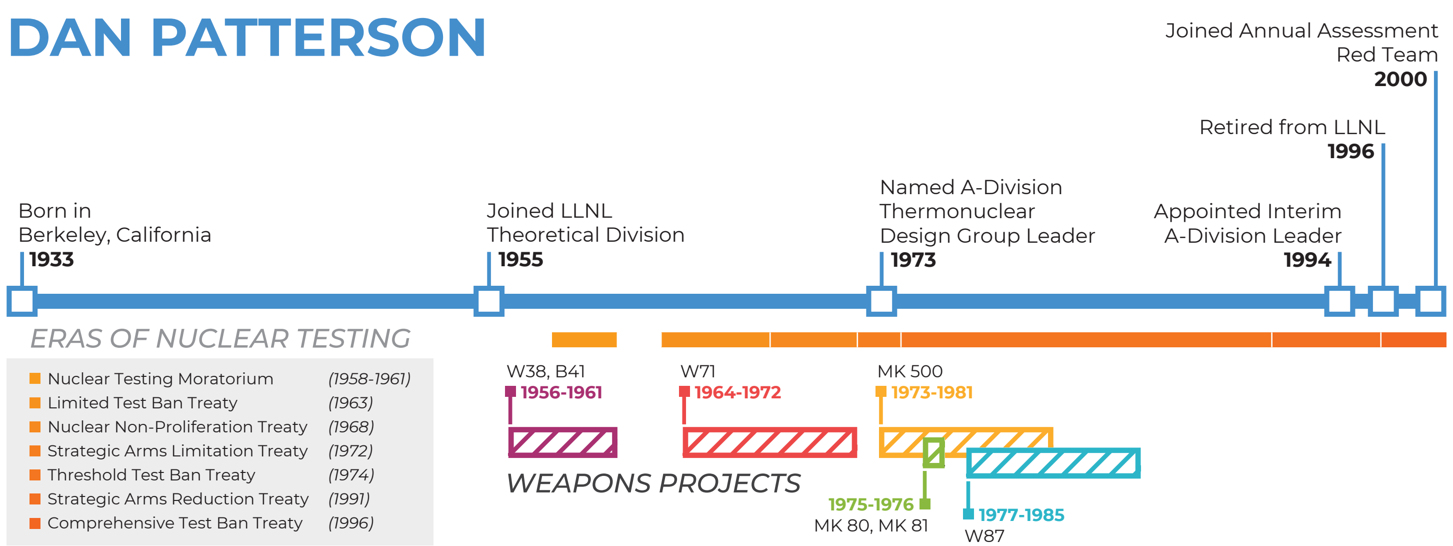
In addition to these contributions, Dan was vitally important in making the transition from the nuclear testing era to the stockpile stewardship era. Learning where our live testing knowledge ended and where the knowledge required for a non-testing future would begin was critical. It was a difficult transition, but we focused our energy on understanding the science better, and we succeeded. Dan's knowledge of design and physics brought great credibility to the work. I still review Dan's briefings on stockpile stewardship to remind myself of all that we ultimately learned.

There are many aspects to Dan Patterson. He is an incredibly talented practitioner of the design arts, and he is a welcoming, encouraging manager. To sum it all up, Dan is an important part of Livermore history and culture.

George Miller, director emeritus

Lawrence Livermore National Laboratory

DAN PATTERSON



DAN PATTERSON: AN INTRODUCTION

Dan Patterson belongs to a revered generation that remembers the arc of World War II. He recalls hearing the news that Nazi troops had crossed into Poland and, later, that Pearl Harbor had been attacked, launching the United States into war[2]. The months, even years, between military attacks and responses during World War II made an impression on Patterson. He wondered what would happen if the response could occur in minutes, even seconds[2].

