

Scientists, security, and lessons from the cold war

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In the years following World War II, the Soviet Union tested its first atomic bomb, President Truman decided the US would develop a hydrogen bomb, Communist North Korea invaded South Korea, Congress quadrupled US defense spending, and the US government turned to a small cadre of physicists for advice.

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On 31 December 1952, with barely three weeks left in his term, President Harry S Truman signed a National Security Council document directing the construction of prototype radar stations. The result would be a chain of more than 60 stations stretching 3000 miles—from Alaska across Canada to Iceland—along the 70th parallel about 200 miles north of the Arctic Circle. The chain, known as the Distant Early Warning Line (see figure 1), was an important part of an elaborate system of radar equipment to warn against an attack by the Soviet Union. The DEW Line was a bold idea that challenged American fortitude and technology. Twenty-five men died building the chain, which required extensive construction in some of Earth's most inaccessible and inhospitable terrain and climate; small groups of men had to live far from civilization—and through arctic winters—to operate the radar stations (see figure 2). One estimate puts the

lifetime cost of the DEW Line at \$7 billion (in 2004 dollars).

The idea of the DEW Line came from a Summer Study, a new style of federal advisory group first tried in 1948. In the early years of the cold war, a few dozen of America's leading scientists—mainly physicists—would come together for two or three months (often in the summer) and focus their talents on a major defense problem. The study groups, able to view their topic broadly and intensively, produced bold new concepts and technical innovations that changed policies and led to large projects. Some of these projects extensively reshaped America's defenses, sometimes against the wishes of the military¹ (see also the article by Albert Wheelon in PHYSICS TODAY, February 1997, page 24).

Summer Studies flourished in the early years of the cold war, when their leaders had the attention of the president and other important decision makers. The influence of the

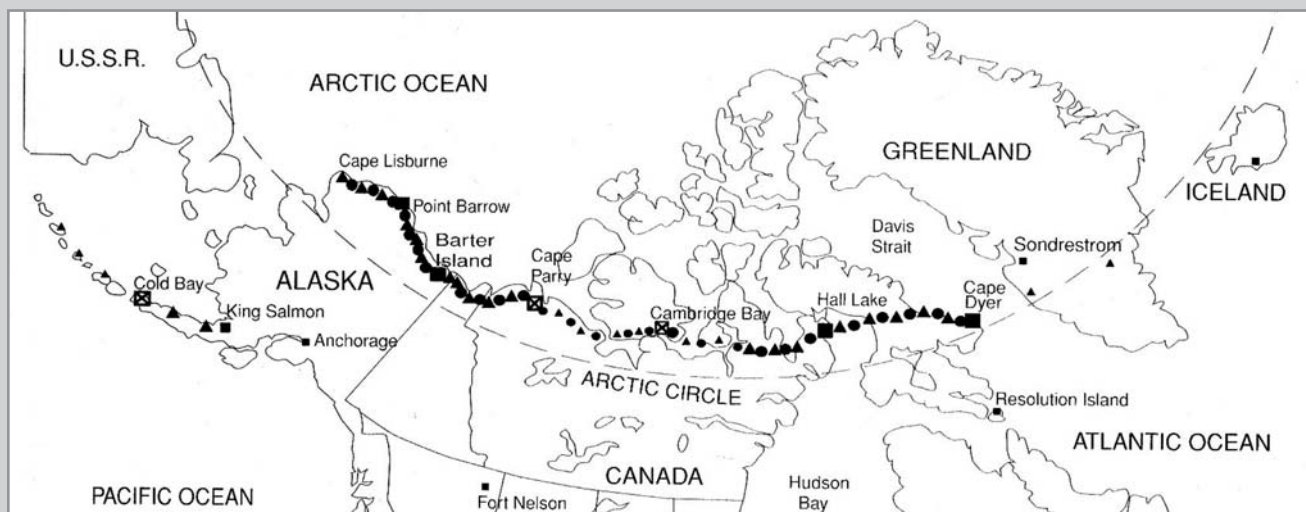


Figure 1. This 1962 map illustrates the continental scope of the Distant Early Warning Line. When declared operational in July 1957, the DEW Line consisted of 58 stations along a 3000-mile arc across northern Alaska and Canada about 200 miles north of the Arctic Circle. By 1962 it had been extended across the Greenland icecap to Iceland.

civilian scientists diminished in the 1960s as politicians became less accepting of technical constraints on policy and as defense agency and military services developed in-house expertise and learned to apply systems analysis to conceive and develop large projects on their own. But the continued need for objective, technical advice led the Defense Department in 1960 to begin funding JASON, a select group of American scientists that each summer works with unusual independence on technical aspects of national security problems. Today, JASON continues to make important contributions, even if not of the scope and impact of the 1950s Summer Studies.²

Do American scientists need to revive the comprehensive Summer Study of the 1950s? Could a modernized version enlist America's best minds to search for comprehensive, technically sound concepts and strategies for ensuring US security?

