HONORING THE LATE DR. JOHN S. FOSTER JR.: A LIFETIME OF SERVICE TO THE NATION

The remarks below were delivered at a symposium "Honoring the Late Dr. John S. Foster Jr.: A Lifetime of Service to the Nation," hosted by the National Institute for Public Policy on June 10, 2025. The symposium honored Dr. Foster, who passed away on April 25, 2025, at the age of 102. A former head of Lawrence Livermore National Laboratory and a senior Department of Defense official under two presidents and four Secretaries of Defense, Dr. Foster's work drove the development of every nuclear weapon in the U.S. nuclear arsenal today.

Keith B. Payne
Keith B. Payne is President of the National Institute for Public Policy and previously served as Deputy Assistant Secretary of Defense for Forces Policy.

Dr. John S. Foster Jr. passed on April 25. He is a legend who deserved that title, an American and international hero. We are here today to honor him as a person, and for his many unparalleled accomplishments. To do so, we are fortunate to have a line-up of renowned, expert panelists who knew and worked with Dr. Foster for decades. They each deserve long introductions, but we will keep introductions very short given the time we have. These are:

- Dr. Miriam John, former Vice President of Sandia National Laboratories and recipient of the prestigious Lawrence Livermore National Laboratory John S. Foster Jr. Medal;
- Dr. Tom Ramos, physicist at Lawrence Livermore National Laboratory and author of the excellent biography of Dr. Foster, *Call Me Johnny*, and the great 2022 book, *From Berkeley to Berlin: How the Rad Lab Helped Avert Nuclear War*;
- Amb. Ronald Lehman, Counselor to the Director of Lawrence Livermore National Laboratory and former Director of the U.S. Arms Control and Disarmament Agency;
- Dr. Bryan Gabbard, CEO of NeuroGen Technologies, Inc., former Chair of the Global Security External Advisory Board for Sandia National Laboratories, and former Chair of the NIF Peer Review Panel at Lawrence Livermore National Laboratory;
- Mr. Thomas Scheber, former Vice President of the National Institute for Public Policy, Director of Strike Policy, OSD, and Director of the Military Applications Group at the Los Alamos National Laboratory.

This extraordinary panel will share anecdotes and also offer commentary on national security issues in which Dr. Foster played a central role. I would like to start with a telling anecdote, and then conclude with a brief discussion of Dr. Foster's critical role in the development of U.S. deterrence policy.

Saving Lives in World War II

First the anecdote: I had the honor of working closely with Dr. Foster for well over 2 decades. He would often describe his amazing life experiences—always with characteristic humility. One such experience was during World War II. As a very young man, Dr. Foster worked with the 15th Army Air Force in the Mediterranean theater as an advisor on radar and countermeasures. He examined captured German radar equipment and came up with effective countermeasures to German air defenses. As a result, while still a young man, Dr. Foster saved the lives of many American aviators.

The part of this account that Dr. Foster enjoyed telling most was when, after the war, he met with German war veterans. Without knowing Dr. Foster's wartime role in U.S. radar countermeasures, the Germans mentioned that they could *not* figure out *how* American air forces were able to counter German radar defenses in the area where Dr. Foster had worked. He solved that mystery for them. Six decades later, during dinner, Dr. Foster shared that story with a well-deserved smile.

Deterrence Policy

Now to the question of Dr. Foster's role in U.S. deterrence policy. His technical contributions are legendary. But this gathering is a suitable occasion to recognize the significance of his work in the development of U.S. deterrence *policy*, and the *continuing value* of that work for contemporary U.S. nuclear deterrence requirements.

In February 1973, Dr. Foster, then Under Secretary of Defense for Research and Engineering, chaired an *ad hoc* working group to review U.S. nuclear policy. This working group "included [Ronald] Spiers, [Seymour] Weiss, [Gardiner] Tucker, David S. Brandwein, and Lieutenant General Louis T. Seith."[1] This "Foster Panel," as it came to be known, produced its summary findings in a lengthy report, National Security Study Memorandum 169 (aka NSSM-169).[2] Dr. Foster forwarded NSSM-169 to Secretary of Defense James Schlesinger, who endorsed it, and forwarded it to Henry Kissinger.[3] NSSM-169 established the basis for the 1974 National Security Decision Memorandum 242 (NSDM-242),[4] and associated Nuclear Weapon Employment Policy (NUWEP-74).[5]

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[1] See, "Summary Report of the Inter-Agency Working Group on NSSM 169, June 8, 1973" at, *Foreign Relations of the United States: 1969-1976*, Vol XXXV, *National Security Policy 1973-1976*, Department of State (Washington, D.C.: USGPO, 2014), p. 47, available at https://static.history.state.gov/frus/frus1969-76v35/pdf/frus1969-76v35.pdf.

[2] See, Ibid., pp. 19-20, 49-82.

[3] Ibid., p. 47.

[4] See, Richard Nixon, *National Security Decision Memorandum 242: Policy for Planning the Employment of Nuclear Weapons* (Washington, D.C.: The White House, January 17, 1974), available at https://www.nixonlibrary.gov/sites/default/files/virtuallibrary/documents/nsdm/nsdm_242.pdf.

[5] Office of the Secretary of Defense, *Policy Guidance for the Employment of Nuclear Weapons* (Washington, D.C.: Office of the Secretary of Defense, April 3, 1974), available at https://nsarchive.gwu.edu/document/20307-national-security-archive-doc-22-office.

NSSM-169, and the resultant nuclear guidance set in motion a much-needed re-direction of U.S. nuclear policy accepted by all subsequent Republican and Democratic administrations. Later guidance accepted, extended, and revised that direction.[6] But NSSM-169 and its associated planning documents established a basic framework for U.S. nuclear deterrence policy that has endured to the present, including intentionally aligning the U.S. deterrence threat to opponents' goals and thinking, and providing limited and tailored nuclear threat options for *credible* extended deterrence. The arguments for these NSSM-169 innovations in policy are *overwhelming* today.

To be specific, the new policy direction that the Foster Panel established included the first actual pre-planned, *limited* strategic nuclear options, particularly for credible extended deterrence. *The smallest previous option employed 2,500 nuclear weapons.* [7] *NSSM-169 advanced the enduring deterrence need for much smaller options for deterrence purposes*.

NSSM-169 also, for the first time, consciously put tailoring deterrence into practice—a practice now universally acknowledged as necessary. That is, declared U.S. deterrence threats must be designed to hold at risk the unique priority values of the opposing leadership. At the time, that meant the leadership in Moscow and deliberately holding at risk Soviet post-war recovery capabilities. Doing so did not get the title "tailoring" until over two decades later,[8] but the Foster Panel set "tailoring" deterrence into motion. NSSM-169's limited options and tailoring were fundamental and enduring changes in how we think about deterrence.