When Patterson graduated from California State University, Sacramento in 1955 with a bachelor's degree in physical science, his advisor encouraged him and other students to consider the University of California Radiation Laboratory, now Lawrence Livermore National Laboratory, for employment. Patterson interviewed at Livermore, solved a few science problems to demonstrate his theoretical physics knowledge, and was hired to work in Livermore's weapons program[3]. He quickly grew his understanding of weapons design by asking questions of Livermore's engineers, materials scientists, metallurgists, and other specialists around him. "I became conversant in many disciplines just by talking to everyone," he said.

Patterson served Livermore's Theoretical Division for 18 years supporting design of the W38, B41, and the W71, the thermonuclear warhead for the Spartan ABM system. In 1973, he moved to the Laboratory's A-Division as thermonuclear design group leader. During his 20 years in A-Division, he guided landmark projects including the Mark (MK) 500 maneuvering Trident warhead, Minuteman II upgrade candidates, the SRAM II warhead replacement, and the W87, which was adapted for today's weapons stockpile. Patterson also applied his expertise to creative projects such as a modern earth penetrator weapon and the x-ray laser[2].

Nuclear testing treaties and agreements bookmark Patterson's career. He worked within a growing list of testing limitations, leading ultimately to the end of live nuclear testing in the 1990s. As Interim A-Division Leader from 1994 to 1996, Patterson led the transition from live weapons testing to stockpile stewardship[2].

After retiring in 1996, Patterson served as a design member of Livermore's Annual Weapon Assessment Red Team, charged with challenging and fine tuning the Laboratory's stockpile assessment process[2]. He continues to report to the site several days a week to mentor Livermore scientists.

Patterson remains modest regarding his accomplishments. In fact, when his family attended his 60th work anniversary celebration, they were astonished at all he had achieved[4]. Patterson replied, in his typical, measured way, "Weapons design is work like any other work with deadlines, a budget, a boss, and critics."

EARLY CAREER IN THE COLD WAR

The Cold War was firmly rooted when Patterson started his Livermore career in 1955, six years after the Soviet Union exploded its first atomic bomb. He remembers a society fully in touch with the threat of nuclear war. Neighborhood ham radio operators organized networks to take part in civil defense. Children practiced duck-and-cover drills in school. Wind direction updates were posted in the Laboratory's Building 131. "Livermore was ringed with potential targets," he said. "We needed to know which way the wind was blowing in case of an attack."

The nation's cautious mood in the mid-1950s and early 1960s heightened the importance of Patterson's work. "We were hustling to get modernized and develop as much national capability as possible," he said. "The penalty was too high. We believed if the Soviets had the weapons, their military would flex them." Patterson, assigned to Livermore's Theoretical Division, supported development of the W38, an intercontinental ballistic missile (ICBM) warhead[5], and the B-41, labeled a strategic bomb[5], from 1956 to 1961.

EVOLVING TECHNOLOGIES AND TREATIES

A nuclear testing moratorium went into effect in 1958, and Patterson worked to develop computing capabilities that could inform weapons design. Livermore's computers, however, were limited to an 8,000-word memory. Yet, Patterson showed an aptitude for manipulating what are considered archaic codes by today's standards in support of the division. Moving to 30,000-word floating point computers from earlier fixed-point machines led to more accurate equations of state. These machines were the Laboratory's workhorses for years to come.