Although the problems the nation faces today are quite different from those of the 1950s, the problems that scientists face when advising on acutely political issues remain much the same. A look back at some 20th-century Summer Studies can show what it would take to have a useful 21st-century program. Some history can also help provide realistic expectations of outcomes.

Participants

The Summer Study was an arrangement that enabled scientists to work on large defense problems made urgent by the intensifying cold war, without giving up their professional and academic independence. For the government a Summer Study was a way to gain the services of the very best of American scientists, unusually talented people with skills, knowledge, and abilities that the military services lacked and urgently needed. A side result was that the participants were relatively free of the biases of government service and agency personnel who had to contend for funds, status, and power; the scientists analyzed, concluded, and advised with some objectivity.

Summer Study participants were a formidable and effective group. Most had worked together during World War II on the atomic bomb project at Los Alamos or on radar at the Radiation Laboratory at MIT. Those physical scientists and engineers knew one another well and had a high regard for each other's abilities. Mutual respect, admiration, and close personal friendships also existed between them and the military men with whom they had worked during the war. As researchers, they were aware of new developments in their fields and were able to identify emerging technologies and imagine how those technologies could serve defense needs. They were experienced, self-confident, and accustomed to being more than advisers. They expected to make things happen.

The scientists also knew from their wartime work that weapons, to be effective, had to fit into the broader organization that would use them. They understood that new weapons required logistical support, training, deployment, maintenance, and often new strategies. They looked at defense problems with what is now called a systems perspective.

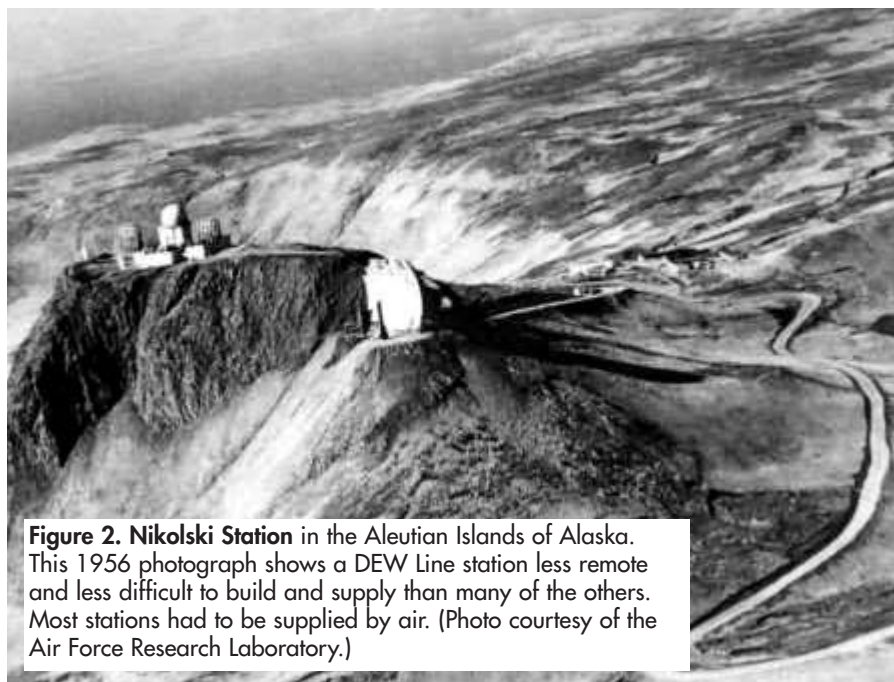


Figure 2. Nikolski Station in the Aleutian Islands of Alaska. This 1956 photograph shows a DEW Line station less remote and less difficult to build and supply than many of the others. Most stations had to be supplied by air. (Photo courtesy of the Air Force Research Laboratory.)

Large-scale consequences

In addition to a vast radar and interceptor shield for US defense against air attack, Summer Studies proposed new and extensive ways to secure and defend the sea lanes to Europe; novel, small-yield nuclear weapons for defending Europe; new technologies and ways to project American ideas and policies through the curtain of Soviet secrecy; and the use of extraordinary technologies to gather more and better intelligence about Soviet capabilities and intentions.¹ Some of those studies led to projects on the scale of the efforts that developed radar and the atomic bomb during World War II.