Fifty years ago, Dr. Foster and his working group successfully met the policy and strategy challenges of the Soviet Union unexpectedly reaching strategic nuclear parity. The Foster Panel reformed the then-existing U.S. strategy for extending deterrence, the credibility of which, in the memorable words of Secretary of State Dean Rusk, required that Moscow believe "we Americans are just [expletive deleted] fools."[9] In doing so, Dr. Foster set aside some long-standing deterrence policy fundamentals.

I will conclude by noting that dynamic geopolitical and nuclear threats, once again, compel us to re-consider U.S. nuclear deterrence policy. Senior civilian and military leaders frequently ask, "what should we do now about nuclear deterrence?" My sincere answer is

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[6] Jimmy Carter, *Presidential Directive/NSC-59* (Washington, D.C.: The White House, July 25, 1980), available at https://nsarchive2.gwu.edu/nukevault/ebb390/docs/7-25-80%20PD%2059.pdf. Ronald Reagan, *National Security Decision Directive 13* (Washington, D.C.: The White House, October 19, 1981), available at https://irp.fas.org/offdocs/nsdd/nsdd-13.pdf.

[7] See, Department of State, Office of the Historian, *Summary Report of the Inter-Agency Working Group on NSSM-169,* at https://history.state.gov/historicaldocuments/frus1969-76v35/d17.

[8] For the initial post-Cold War discussions of the need for "tailoring deterrence" and its requirements, see, Keith B. Payne, "Deterring Emerging Nuclear Actors?" Presentation at the Strategic Options Assessment Conference, sponsored by U.S. Strategic Commend, Dougherty Conference Center, Offutt Air Force Base, July 7, 1993; Keith B. Payne, *Deterrence in the Second Nuclear Age* (Lexington, KY: University Press of Kentucky, 1996), pp. 123-129. See also, Department of Defense, *Deterrence Operations: Joint Operating Concept* (DO JOC), Version 2.0 (August 2006), p. 3, available at https://www.jcs.mil/Portals/36/Documents/Doctrine/concepts/joc_deterrence.pdf. For a later discussion see, M. Elain Bunn, "Can Deterrence be Tailored?," *Strategic Forum*, National Defense University, No. 225 (January 2007), pp. 1-8.

[9] Dean Rusk, *As I Saw It* (London: W.W. Norton & Company, 1990), p. 228. See also, Arnold Beichman, "How Foolish Khrushchev Nearly Started World War III," *The Washington Times*, October 3, 2004, p. B 8.

that the first step in understanding what to do today is to study Dr. Foster's NSSM-169. See how an experienced team, chaired by the brilliant and somewhat iconoclast Johnny Foster, successfully moved U.S. policy forward in response to a fundamental worsening of the Soviet nuclear threat.

Now, I look forward to hearing from our august panel.

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Miriam John
Miriam John is former Vice President of Sandia National Laboratories and recipient of the prestigious Lawrence Livermore National Laboratory John S. Foster Jr. Medal.

Let me start by thanking Keith Payne and his NIPP colleagues for this opportunity to honor someone who has meant so much to so many in the national security community. Johnny Foster's reach was far—even further than many of us appreciated until the outpouring of sentiment that has come with his passing. My colleagues who supported the webinar have done an exceptional job at covering his singular accomplishments and impact on the security of our nation. I was late to enter Johnny's orbit, long after he was a firmly established icon in the nuclear and broader defense communities. So I have focused on those things that make Johnny a true hero both in his time and for the uncertain future we face today.

Johnny, the Mentor

Johnny came by it naturally. No doubt a large number will claim him as a mentor as I do. I met him at my first Defense Science Board (DSB) summer study in 1996. What struck me as I entered that community of well-established individuals (that included a number of outsized egos) was how open and welcoming Johnny was. He seemed to inherently gravitate toward a coaching and mentoring role. Through the next several years, with his questions that would challenge my assumptions and logic, and his stories to illustrate some important lesson to be learned, he helped teach me what a good study should look like. He then went on to support me over the next two decades studying weapons effects and nuclear survivability, and nuclear proliferation monitoring and verification.

While it made me feel special to have drawn Johnny's interest, I was far from the only one. The sentiments that poured forth on his passing which talked about his mentoring could have been excerpted from a "who's who" in national security…such names as ADM Rich Mies (ret); ADM Fox Fallon (ret); Hon Frank Kendall; Mr. Rich Haver; Dr. Eric Evans; Mr. Jim Shields; Hon Anita Jones; Dr. Ted Gold; Hon Rich Wagner; Gen Larry Welch (ret). As Dona Crawford, former Associate Director of LLNL, noted: *"In many ways he was a mentor to thousands just by being who he was, by setting an example."*

Johnny, the Sage

A couple of bookends in his long professional life illustrate his innate wisdom in addition to the better known examples discussed by my colleagues. In the first instance, Rich Wagner tipped me off to something Johnny practiced near the start of his time at LLNL called "pre-mortems" (vs. post-mortems). Asking Johnny about it a few years ago, I observed that he—even at that early stage of his career—intuitively understood the value of critical self-assessment. In his telling, he deflected credit to his boss, then lab director Herb York, who "encouraged" him to do everything he could think of to avoid yet a fourth nuclear test failure by the infant laboratory. Johnny added a new step shortly before the test date. Pulling the design and engineering groups together, he started the conversation with "it's the morning after, the test was a dud…what happened?" It forced a conversation in which the team relooked at every detail together and challenged each other to convince themselves collectively that no detail, regardless of who was responsible, would be the source of failure. While a straight line between cause and effect cannot be drawn, LLNL nuclear tests started to be successful.

Fast forward to the other bookend for a second example when Dona Crawford and I visited Johnny in Santa Barbara last year about this time…we went to update him on the undergraduate fellowship we had established through the Livermore Lab Foundation in his name. I also couldn't let the opportunity to pick his brain once more go to waste, this time on nuclear survivability, a topic which our DSB subcommittee had been asked to take up once more. He came prepared for the conversation with four pages of notes through which he reminded us of the principles that were developed in the early days of the Cold War and the many avenues to investigate to create a survivable force. He then summed it all up simply with the statement that became the study's tag line: *"There is no deterrence without survivability."*

Johnny and His Crystal Ball

The next facet that contributed to Johnny's hero status was his foresight. In the wake shortly after Johnny's passing, Rob Soofer resurfaced one of Johnny's guiding principles: *"Take a big enough step so that things get a little radical. Don't look so far ahead that you really don't know what you're talking about."*

The Foster Panel of 1973, about which Keith Payne so skillfully re-educated us, is possibly the penultimate example. But two lesser known stories make this point as well and illustrate how wide ranging his thinking could be.