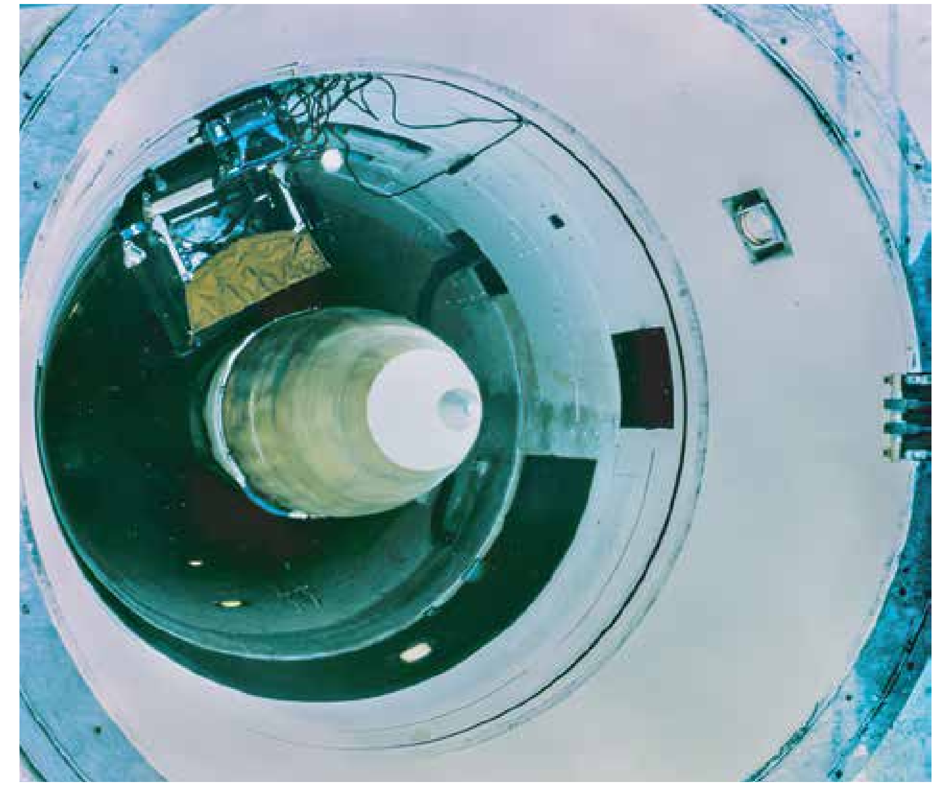
In 1961, the Soviet Union broke the international nuclear testing moratorium. By 1963, the U.S., U.K., and Soviet Union agreed to the Limited Test Ban Treaty, which prohibited testing of nuclear weapons in the atmosphere, underwater, or in outer space.

Around this time, Patterson participated in Project Dribble, funded by the Department of Defense to assess if hidden nuclear tests could be detected using a worldwide network of seismic shock measurement stations[2]. Patterson devised three nuclear tests that could be scaled to provide the oversight required. The designs were tested in subsurface locations, and Patterson published the results in the July 15, 1966, *Journal of Geophysical Research*[6], his only unclassified manuscript.

The LARC (Livermore Advanced Research Computer), built in 1960 to Livermore specifications, was large enough to fill a building.

INNOVATIVE WARHEADS

The mid-1960s saw Patterson contribute to designs for the W62 ICBM and W68 submarine-launched ballistic missiles (SLBM)[7], both deployed in 1970[8]. The W62 and W68 boasted high yield-to-weight ratios to support the military's desire for multiple independently targeted reentry vehicles (MIRVs), enabling each missile to reach several targets[8]. MIRVs offered flexibility in targeting and cost-effectiveness because they deployed from existing missile silos (Minuteman III) and submarines (Poseidon C-3)[8].



In the 1970s, Minuteman III missiles with Livermore-designed W62 warheads were deployed in 550 silos at U.S. Air Force bases in three states.

Livermore met extreme challenges to deliver the W62 and W68. In particular, the design team reduced warhead size and volume to suit both delivery and reentry vehicle specifications and achieve high accuracy. The warheads were hardened to be able to penetrate threatening anti-ballistic missile (ABM) systems and survive[8]. Patterson, still in Livermore's Theoretical Division, added to his expertise in thermonuclear or "secondary" design concepts (versus fission or "primary" design) while collaborating with A-Division, the Laboratory's secondary design group, on this landmark project.

A DIFFERENT DESIGN: W71

Arguably, Patterson's most notable effort from the mid-1960s to early-1970s was serving as a major part of the team that designed and tested the W71, the Spartan ABM warhead. The Spartan's mission differed from that of weapons intended to destroy a target on the ground. Instead, the missile was designed to intercept the opposition's reentry vehicles (RVs) above the atmosphere and destroy incoming warheads with high-energy x-rays. Emitting more x-rays, but with less debris, helped to prevent ABM radar malfunction[9].