The projects could affect the entire society. For example, following the recommendations of Project Charles, the 1951 Summer Study, the US Air Force and MIT established the Lincoln Laboratory to develop components of a radar shield to warn the continental US against Soviet bomber attacks. The goal was to develop an extensive system to collect and analyze radar data in real time. Semiautomatic ground environment, or SAGE, as the project was called, required a computer far more advanced than any then existing; it had to be fast enough and reliable enough to work in real time. The air force funded the development of the Whirlwind computer, which ran on vacuum tubes and filled large rooms.³ The work on Whirlwind led to such innovations as magnetic core memory and the first programming language, which were fundamental to the subsequent computer revolution.

MIT and Zacharias

Many Summer Studies were associated with MIT. The association was a natural consequence of the wartime work on radar done at MIT's Radiation Laboratory. When the Rad Lab was shut down at the end of the war, MIT created its own Research Laboratory for Electronics (RLE) to preserve and further expand the expertise developed in the Rad Lab. As a result, air force leaders sought help from MIT. They knew that in addition to setting up RLE, MIT had recruited as permanent faculty members outstanding physicists and engineers who had made the Rad Lab so successful—men like Albert Hill, George Valley, Jerome Wiesner, and Jerrold Zacharias. The work at the Rad Lab gave them unique prac-

Major cold war Summer Studies of the 1950s						
Project	Date	Location	Sponsor	Purpose	Outcome	Directors
Lexington	1948	MIT	Atomic Energy Commission, US Air Force	Feasibility of nuclear-powered aircraft	USAF development program that lasted to 1961	Walter Whitman (MIT), Jerrold Zacharias (MIT)
Hartwell	1950	MIT	US Navy	Security of overseas transport; undersea defense; defense of supply lines to Europe	Sound surveillance system; fast cargo ships; spread-spectrum radio transmission to avoid jamming; redesign of harbor facilities	Jerrold Zacharias (MIT)
Troy	1950	MIT	State Department	Coordination of propaganda effort; penetration of Soviet jamming	Center for International Studies at MIT; US International Information Education and Exchange Program; CIA funds for the Congress for Cultural Freedom	John Burchard (MIT), Edward Purcell (Harvard)
Charles	1951	MIT	US Air Force	Air defense of continental US	Lincoln Lab; use of high-speed digital computers with radar	Wheeler Loomis (U. Illinois at Urbana-Champaign), Jerrold Zacharias (MIT)
Vista	1951	Caltech	US Air Force	Tactical effectiveness against Soviet forces in Europe	Tactical nuclear weapons for the army; better tactical air support; trouble for Vista leaders	Lee DuBridge (Caltech), William Fowler (Caltech)
East River	1951–52	Princeton	Federal Civil Defense Agency	Civil defense	Recommendation for decentralizing industry; call for at least a two-hour advance warning of an attack	Otto Nelson Jr (retired army general)
Lincoln Summer Study Group	1952	MIT	US Air Force	Development of a broad view of air defense	Distant Early Warning (DEW) Line	Jerrold Zacharias (MIT)
Technological capabilities panel	1954–55	Washington, DC	President Eisenhower	Assessment of Soviet first-strike capabilities	High-altitude and satellite reconnaissance; signals intelligence	James Killian Jr (MIT), Edwin Land (Polaroid)
Lamplight	1955	MIT	Department of Defense	Naval and air defense	Seaborne computer systems	Jerrold Zacharias (MIT)
Nobska	1957	Woods Hole Oceanographic Institution	US Navy	Assessment of effects of advanced technology on submarine warfare	Polaris submarine: missiles with 1-megaton nuclear warheads launchable from underwater	Columbus Iselin (WHOI), Ivan Getting (Raytheon Corp, MIT)

tical and theoretical expertise that the air force needed to deal with its defense problems.

Zacharias, an MIT professor, was a major Summer Study figure. He had followed I. I. Rabi, his mentor, colleague, and friend, to the Rad Lab when Rabi became its associate director in 1940. Near the end of the war Zacharias joined the MIT faculty and spent four months at Los Alamos. Known for his work on atomic clocks, he was clever, energetic, forceful, blunt, imaginative, and intolerant of mediocrity. His trenchant personality, vigorous self-confidence, varied wartime experience, and wide range of friends and close colleagues in physics made him an effective leader. He was deputy director of Project Lexington in 1948, director of Project Hartwell in 1950, associate director of Project Charles in 1951, director of the 1952 ad hoc Lincoln Lab study, and director of Project Lamplight in 1955. All this experience taught him what makes a good summer study. For a list of major cold war Summer Studies, see the table above.

Get the best

Unrepentantly elitist, Zacharias insisted that participants be the very best of America's scientists, military leaders, technologists, and industrial engineers, a group of around 200 people in all. He was very effective at recruiting small groups from that pool and at getting them to spend 10 to 12 weeks together grappling with big defense problems.