The first has to do with Sandia's presence "across the street" from LLNL. While I did not meet Johnny until the mid-1990s, he had already played a pivotal role in my own career. Fact and fiction have become inseparably intermingled over the years as to why Sandia has a lab across the street from Lawrence Livermore, where I am grateful to have spent all 28 years of my national laboratory career. The version I like best is Johnny's own. In the mid-'50s, Johnny and his colleagues were doing a lot of commuting to Albuquerque to work with Sandia

engineers on weaponizing the Livermore concepts. Johnny often stayed with Jim McRae, who was head of Sandia at the time. He mentioned to Jim at breakfast one morning that the 12+ hour trip one-way at that time was difficult and time consuming, even when travel went as planned. He asked if Jim had ever considered locating a few folks from Sandia in Livermore. Johnny had already scouted an old barracks on the south side of East Avenue that could serve as an initial base camp, and he noted that both labs could get a lot more done with day-to-day contact.

Jim was non-committal, but a few months later, Jack Howard showed up with a dozen people and set about establishing SNL/Livermore (SNL/L). Jack, by the way, is a legend in Sandia's history, as Johnny is in Livermore's. Within a couple of years, the initial dozen Sandians grew to over 1000 focused on partnering with LLNL on Livermore Valley weapons design and development.

Jack and Johnny went on to be close friends and colleagues—so much so that both of them confirmed separately to me that even the mumps couldn't stop them from meeting an important deadline. Jack got the mumps, but undeterred, Johnny just showed up at Jack's bedside to get things done in time.

That trusting partnership set the tone for successive decades in the Cold War of seamless teaming—and often energetic arguing—between the north and south sides of East Avenue, something that geography prevented the New Mexico labs from replicating. To help solidify Sandia's presence in Livermore, Johnny also supported SNL/L assuming greater responsibilities for weaponization than Los Alamos did with Sandia Albuquerque—in particular, gas transfer systems, around which the tech base that developed led to a string of new research endeavors and programs for Sandia in Livermore that included combustion research and extreme ultraviolet lithography. Looking back to that breakfast conversation, Johnny could foresee that a strong Sandia partnership and moreover, a strong Sandia in Livermore were important to his own lab's success, and he did his part to make it work.

The second story takes place in the parking lot of the Beckman Center at UC Irvine. When I met Johnny at that DSB study in the mid-1990s, he was famously known to spend part of each afternoon there flying his remotely piloted helicopter. Michael Bayer, who has held numerous positions within and outside government supporting both DoD and DOE, related an encounter with Johnny there: *"I remember Johnny came to the Army Science Board to visit when I was Chair (in the late 1990s). That evening he flew a small, remotely controlled helicopter from the Beckmann parking lot. Watching him fly it, I told him I thought it was a great toy. Johnny looked at me as only he could, and said 'this is not a toy, it's the future'."*

Some of us are such slow learners that it took a quarter century and another country – Ukraine—to drive home that prediction.

Johnny, the "People Person"

The last aspect about Johnny that solidifies his hero status is what a pleasure it was to work with him. Anita Jones, one of Johnny's successors in the DDRE role, said it best: *"Johnny connected with others, mentored with graciousness, and spiced work with fun."* By starting

with *"Just call me Johnny,"* he put a new acquaintance at ease. And he did indeed enjoy having some fun, as well. Drawing an example from my earliest encounters with him, many know that Johnny always greeted me, not as Mim, but as Ferragamo. The origin of the story was a DSB task force in which he complimented me on whatever it was that I happened to be wearing that day. In turn, I had noticed that Johnny himself had excellent sartorial sense and always stood out in a crowd of scientists and engineers who are not usually known for their up-to-date fashions. So it was easy to return the compliment. He beamed and joked that he bet I surely patronized the Ferragamo brand…and as luck would have it that day, I took off my shoe to show him. That also made the decision for what shoes I should pack for a trip when I knew I would probably see him.

The many stories about individual encounters and relationships with Johnny could easily fill a very thick book. But stepping back to try to sum it all up, the sentiment from Gen. Larry Welch, another hero in our national security world, says it best. Such is his admiration for Johnny that he has maintained that being awarded the Foster Medal meant more to him than the countless other accolades that he received during his long career, both in the military and after. On Johnny's passing, Larry wrote:

> *"I don't know why we preface such announcements 'with great sadness.' Johnny's passing is a time to honor his life and the effect on the nation and all our personal lives. A great mind full of knowledge and understanding, still always open to new thoughts. A great heart that made all he touched better for the experience. Unparalleled integrity, dedication, and contribution. A legacy that lives on and on."*

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Tom Ramos
***Tom Ramos is a physicist at Lawrence Livermore National Laboratory and author of the excellent biography of Dr. Foster,* Call Me Johnny*, and the great 2022 book,* From Berkeley to Berlin: How the Rad Lab Helped Avert Nuclear War.**

In a dimly lit room the size of a small auditorium, a young man stood looking at a sea of young faces surrounding him. He was speaking to them with passion, and they listened intently, for after all, what he had to say could save their lives. The speaker spoke with an authority that belied his youth, and his words conveyed a rich Canadian accent. Johnny Foster, all of twenty-two years old, was a technical advisor to the 15th Army Air Force, stationed in Foggia, Italy. It was the height of America's involvement in World War II and its armadas of bombers were daily pummeling factories, railroads, anything of military value, in Hitler's Third Reich. The air raids came with a price though; casualties in the Army-Air Forces were extraordinarily high. More American airmen were dying over the skies of Europe than the Marine Corps was losing in the entire Pacific theater. Johnny was passionately determined to do everything in his power to have the young men in front of him survive the wrath of German anti-aircraft weapons.

The airmen surrounding him were crewmen of large Consolidated B24 bombers, serving on missions to strike targets in eastern Germany, as well as the Nazi's allies in Hungary and Romania. Johnny had been studying German tactics. He knew how the Germans used radar to become aware when the Americans were coming, and so he knew how German defenses were then able to intercept them and shoot them down with deadly efficiency. He was telling the aircrews how to be smart and stay alive.