Different requirements required different design methods. As many of his colleagues noted, when a project was challenging, it was given to Patterson. In fact, the project had started at Los Alamos National Laboratory but was handed over to Patterson's group at Livermore for completion and testing.

At Patterson's side on this project was Dave Stanfel, 10 years younger than Patterson and fresh out of school with a master's in physics. "In retrospect," said Stanfel, "it's hard for me to believe we made it work. There was a lot of uncertainty in what we did."

Colleagues and Laboratory staff familiar with the design unilaterally use the word “sophisticated” to describe the W71. “What made it a sound design was Dan’s ability to pay attention to a raft of details all at once,” said Livermore weapons designer and W87 Life Extension Program manager Hank O’Brien. “Everything had to be right for the W71 to work, and Dan could get everything right.”

A LANDMARK TEST: CANNIKIN

At less than five megatons, the W71 was the highest-yield warhead the United States tested underground[7]. Achieving a large enough emplacement hole for a full yield test (6,150 feet deep and 90 inches in diameter with a 52-foot-wide cavity at the bottom) required two years of drilling at the test site on Amchitka Island in Alaska. As the November 6, 1971 test date approached, the Livermore team waited, in the face of gale force winds, for a U. S. Supreme Court ruling before the test could proceed. The court reached a 4-3 decision, during a special Saturday session, to not delay the test in response to an anti-nuclear group’s lawsuit against the Atomic Energy Commission[9]. The test event, named Cannikin, went forward.

A Spartan missile body with the nuclear device is lowered downhole for the Cannikin event. The test was successfully conducted on November 6, 1971, on Amchitka Island, Alaska.

The blast generated ground motion equivalent to a 7.0 magnitude earthquake. Nearly 300 observers located 23 miles from the test site saw the earth rise in response[10]. Yet all test data was recovered thanks to shock-mounted recording trailers, laser-aligned downhole diagnostics, and computer-assisted field operations[9].

The test led to one very unexpected outcome. Canadian activists had sailed toward Cannikin in a fishing boat attempting to get close enough to force a stop to the test. High winds and rough seas deterred their efforts, but the group formed a new environmental organization named for their boat, The Greenpeace[11]. Limitations on ABM deployment agreed to by the USSR and United States in a 1972 treaty led to an early retirement of the Spartan System in 1976 along with its companion Sprint ABM missile system.

THE ART AND ENGINEERING OF WEAPONS DESIGN

Many people may think of a weapons designer as someone with deep expertise in a complicated, but limited field of physics. In fact, a weapons designer is the supreme systems engineer, knowledgeable and skilled in all the physics, materials science, engineering, and manufacturing processes required to produce a warhead that can function properly in the required military environment.

As George Miller explained, this knowledge and skill must be both broad and deep, covering everything from detailed physics approximations in sophisticated computational simulations to machining tolerances and processes used to manufacture weapons in a production environment. “Dan’s career experiences, personal inquisitiveness, and superb capabilities made Dan a preeminent weapon designer,” said Miller.

ALWAYS A NEW PATH

Supported by his expertise, Patterson achieved successful, creative designs by consciously taking a new path rather than building on past iterations. “He would say, ‘Here’s what I want to do that’s different,’ and then identify the physics and materials fundamentals to solve this new problem,” said Hank O’Brien. O’Brien watched Patterson literally go back to basics, consulting, for example, the periodic table to find elements with the characteristics and properties needed to match his new concepts[12].

“Everything was from the base up,” said designer Scott Carman, who worked with Patterson starting in the 1980s. “He has a complete understanding of the tools and the physics, and neither are static. Tools change. Physics adjusts. These systems are very complicated and, as a designer, you’re up to your shoulders in details. Yet Dan’s mind is a neural net.[13]”

A Minuteman III intercontinental ballistic missile streaks through the night sky carrying a mock W87 warhead during a highly-instrumented flight test.