Johnny had a unique trait to his character; he could place himself in the place of those airmen and that allowed him to better understand how he could help them. That talent seemed to come naturally to him. He was not only a scholar, graduating second in physics out of McGill University, he was also an athlete and a leader. Captain of the university's gymnastics team, he had been chosen to represent Canada in that sport before a shortfall in funding with the Canadian Olympic Committee canceled his dream. In 1948 he set a North American ski jumping record at an athletic competition held at Dartmouth University. At his father's behest, Johnny accepted a position to join Ernest Lawrence's Rad Lab in Berkeley, where he demonstrated his skills as being one of America's best experimental physicists.

A few years later Johnny held a PhD as he led a team of physicists to design atomic weapons for the nation. He had taken over at a time when the team had just suffered through two failed attempts to design a weapon. With the same fervor he had shown in Italy, Johnny took stock of the situation and organized his team to figure out what they had learned from their earlier failures. He would never be content to just duplicate work that had been done earlier for the sake of showing some form of success. Johnny had a very real concern and fear that the country faced a threat to its existence from a growing tide of Communism, and that the nation had to be strong if it hoped to survive. He was determined to get his team to design something new; something that would make a difference against a Soviet Union that was flexing its newly won nuclear muscle.

A year later, Johnny brought his entire team out to the Pacific atoll of Eniwetok, where the United States was conducting a series of nuclear tests. In the previous twelve months he had guided his team to design its first successful device, and now they were on the verge of testing devices that dramatically changed the way physicists had thought that they knew about such devices. Much as he had done in Italy during the World War, Johnny led a group of men to excel beyond anything they had done before. His team was on the verge of changing the landscape of the Cold War.

In another ten years, Johnny was serving the country at an even greater level. He was in the Pentagon, nominated by President Lyndon Johnson, and confirmed by the United States Senate to be the Director of Defense Research and Engineering. His was the third highest rank within the Department of Defense; he was responsible for deciding what weapon systems the Pentagon needed to invest in, to develop, and ultimately purchase. Secretary of Defense McNamara, and the President, expected him to balance the pressures being forced on him from the military services, the manufacturers of the military-industrial complex, and the politicians on Capitol Hill, and to make the decisions that gave our servicemen the best equipment possible with which to fight the country's wars. The country was in the throes of yet another war, in Viet Nam, and Johnny's inclination was to devote himself to the soldiers,

sailors, and airmen who were facing a determined and frightfully effective foe.

Throughout the decades of service that Johnny Foster gave to his country, he showed a consistent, devoted passion towards those who were actually in harm's way. This is an unusual trait, and it is this strength in his character that made him such a powerful and effective presence. He had an innovative mind, and that combined with his natural leadership skills, created a legacy of revolutionary ideas that continue to have an effect to the present day. The idea of using drones to fly over far-reaching areas to strike foes from the sky had its start in Johnny's office at the Pentagon.

Once out of the Pentagon, he continued to serve the public, now through a civilian corporation, TRW. As the country was about to experience fuel shortages triggered by the OPEC boycott, he devoted himself to addressing the energy needs of the country. He seemed to get involved with events that were important in their times, and he seemed to make an impact on them. The country owes a debt to him; he made it a better place.

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Ronald Lehman
Ronald Lehman is Counselor to the Director of Lawrence Livermore National Laboratory and former Director of the U.S. Arms Control and Disarmament Agency.*

Johnny Foster was more than a mentor; he was a wonderful friend with a million stories. How Johnny became the male model for the first neoprene wet suit was just one of them. How E. O. Lawrence himself told Johnny to stop riding his motorcycle was another. And I enjoy playing over in my mind Johnny's version of the Polaris story and what really happened at Nobska when the Chief of Naval Operations, Admiral Arleigh Burke, asked Johnny if he agreed with Edward Teller's assertion that thermonuclear weapons could be greatly reduced in size. Johnny's dramatic and clever re-enactment of this historic turning point that he experienced first-hand has the additional virtue of being funny. In Johnny's words: "Having no idea what Edward was talking about, I replied that I had no reason to disagree." Of course, as Tom Ramos's history makes clear,[10] they both knew what they were

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[10] See T.F. Ramos, *Call Me Johnny: A biography of John S. Foster Jr*. He designed the modern atomic bomb and directed Defense research & acquisition for two presidents. LLNL-BOOK-783447, July 26, 2019, p. 27, available at https://www.osti.gov/servlets/purl/1576166.

talking about. Still, when recounting how Johnny told Harold Brown back at Livermore what Edward had committed them to do, Johnny acted out Harold's silent response by making a face that looked like Edvard Munch's painting "The Scream."

It would be easy to drift off into such nostalgia, but today I want to focus on Johnny as an icon of national security. Actually, Johnny was far more important than an icon. He was an iconoclast—constantly agitating for innovation. As the Director of Defense Research and Engineering—the number three job at the Pentagon—Johnny was a prime mover in what Soviet military thinkers would label the "Revolution in Military Affairs." No one was surprised, because Johnny was one of the founders of the world's most iconoclastic laboratory.

In that spirit, I will try to follow Johnny's admonition to challenge complacency by looking back at the disruptive technologies for which Johnny was a prime mover at DoD. My hypothesis is that the steady advance in those technologies nurtured by Johnny in the Pentagon more than fifty years ago now requires us to rethink their impact today on military capabilities including the offense-defense balance and the role of air and missile defenses.

That story still begins here at the Lab. Remember, every nuclear weapon currently in the U.S. stockpile has a primary based on concepts created by Johnny and his "B Division" colleagues. For that matter, they all have secondaries based on concepts developed by Johnny's predecessor Harold Brown and Harold's "A Division" colleagues. And the radiation cases are based upon a concept from Herb York, who was the first Livermore Lab Director just before Edward Teller. And while Johnny advised Defense Secretary Mel Laird on the negotiation of the SALT I Offense Arms Limitation Agreement and the ABM Treaty, Johnny's successor as Lab Director, fellow weapons designer Mike May, was actually on the U.S. Delegation.

Roger Batzel followed Mike. Under Roger, as our current generation of offensive warheads were introduced, the Lab also played a leading role in the Strategic Defense Initiative (SDI). And our last Lab Director from that founding generation was John Nuckolls who, shortly after the laser was invented, became the godfather of Inertial Confinement Fusion. That science has now led for the first time to fusion ignition in a laboratory. As you can see, Johnny was among the foundational nuclear pioneers who set the standard for all who follow. With Johnny often the catalyst or provocateur, they fed off each other, and they worked both sides of the offense/defense equation. They were also godfathers of supercomputers, advanced simulations, high powered lasers, and many other technologies that impact even more today both offense and defense.

Well into his 102nd year, Johnny continued to advise follow-on generations that if they didn't take the risks necessary to overcome "Grand Challenges," they wouldn't be as great as the nation needs them to be. He inspired the official chain of command but, more importantly, he energized generations of innovators buried in often sticky systems. In that spirit, now is a good time to think again about the offense/defense relationship in nuclear deterrence. We are beginning to debate the "Golden Dome," which has many similarities to the Strategic Defense Initiative or "Star Wars" debate when I was in government. And for that

debate, we learned much from the first great debate over Anti-Ballistic Missile (ABM) systems that took place when Johnny was in the Pentagon from 1965 through 1973.

At that time, Johnny was pushing American military systems to increase their performance, both offensive and defensive. He established the "Foster Criteria"—the requirement that endoatmospheric ABM interceptors achieve 100 Gs of acceleration. But Johnny was also driving other technologies. Some were immediately applicable to the offense-defense nuclear balance at that time. Consider the electronically steered phased array radars and the W71 warhead that emphasized x-rays to expand the exoatmospheric missile defense kill zone while countering Penaids and reducing radar "blackout." And on the offensive side of the equation, Johnny pushed MIRVs and research on maneuvering reentry vehicles to counter Soviet defenses. Johnny's contributions to helping American bombers penetrate Nazi radars in World War II gave him real insight into the offense-defense competition.

Johnny recognized that technological change and the measure/countermeasure dynamic would constantly change the balance over time. If you weren't getting better in many different ways, you were almost certainly falling behind in some important thing that matters. Thus, many other technologies that Johnny was advancing would eventually become as vital to the offense-defense equation as the missiles and interceptors. For example, the American response to Sputnik was more than the Polaris; we went into space. Indeed, on Johnny's watch, the Defense Department went from just transiting space to staying up there with the first KH spy satellites, the DSP early warning satellites, satellites for communications and navigation, and other special space-based sensors.

And Johnny was pushing other transformative developments for military modernization—high performance computations for simulations and modeling, precision guided munitions, the network of networks, total situational awareness, integrated deterrence. Johnny oversaw the first massive introduction of integrated circuits into military systems—a process that had begun with the Minuteman II. And remember that the ARPANET—the precursor of the Internet—began in 1969. This acceleration of digital and information technology 50 years ago was the catalyst for much of the "superconvergence" of technology we see today.

Most of the deterrence debate when Johnny was in government focused narrowly on the top of the escalatory ladder—a "bolt out of the blue" World War III with cataclysmic nuclear exchanges and massive retaliation. Given that the number of deployed warheads would expand greatly as both the United States and the Soviet Union placed multiple warheads on ballistic missiles, one had to ask how the U.S. Sprint and Spartan ABM interceptors and the Moscow ABM system would deal with thousands of independently targeted reentry vehicles.

Prominent ABM opponents demanded that any defenses be leakproof against the worst case, and many enthusiastic ABM advocates accepted that as the goal. Unfortunately, that debate over the achievability of perfect defenses crowded out a broader discussion of more optimal balances of offense and defense. Much of this debate was abstract, ideological, and partisan, but the high comparative economic cost of leakproof defenses against massive missile barrages discouraged exploitation of less than perfect defenses for other scenarios.

Let me give one personal example of how easy it is for the process to "lose the bubble." On an Air Force Gulfstream flight from a Moscow Summit to a NATO capital, Paul Nitze, whose friendship I valued greatly, asked me how SDI would deal with the problem that building additional offensive nuclear warheads might be cheaper than the defenses against them. I had been up all night and was crashing preparing talking points, so I said somewhat abruptly, "if it isn't cost effective, we won't do it." Later, Paul came back to me with his yellow legal tablet on which he had written that the policy should be that we would not deploy SDI unless it was "cost effective at the margin" in preventing the missile defense system from being overwhelmed. Paul was a bit surprised that I reacted negatively. I said that "cost effective at the margin" reflected too much the "leakproof" standard, but that in many scenarios in which missile defenses could ultimately be overwhelmed, the defenses would still be valuable. I countered with a word formulation that said: "cost effective for its missions." Paul seemed to agree, but later in testimony Paul spoke of "cost effective at the margin," and that was the theme that caught on. This again turned the debate back to the top of the escalatory ladder and the cost of "unobtainium" rather than exploration of more optimal balances of synergistic capabilities.

Over the years, however, technological and geostrategic changes have shifted the debate toward the broader utility and greater affordability of less than perfect missile defenses with much of that utility being demonstrated at lower levels of conflict. Again, Johnny Foster played a major role. When Johnny was at the Lab, he and his colleagues had successfully reduced the size of nuclear weapons down from tons to pounds. This, of course, shaped the ABM versus MIRV debate, but it also had great implications for theater offensive weapons and for defenses against such weapons. Johnny understood that a strong deterrent at the lower end of the escalatory ladder where wars begin was as important as at the top.

Although air and missile defenses have been overshadowed by offensive systems at the top of the nuclear escalatory ladder, such defenses have become the "go to" systems with allies in violent regions around the world. Defenses offer additional options to manage escalation. Defenses have become critical to protecting vital leadership, forces, communications, infrastructure, and urban centers. Defenses have become a key tool for shaping the battle space and altering the contexts in which conflicts occur. And defenses have become almost as important as our extended deterrent for dissuading adversaries from proliferating and for offering insecure allies alternatives to their own proliferation or escalation.

What is currently true at the lower levels of conflict is increasingly true at the higher levels and also at much lower levels. Just as it is a mistake to assume defenses must be leakproof to be valuable, it is a mistake to think that deterrence is only about the ability to punish. Deterrence is more resilient when it includes the ability to deny success, to raise the risk of escalation failure, to confirm early warning, to take away the cheap and easy options, to avoid being presented with a fait accompli, to unite allies, to manage more than one threat at the same time, and to shape thinking in other ways to prevent conflict. In deterrence, less than perfect defenses may be significantly undervalued assets.

Some go so far as to argue that defenses should always be given moral or policy primacy over offenses, but historically, military doctrine has always looked to the offense first, and for good reason. Some armies have gone to war with only swords. It is true that I don't know of any armies that went to war with only shields. If they did, however, I am certain that they would be beating their opponents over the head with their shields or throwing their shields at the enemy like a discus. Even in the Golden Age of Fortifications culminating in the "Star Fortress" masterpieces, the brilliant engineer Vauban himself emphasized the importance of finding the right mix of offense and defense. Fortresses were an economy of force measure to support the offense. Of course, the balance would change each time new technology such as gunpowder presented either better options to breach fortified defensive positions or better options to devastate insufficiently protected troops engaged in the offense.