COMMANDING THE DETAILS

No detail was too small to Patterson, and he understood them all. “If you asked him what matters, he would say, ‘Everything. It’s all important. All the details matter,’” said O’Brien.

More than one colleague recalls a time when Dan walked into a production area and immediately spotted an assembly error. “It was easy to get confused whether you were looking uphole or downhole working on the canister,” said O’Brien, “but Dan was never confused.”

RELATIONSHIP BUILDER

Patterson was an expert and an integrator, never staying put in his design office. He went to production agencies to see the parts and watch the assembly — every joint, feature, and finish — making sure the device was built the way he intended and met all tolerances[12].

He insisted that the project could only succeed with strong technical relationships across the Lab[12]. Patterson was noted for working well with everyone—the engineers who built devices, the physicists who wrote computer simulations, and the experimentalists doing the testing[12]. “He built all those relationships and made sure others in his group did the same,” said O’Brien. “Dan showed us the way to achieve integration across all divisions.”

MILITARY COLLABORATIONS AND "A" DIVISION

Following the successful test of the W71, Patterson joined the Laboratory's A-Division in 1973 and became thermonuclear design group leader. The early 1970s were marked with an accelerated weapons design and test program in anticipation of the 1976 Threshold Test Ban Treaty, which limited the explosive yield of nuclear tests to 150 kilotons. Despite delays in the treaty's formal ratification, both the USSR and United States complied with the yield limitation[14].

One of Patterson's A-Division responsibilities was managing members of the military research associate (MRA) program, in which United States Army, Navy, and Air Force staff were embedded in the design group for stints of two to four years. Patterson supervised MRAs with the goal of creating military officers who understood weapons design enough to inform military colleagues for the rest of their careers.

The military also worked directly with Livermore, specifying device goals and reviewing options developed by Laboratory designers. Patterson led the secondary design group for military projects, including the MK 80 and MK 81 designs for the U. S. Air Force's Minuteman II upgrade as well as the SRAM II Warhead Replacement[2].

A MODEL PROJECT: MK 500

Another military project, the MK 500, is considered by colleagues to be one of Patterson's finest achievements. The MK 500 was a maneuvering RV designed to U. S. Navy specifications to evade a defensive, anti-ballistic missile system and survive all environments[7]. In his classic, integrative style, Patterson collaborated with Laboratory colleagues and defense contractors to create a solution[12].

The MK 500's unique bent nose design played a part in achieving maximum evasiveness from anti-ballistic missile systems.[24]

The resulting reentry body design featured a bent nose to provide aerodynamic lift, controlled by the shifting weight of the electronics package inside the body to roll the reentry body and maximize evasiveness[15]. Kenneth Malley, Director of the U. S. Navy's Strategic Systems Programs, noted that Patterson worked within severely limited maneuvering, volume, and mass constraints to devise the MK 500 concept while also incorporating surprisingly high yield. Malley called the MK 500 a model for future warhead developments and noted Patterson's outstanding leadership and cooperative spirit[16].

The warhead was successfully flight-tested five times on Minuteman I boosters from 1975 to 1976 and was demonstrated to be compatible with the C4 missile in 1977[15]. At least one test was performed at sea, in clear view of a Soviet Union vessel, with the belief the USSR would realize it did not have a device in its arsenal capable of intercepting the MK 500[2]. Nevertheless, the 1972 ABM Treaty was so limiting to Soviet capability that a maneuvering RV wasn't necessary, and the MK 500 was not deployed.

ADDING TO THE STOCKPILE

In a project spanning the late 1970s through mid-1980s, Patterson led the W87 design team in collaboration with Livermore's B-Division, the primary (fission) design group. The project was designed for the Peacekeeper, a ICBM carrying ten MK 21 RVs with W87 warheads[17].

Engineering tests supported the development of the W87 warhead for the Peacekeeper missile, which carried 10 RVs with W87s. Through a stockpile life extension program completed in 2004, W87 warheads were refurbished to extend their long-term use on Minuteman III ICBMs.