Getting the mix right is even more complex today because of the maturation of technologies from Johnny's generation. Truly integrated deterrence requires a more optimal use of defenses as both offense and defenses engage today's multiple, technologically empowered threats operating in all the domains such as space, cyber, EW, land, sea, air, and information. These threats blur the distinctions between strategic and nonstrategic, between regional and global, between conventional and nuclear, and between offense and defense. This is not new, but it is far more intense.

But let me give a contemporary example of how categories overlap and boundaries blur. Right now, great emphasis is being placed on defenses against theater hypersonic systems that threaten high value assets in regional conflicts. Because some of these hypersonic systems are hybrids of high speed ballistic missiles and highly maneuverable cruise missiles, defenses against them are especially demanding. But this raises the question of whether the achievement of effective defenses against these hypersonic hybrids at the lower levels of conflict will result in defensive capabilities applicable further up the escalatory ladder that could threaten the traditional offensive tools of strategic deterrence; namely ballistic missiles and cruise missiles.

Likewise, air and missile defenses are becoming more important at even lower levels on the escalatory ladder. When Secretary Carlucci and I toured the new Soviet guided missile cruiser Slava in 1988, we were impressed with its massive armament of cruise missiles. It was renamed the Moskva to be the flagship of the Russian Black Sea Fleet. The Ukrainians sunk it with upgraded R-360 "Neptune" anti-ship cruise missiles while a Ukrainian operated Turkish Bayraktar TB2 drone in the area reportedly played some role. Ukraine later used very low cost drones to destroy a large number of Russian cruise missile armed strategic heavy bombers. The search is on for low cost defenses against low cost drones down to small unit actions and even hybrid and covert operations, some of which can have a strategic impact.

Whether we like it or not, defenses are going to be playing a greater role in deterrence at all levels of conflict. And whether we like it or not, the measure/counter-measure dynamic will alter the balance between offense and defense creating uncertainties that may favor or undermine deterrence. And whether we like it or not, the success of low cost drones against tanks and even strategic nuclear bombers reminds us that cost effectiveness for the mission

matters. And whether we like it or not, we can't afford to do everything, so trades must be made. The good news is that—thanks in so many ways to Johnny—the United States has been the world leader in the enabling technologies. The bad news is that if we don't rethink our assumptions and understand better the current dynamics of the offense-defense balance we could lose that edge—especially if we fail to follow Johnny's advice to be bold.

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C. Bryan Gabbard
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Preface

My personal connections and collaborations with Johnny came shortly after my graduate school in the early 1970s. I had moved from Cambridge, Massachusetts, to Santa Monica, California, to work with several individuals who were then at the Rand Corporation (including Albert and Dick Latter, Art Biehl, Bob LeLevier, Ernie Martinelli, and others from Lawrence Livermore National Laboratory) with whom Johnny had a close relationship. Johnny was becoming increasingly involved with national intelligence issues but had less time to support them than he hoped. He asked Albert and Dick to recommend "new blood" to back up and cross check numerous ongoing technical and policy deliberations, particularly those ongoing within the President's Foreign Intelligence Advisory Board (PFIAB) in which Johnny was a member. Albert and Dick pointed to me, which began a lifelong friendship and collaboration with Johnny that ran from the 1970s onward.

Introduction

Thanks are due, up front, to Keith Payne, Amy Joseph, and the whole National Institute for Public Policy (NIPP) Team for initiating and shaping this important tribute to Johnny. Johnny was truly an important part of, and indeed a leader of, the "Greatest Generation," to steal a phrase from Tom Brokaw. In this short paper, I plan to make a few remarks, both anecdotal and substantive, to supplement the excellent comments by Miriam John, Ron Lehman, and Tom Ramos, by providing a quick peek behind the Green Door into some of Johnny's less frequently discussed activities that were key in supporting the National Foreign Intelligence Program.

Over his career, Johnny made numerous intelligence community (IC) contributions of consequence. Some were at the enterprise level, others at the organizational level, and many at the technical, detailed level. As expected, many of these contributions dealt with better understanding of the then surging changes in Soviet Strategic Systems and Soviet nuclear

weapons. A few examples of each of these activities are briefly highlighted in the sections below.

Enterprise Level Contribution Examples

In the early 1970s Johnny was invited to join the PFIAB. PIFIAB had an on-again, off-again history through the presidencies of Eisenhower, Kennedy, Ford, Carter, and Reagan. During this period there was a growing concern regarding Soviet missiles, their purpose, and their accuracy. Exacerbating these issues were the growing concerns that the "official U.S. position," as reflected by the Central Intelligence Agency's National Intelligence Estimates (NIEs), were biased and being heavily influenced by the equities of congressional stakeholders rather than by substantive technical analyses. The PFIAB was asked to review this matter. In quick reviews, the Board disagreed with most findings of the NIEs on this subject. Johnny was instrumental in highlighting discrepancies associated with the official reporting and weak analytic evidence associated with, for example, SS-9 guidance accuracy and Soviet MIRV capabilities.

During the next several years, Johnny, with others, led a push toward having an independent review of these matters by leading technical experts not associated with the Intelligence Community (IC). The idea was rejected by several Directors of Central Intelligence (DCIs) until George H.W. Bush agreed that such an exercise would be interesting and could be helpful. Two teams were then formed to concoct a net assessment of several IC issues, each using the same identical data sets. An A-TEAM was composed of CIA professionals, and a B-TEAM was formed by outside technical experts and led by Dick Pipes of Harvard. The comparative analysis was done and briefed to the PIFIAB. The B-Team's results were wholly endorsed by the Board in contrast to CIA analysis results.

Institutionalizing the lessons learned from this process took several more years, but the IC products, including the NIE's, benefitted from this work, and their impact is apparent today. Although Johnny was not part of either the A-Team or the B-Team, his diligence as a forcing function for the process reflects the unique contributions that he made to all fields that he touched.

Organizational-Level Impacts and Soviet Nuclear Matters

In addition to process reforms at the enterprise-level, Johnny made specific technical contributions of consequence supporting the missions of several IC agencies and components, particularly the Weapons Intelligence, Non-Proliferation, and Arms Control Center (WINPAC), the Special Weapon Effects Group (SWEG), and the National Reconnaissance Office (NRO). Not surprisingly, many of these were related to emerging nuclear matters within the Soviet Union.