The W87 design is noted for several safety features, particularly its use of an insensitive high explosive, triaminotrinitrobenzene (TATB), developed at Livermore to be inherently unresponsive to shock, heat, explosions, and small arms fire, yet reliably fired in nuclear weapons. Other safety enhancements included a fire-resistant pit that confined and contained molten plutonium as well as detonator strong links.

The START II treaty signed in 1993 led to Peacekeeper's retirement, but W87 warheads remained in the nation's nuclear stockpile for use on Minuteman III missiles. In the 1990s, a life extension program (LEP) for the W87 took the warhead out of the stockpile for minor design changes and refurbishments. Hank O'Brien, who had worked on the W87 early in his career, was named the W87 LEP leader. O'Brien made sure Patterson and his longtime associate Dave Stanfel were present to review the process and offer critical review and suggestions[12].

COLD WAR CLOSER

In the 1980s, Patterson supported Livermore's x-ray laser project, which was part of President Ronald Reagan's strategic defense initiative. Much of the work on this project remains classified[14], but its potential to counter any weapon had global political influence, according to George Miller.

"In my opinion, it contributed to the end of the Cold War," said Miller. "The device that was the nuclear source for these experiments was a true tour-de-force. Patterson was the leader, architect, principal designer, and force behind it."

TRANSITION TO THE NON-TESTING ERA

The final period of the Cold War, marked by the Soviet Union's moratorium on nuclear testing and the USSR's dissolution in 1991, was followed by a U.S. testing moratorium in 1992. Laboratory leaders acknowledged that nuclear testing would eventually come to an end and began the process to understand and adopt a stockpile stewardship model. The key would be turning to validated computer simulations, rather than live nuclear testing, to maintain confidence in the safety, security, and effectiveness of stockpiled weapons[18].

THE IDEAL EXPERT

Patterson had witnessed 50 live nuclear tests validating nuclear weapons design projects throughout his career. Colleagues might have understood if he had been the most skeptical among weapons designers about the move to end live nuclear testing.

Instead, Patterson led the transition from nuclear testing to the stockpile stewardship model as interim A-Division Leader from 1994 to 1996. His testing experiences plus a career-long familiarity with computer simulations and the Laboratory's growing computing capabilities, made him the ideal person for the job. He determined the steps and staff needed to maintain competence in existing weapons systems[2]. To support this significant shift, Laboratory leadership increased capabilities in high-performance computing and commissioned the National Ignition Facility to address a key experimental element of stockpile stewardship[18], the examination of thermonuclear burn.

NO COOKBOOKS

While Patterson's colleagues recall his extreme willingness to educate new designers and share his expertise, his communications were strictly oral. Patterson did not leave behind a "cookbook" for weapons design.

As he said, "Cookbooks can get in the hands of bad cooks," referring to people who lack judgment to make the most of the recipe.

On a practical side, finding the time and space to write all he had to share would have been difficult, according to his team members. "Dan had an amazing depth of knowledge," said O'Brien. "He thought everything was important, so that made it difficult to write a report. It was easier for him to talk."

"Dan was in the strongest position to judge the tools used for stockpile stewardship in terms of (1) the physics being correct, and (2) the alignment with underground test data," said Hank O'Brien. "He also brought a profound skepticism. As sophisticated as simulations are, they're not the real world. Dan's experience led him to understand where codes were the most useful."

Although Patterson retired in 1996, he continues to come to the Laboratory to teach the secondary design process to young scientists and give vault tours. "He can talk in depth and detail about weapons design to this day," said Dave Stanfel.

In 2000, Patterson joined the Annual Weapon Assessment Red Team as a secondary design member. The team is charged with challenging the warhead assessment process and providing recommendations to the Laboratory Director who, in turn, writes an annual letter to the U. S. President ensuring the safety, security, and reliability of the nuclear weapons in Livermore's stockpile. Patterson describes the team as "meddlers wearing white hats."

TEAM SCIENCE IN PRACTICE

Slap Shot, a 1977 movie about a hockey team striving for success, was a favorite for Patterson and his team of designers.

In his early days at the Livermore Rad Lab, today's Lawrence Livermore National Laboratory, Patterson met a collection of people infused with Ernest Lawrence's collaborative design culture. Each scientist and engineer brought a sense of responsibility. Together, they were dedicated to the same end goal, bringing together their discoveries in an integrated way.

As a young designer, Patterson learned about each expert's field—metallurgy, engineering, computer coding—in open doorways and hallway conversations. Lawrence's system of optimization called for continuous, across-the-board assessment and correction, which Patterson found the most efficient way to achieve design goals.

He said, "Each group had their own projects, but we weren't competing. We worked as a coordinated team, understanding what the engineers' problems were and what the primary designers' problems were. This was a very supportive way of attacking the problem."

COLLABORATIVE SUCCESS

Patterson adopted the practice of coming up with his best approach then explaining it to another designer. "Then you'll see what's not right," he said, adding that Seymour Sack, honored in an earlier Giant's Notebook, was an excellent sounding board.

A sentiment Patterson often repeated to colleagues was not to trust themselves alone. Dan said, "We had a tremendous infrastructure and the support was massive. You could certainly be a failure in this process if you didn't take advantage of the massive infrastructure that helped to get what was needed for designing[19]."

Patterson created strong teams, even making staff members considered difficult to work with seem indispensable. "He brought out the best in people," said O'Brien. "He gave them the opportunity to develop skills. Dan described it as loading someone up and aiming them in a direction."

A SENSE OF FAMILY

Patterson hosted new designers at his home to welcome them and capitalize on their eagerness to integrate with the group and get to work. In doing so, he built a sense of family.

Patterson's favorite diversion from the 24/7 focus of weapons design was to invite the group to his house, just a few blocks away, to eat pizza and watch a movie. *Slap Shot*, a 1977 movie about a hockey team fighting against incredible odds, was a favorite. In the 1980s and 1990s, as weapons testing programs wound down and young designers faced an uncertain future, the movie was an appropriate choice.

As designer Scott Carman explained, the pizza and movie afternoons only strengthened the team and its output. "Instead of 24/7 that day, we were 22/7. But when physicists watch a movie, they don't leave the physics behind."

MENTOR AND TEACHER

Patterson established his own open-door policy and mentoring approach, remembering the value of others' expertise during his early days at Livermore. "He shared knowledge by oral tradition, like graduate school," said weapons designer Joe Bauer, who joined the division in 1992[20].

Hank O'Brien joined Patterson's group in 1987. Patterson spent a great deal of time teaching him how devices work and how to do the codes required to make a robust, resilient design. Then, he left the young designer to do the work, sometimes poking his head in the office to ask, "Any breakthroughs?"

"He knew there were many ways to achieve a design to meet goals," said O'Brien. "I'd think of an approach, and Dan would say, 'Go do that.' I'd learn something else, then tell Dan my new direction, and he would say, 'Go do that, then.' I finally realized he wasn't going to tell me the answer, because there's more than one right answer. He was making sure I took responsibility to make my own decisions. That was my job. He didn't give me the answers, he gave me the tools."

IN THE THICK OF THE DESIGN

Patterson encouraged young designers to stay the course. O'Brien remembers his expression, "You're going through the knot hole," meaning the path might seem impossible, but he would push through. When Bauer encountered a difficult problem, he recalls Patterson saying, "You're in the thick of it now," confident the designer would find his way out.

Tom Thomson, who started working at Livermore in the 1960s, remembers the value of Patterson's briefings. "Dan's review process kept people connected," said Thomson[21]. "We shared knowledge." Adds George Miller, "Dan's leadership style was low key, and he was generous in sharing credit."

In concert with his years of experience and his accomplishments, Patterson's colleagues always saw him as a warm and caring leader with a great sense of humor. He never blamed anyone else, so he inspired loyalty, according to Dave Stanfel. "I've worked with Dan for 50 years," said Stanfel. "I consider the day I was assigned to work with him to be one of the luckiest days of my life."