The organization within the CIA charged with evaluating and characterizing the status of Soviet nuclear weapons was WINPAC. As a member of the WINPAC Advisory Board, Johnny's pointed questions and depth of nuclear design understanding led to improved collection

tasking and better asset utilization and indeed, better analysis and net technical assessments.

These interchanges led to an improved U.S. understanding of Soviet nuclear testing protocols and instrumentation signatures in field experiments and stimulated deeper insights into of the range of fielded weapons as well as possible research devices evaluating nuclear weapon designs. This included advanced, Nth generation Soviet weapons, the so-called "neutron bombs," sub-nano second gamma rise times and testing puzzles from Novaya Zemlya campaigns.

Johnny is well recognized for his capabilities in nuclear weapon designs and testing, but Johnny also played an important role in advancing U.S. understanding of nuclear weapon *effects* through the analysis of Soviet nuclear tests, particularly high-altitude nuclear tests. Johnny's involvement in assessing the advancement of Soviet missile capabilities was nearly continuous in substantive ways throughout the 70's and 80's, as has been mentioned through PIFIAB and other IC venues. A natural correlate of these Soviet missile developments at the time were Soviet ABM activities and attendant capabilities growth.

Johnny's involvement in culturing a better understanding of Soviet ABM activities sparked a series of initiatives that, somewhat unexpectedly, led to marked improvements in U.S. understanding of nuclear weapon effects, particularly the effect from high altitude nuclear detonations, as well as the Soviet ABM Program itself. Again, leveraging his links to both the Defense and Intelligence enterprises, Johnny pushed for an all-source IC/DDR&E/DTRA-sponsored look by U.S. technical experts at the Soviet High-Altitude Nuclear Test series of 1961 and 1962. The resulting SWEG was constituted in the 1960s-1970s and several technical issues spawned by SWEG continue as research areas today.

"Shouldn't you consider the question of creating ABM equipment?" This question, posed by seven Marshals of the Soviet Union to the CPSU Central Committee in August 1953, set into motion a research and development program that led the Soviets to abrogate the limited test ban treaty with high altitude nuclear explosions (HANE) in October 1961. It even motivated commencement of the construction and deployment of a Moscow ABM system well before the results of the HANE tests were completed and fully analyzed.

During the negotiations in Geneva in 1961 on a comprehensive nuclear weapon test ban, the Soviet Union abruptly abrogated the then existent atmospheric test ban and exploded two low yield nuclear explosions, ~1-2 KT, on 21 and 27 October 1961 at altitudes of 150 km and 300 km, respectively. These were followed the next year by what the United States believed to be megaton range bursts on 22, 28 October and 1 November 1962 at altitudes of 300 km, 150 km and 50 km, respectively.

These tests involved three IRBM missiles, designated by the United States as SS-4s, launched from Kapustin Yar toward the impact area of the ABM test range created on the shores of Lake Balkash near the village of Sary Shagan in south central Asia. The lead SS-4 carried the live nuclear warhead followed by an instrumented SS-4 spaced at one or two minutes behind the first SS-4, the last SS-4 followed about ten minutes behind the first. In all five events of 1961-62, a vertical probe at an altitude of 500 km above the burst point conducted geophysical measurements.

Multiple diagnostic measurements were made including trajectories, seismic signals, very-low frequency (VLF) electromagnetic pulse (EMP) field measurements, trapped electron belt populations, and high frequency (HF) link performance and acoustics signals. The data collected by the IC provided a basis for tasking the SWEG to assess the altitudes and yields of the Soviet events of 1962. The five events of 1961-62 are referred to as "Operation Khariton" in the Russian literature in honor of Academician Yu B. Khariton, the father of the Soviet atomic bomb. Through trajectory information and the EMP timing, SWEG deduced fairly accurately the altitudes of all five events. The three events of 1962 each created artificial Van Allen belts of trapped fission decay electrons or beta rays within the earth's magnetosphere.

The SWEG estimates of the yield of the K5 shot at 60 km came from the acoustic gravity wave (AGW) amplitude measurements, which placed the yield in the megaton range. It was conjectured at the time that the purpose of the shots was to test their ABM systems in an operational environment, and that the yield of K3 and K4 was the same as that of K5, that is, in the megaton range. SWEG was correct about the purpose of the events, testing their ABM system which was already under construction around Moscow. However, the SWEG was wrong about the inferred yields of the tests of 1962.

The Soviets subsequently stated that the total yield of each of their high-altitude shots was less than one megaton. The instrumentation capsule was deployed from the lead IRBM, the missile carrying the nuclear warhead. This capsule was deployed at a range of a few hundred meters from the burst point. At this distance, a modern warhead in the megaton yield range would deposit x-ray fluences in the tens of thousands of calories per square centimeter on the surface of the capsule. This would crush the structure. In fact, the actual capsule was in free fall and was recovered on the desert floor after the detonation and taken relatively intact to Soviet laboratories for analysis. There was no mention at all of x-rays in any of the resulting analyses of the instrumentation in the capsule. The recovery of the uncrushed capsule was quite consistent with the 300 KT yield disclosed by the Russians some years later and, importantly, consistent with a *massive fragmentation warhead, with a low, cold x-ray emission*.

Johnny's nurturing of these analyses led to a marked improvement in U.S. understanding of high-altitude nuclear weapon effects that was complementary to the knowledge base developed from events such as the U.S. Hardtack and Fishbowl series of high-altitude tests in the Pacific.

The three Soviet HANE events of 1962 created artificial radiation belts of fission electrons injected into the earth's magnetic field. This is important because these electrons can seriously degrade satellite lifetimes due to accumulated electron doses in the spacecraft electronics on passage through the belts. The U.S. predictor techniques are largely empirical and are based on the ARGUS shots of 1958, and the STARFISH shot of Operation Fishbowl (1.4 MT at 400 km burst altitude). The electron injection efficiency predictions changed dramatically given the Soviet detonations were near 300 KT instead of the megaton range. The Soviet shots also took place at northern magnetic field latitudes whereas STARFISH took place in the Pacific under the magnetic equator. The electron injection efficiency was shown

to increase significantly in terms of electrons injected per KT in northern latitudes, which is central to current satellite vulnerability calculations in wartime.

Subsequently, in the 1980s, Russian scientists reported at international conferences that extensive damage occurred to the terrestrial power/communications grid in the vicinity of the test site at Sary Shagan during the 1962 tests. The responsible mechanism is the magnetic hydrodynamic (MHD) wave generated by the downward moving debris from the high-altitude event. Ongoing research continues to understand how mid-range yield nuclear detonations (hundreds of kilotons rather than megatons) can be highly effective at causing MHD damage to power grids and long-line communications.