> Simply put, everyone wants to be on Dan's team.
>
> ~ Richard Ward, Design Physics Deputy Division Leader, Lawrence Livermore National Laboratory

> Dan always told us we have to make sure the weapons do what they're supposed to do. But the point is never to use them, except in the political sense. If these weapons are ever used, the program has failed.
>
> ~ Hank O'Brien, Weapons Designer, Lawrence Livermore National Laboratory

> Dan's work epitomized the effective integration of warhead design with sophisticated vehicle concepts.
>
> ~ Kent Johnson, Weapons Designer, Lawrence Livermore National Laboratory

> Dan gave his staff a concrete mission. We could see the bigger picture, the national importance. He encouraged me, personally, and gave me ownership and guidance. He was like an older brother rather than a father figure. I could depend on him, but he wasn't an overlord, even as division leader. Dan continues to encourage me to this day.
>
> ~ Joe Bauer, Weapons Designer, Lawrence Livermore National Laboratory

> Dan's work has always been solidly in the mainstream of nuclear weapon design. In many ways, he has been a leader in defining the mainstream[22].
>
> ~ Richard Wagner, Assistant to the Secretary of Defense for Atomic Energy, 1981-1986

> I have been impressed over the years by Dan's creative, incisive approach to the theoretical physics design of nuclear weapons. Dan's research has spanned a wide range of conventional and special purpose weapons and, in my mind, there is no doubt that Dan has made significant and impressive contributions to national security[23].
>
> ~ James Gordon, Laboratory Fellow, Los Alamos National Laboratory

> Dan is the only person who, when he walks into my office, I don't care if I have a deadline in five minutes. I will drop everything and listen to Dan for as long as he is willing to talk.
>
> ~ Joe Wasem, Weapons Designer, Lawrence Livermore National Laboratory

> Dan is a wonderful person, in addition to being talented. Everyone who knows Dan loves him.
>
> ~ George Miller, Director Emeritus

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IS DAN PATTERSON A GENIUS?

Dan Patterson's long list of accomplishments, uncanny memory, and ability to derive unique approaches unlike any tried before could lead one to wonder: "Is Dan Patterson a genius?"

A few of Dan's colleagues offered their opinions:

> **Hank O'Brien**: *"Is Dan a genius? If so, he's like Edison's genius – 1% inspiration and 99% perspiration. Although in Dan's case, there is much more inspiration. He comes across as practical, humble, not at all showy like the stereotypical genius. He has a genius for weapons design and for getting a lot out of people."*
>
> **Scott Carman**: *"Everyone wanted to know how he did it. 24/7 had a lot to do with how he did it."*
>
> **Tom Thomson**: *"When I think of Dan, I think of technical veracity."*
>
> **Dave Stanfel**: *"We used to say, 'How do you know when you've calculated enough? When your answer agrees with what Dan said it would be.' Dan's children and grandchildren think he can do anything. I think he can do anything."*

Part of the A-Division design team watches as Department of Energy (DOE) Acting Deputy Assistant Secretary for Military Application John Meinhardt presents a DOE Weapons Recognition of Excellence Award to the team's leader, Dan Patterson. Left to right are: T. Scott Carman, Meinhardt, Dave Stanfel, Patterson and Wes Nelson.

AWARD-WINNING CAREER

Born in Berkeley, California
1933

Joined LLNL Theoretical Division
1955

Named A-Division Thermonuclear Design Group Leader
1973

1987
A-Division Design Team Lead, for developing drivers for the nuclear-driven x-ray laser program

1987
W87 Project Team Member, for designing the Peacekeeper missile warhead to meet all required military characteristics ahead of schedule

1991
Technical Leadership in Weapons Design - Individual Award, for a career "unsurpassed in its quality, dedication, innovativeness, and design competence" and contributions substantial in keeping the nation at the forefront of defense technology

Appointed Interim A-Division Leader
1994

Retired from LLNL
1996

Joined Annual Assessment Red Team
2000

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