With the current world-wide proliferation of nuclear warheads and missile technology, these technical issues are of major importance to, respectively, threats to satellites from low yield high-altitude events at northern magnetic latitudes, command and control continuity of terrestrial power/communication grids and the detection and interpretation of possible future high-altitude events by third world countries, based on acoustic gravity wave (AGW) phenomena.

These analyses led to a better understanding of offense-defense trade spaces in adversary weapon designs and engagement protocols, particularly fragmentation warhead designs. For example, a 300 KT kinetic energy warhead weighing ~2,500 lbs. with 500 lbs. of instrumentation would involve nearly 2,000 lbs. of fragmentation metal, i.e., a yield to weight ratio of 0.15 KT/lb.

Johnny's initiatives like SWEG helped to shape our understanding of the nuclear weapon *effects* field, as he has done so often in the nuclear *design* field**.**

Broader IC Impacts—A National Reconnaissance Office (NRO) Example

Intermittently, Johnny was a key advisor to the NRO, during a period when new technologies were being rapidly integrated into space and ground segments. This period also saw burgeoning digital technologies and network advances within the civilian sector, particularly among hobbyists interested in spaceflight. The union of these components led to selected security concerns which were raised by Johnny and others regarding the ease with which low altitude reconnaissance could be viewed with the naked eye and reveal sensitive orbital data. Since the national space reconnaissance program was then a covert operation, Johnny raised a growing concern that some of our national assets were becoming too visible, based upon sun glints during certain operational periods. This was exacerbated with technological developments that enabled global hobbyist networks (including many foreign participants) to track satellites and share ephemeris data.

Johnny was asked by the NRO Director to verify the ease with which data could be collected and used. This led to regular "Walks in the Park" by Johnny and his colleagues. These activities began to garner a growing following of curious on-lookers trying to understand what observations were being made. At this point, Johnny began giving full seminars on the U.S. Space Shuttle program, its importance, contractors, and operational capabilities. These seminars created a following and provided an effective smokescreen

obscuring the fact that the satellites of interest here had nothing to do with the space shuttle but were, in fact, highly classified low altitude imaging satellites.

Johnny's abilities to protect important, sensitive national issues with publicly acceptable overlays, was without peer. He was always a driving force in pushing the need for good science and engineering in addressing critical defense-intelligence challenges. Interestingly. even many of Johnny's "hobbies" (that Tom Ramos has mentioned) became DARPA and other programs within the military services. A good example here was his enjoyment of model airplanes and helicopters and how this interest helped shape several drone programs.

Closing Remarks

It is interesting to note in closing that Johnny always maintained a level of discomfort with broad national security matters and how technologies might help move U.S. policies forward responsibly to address challenges posed by shifts in geopolitical threats. In decades of discussions with Johnny, from the 1970s to his 100th birthday, Johnny would regularly say, *"We still do not have national security right."* He continued to be concerned that our capabilities to "blow-up" things (people, facilities, cities, etc.) obscured our lack of ability to address real challenges to U.S. principles. He expressed concerns about how falsely we can change "isms….to ists" and believe that we have changed hearts, minds, and ideologies. It is easy to replace terrorism with terrorists, or communism with communists, because we are good at destroying the "ists." We are less good at changing the "isms," and the "isms" may be the real challenges to U.S. national security.

Johnny was the Eru Ilúvatar in a *Lord of the Rings* saga involving the nuclear labs and the national nuclear enterprise, from the Trinity to NIF. He will be missed.

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Thomas Scheber
Thomas Scheber is former Vice President of the National Institute for Public Policy, Director of Strike Policy, OSD, and Director of the Military Applications Group at the Los Alamos National Laboratory.

When I joined Los Alamos National Laboratory in the late 1980s, I was unfamiliar with the name Johnny Foster. That lack of knowledge was not to last for long.

As the late industrial phase of the nuclear weapons complex gave way to shutdown, reconfiguration, and organizational confusion, Congress directed the formation of a panel of experts to recommend next steps for the nuclear weapons stockpile and nuclear complex. The Defense Authorization Act of 1999 commissioned a panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile. That panel was led by Dr. Johnny Foster.

My first exposure to the work of Johnny Foster was from reading the progress reports from the Foster Panel. The interim reports from the panel included recommendations that

seemed to bring order out of the confusion at the time regarding the future direction of the stockpile and nuclear infrastructure.

When I changed job locations and began working in OSD Policy, I came across the name Johnny Foster over and over again. I read a terrific summary of steps to maintain the security of the U.S. fleet of ballistic missile submarines. The program to study technical issues related to submarine detection was initiated by Johnny Foster. At that time, Dr. Foster was the Director of Defense Research and Engineering. A short time later, I came across a report on lessons learned after resuming nuclear testing following a short test moratorium. The name at the bottom of the report was again familiar, Johnny Foster. He designed products as diverse as a new kind of wet suit for diving and miniaturized nuclear weapons. Over and over, one name seemed to be associated with innovative technical issues regarding national security. I had still never met Dr. Foster but, in my mind, he had become an intellectual giant regarding science and technology for defense-related matters.

I finally got to meet Johnny about 2008 when I was working with Keith Payne at National Institute for Public Policy. Johnny would stop by to see Keith when he was in the D.C. area and would sometimes discuss nuclear policy issues or ideas for an upcoming talk that Johnny was working on. Keith knew of my background at Los Alamos and suggested to Johnny that I take a look at a couple of issues in a draft talk that Johnny was preparing. The first time that Johnny stopped by my office and asked me to take a look at his draft remarks for an upcoming talk, my first thought was, "who am I to review and comment on a draft by Johnny Foster."

I soon learned what Dr. Foster was like as a real person—not the legend in my mind. He was humble, personable, and a true gentleman. Since Johnny was twenty some years my senior, I always treated him with deference and called him "Dr. Foster" when greeting him. Not one to stand on formality, he would then say something like, "Please, just call me Johnny."

On complex issues, he sought the views of a variety of people and often found value in the ideas of others. During those "review" sessions we developed a professional friendship that involved many memorable discussions. Our conversations would devolve from specific topics to include a wide range of issues. He never dwelt on his past successes. The few times that I mentioned his notable accomplishments, such as initiating the SSBN Security Program, he would think for a minute and usually say something modest, such as, "Oh yes, I remember a few things about that."

Those are my fondest memories of Johnny Foster—sitting in my office and talking about the state of affairs at the national laboratories and the world and what could be done to improve each. During my life, I have encountered only a few people who possess both the technical brilliance and the engaging personality that was exemplified by Dr. Johnny Foster!