Zacharias's persuasiveness aside, it was not difficult to recruit the best American academics. The additional salary

was welcome, and the intellectual challenges of cold war problems, combined with a sense of high purpose, were a big lure. The eminent Harvard physicist Ed Purcell felt those attractions when asked to join Project Troy, the 1950 Summer Study sponsored by the US State Department. Project Troy brought together a group of outstanding social scientists and physical scientists to envision and recommend strategies and technologies for learning more about Soviet bloc societies and for better communicating American ideals and intentions to them—that is, to improve intelligence gathering and make propaganda more effective. Agreeing to be Project Troy's deputy director, Purcell wrote, "I am glad to be in this thing myself because it is so important an experiment that I would rather make even a small contribution to it than a big contribution to anything else I can think of."⁴

The studies also provided engaging camaraderie. The psychologist Jerome Bruner wrote years later, "For all the gravity of the proceedings, Project Troy was the best club I ever belonged to."⁵

Give them a big problem and leave them alone

Project Lexington taught Zacharias that a Summer Study must be able to take a broad view of its problem. The first of them, Project Lexington, was run in 1948 for the Atomic Energy Commission (AEC) and the air force to evaluate whether a nuclear-powered aircraft was technically feasible. The answer was yes. But Walter Whitman, the MIT chemical engineer directing the project, would not allow the participants to look beyond the



Figure 3. J. Robert Oppenheimer directed the Manhattan Project during World War II. After the war he advised many branches of the US government on nuclear weapons and was a frequent Summer Study participant. Oppenheimer's support of nonnuclear military strategies led some officials to question his loyalty and subsequently strip him of security clearance in 1954. (Photo courtesy of AIP Emilio Segrè Visual Archives.)

narrow question of technical feasibility. Aside from the laconic remark "crashes may occur, and the site of the crash will be uninhabitable," Project Lexington's report said nothing about why a nuclear-powered aircraft might be impractical.⁶ Nor was the study group allowed to consider other, possibly more practical technologies for long-duration flights. For the nuclear-powered aircraft, as for the supersonic transport

two decades later, technical feasibility did not mean that it made sense to build one. Zacharias had Project Lexington in mind when he said, "Summer Studies and some are not."⁷

Zacharias applied the lesson two years after Project Lexington when asked to organize and lead Project Hartwell for the US Navy. Given the narrow topic of "defenses against submarines," he went to Washington, DC, met with the chief of naval operations—the senior officer of the navy—and got him to agree that the study should be broadened to "assuring the security of overseas transport." As a result, Project Hartwell looked comprehensively at the problems of moving men and materiel across the Atlantic Ocean during a war.

Zacharias also understood that, having recruited the best scientists, he could only direct them loosely. As Hill said, "[W]e wouldn't have stood still if he had written us a list of how? when? where? why? on the board more than once. If he'd repeated it, we would have thrown him out, you know. We were his contemporaries" (reference 6, page 101). Zacharias would pose the problem in its proper context, get the participants divided into working groups, and then leave them alone to reshape the problem and formulate possible solutions.

That approach certainly worked for Project Hartwell. The participants did not neglect antisubmarine warfare. They proposed using the recently discovered deep sound channel to detect and track submarines with an extensive system of passive sonar detectors on the ocean floor. They also proposed developing both nuclear depth charges to attack submarines at sea and small nuclear bombs to attack bunkered submarine bases. Beyond antisubmarine measures, Project Hartwell scientists recommended construction of a fast merchant fleet and the redesign and reconstruction of harbor facilities to speed up the loading and unloading of ships. They also pointed out how the navy might gain from focused research on radar, sonar, and magnetic detection and from basic research in oceanography.

Naval leaders received Project Hartwell's extensive report with enthusiasm. They built the sea-floor sonar network known as SOSUS (sound surveillance system), initiated construction of the mariner class of merchant vessels, and

improved training methods. They adopted all the Hartwell recommendations, and then adopted the project's systems approach, which involved making significant changes in navy practice and organization.

Understand the politics

Summer Study participants often wanted to think of their work as disinterested. Their recommendations might be bold and grand, but they were based on objective, rational—that is, scientific—assessments of options. There is truth in that view, but it is also true that both the recommendations and their reception depended on whose interests were involved and what those interests were. For a Summer Study to be useful, it must be responsive to the political needs of its era.

The politics of national crisis were critically important. In February 1948 the Communists took over Czechoslovakia. A few months later the Soviet Union blockaded Berlin. In August 1949 the Soviets tested their first atomic bomb and ended the US nuclear monopoly. Two months after that the Chinese Communists completed their takeover of China. In June 1950 Communist North Korea invaded South Korea, and American leaders feared there might soon be war in Europe. Truman decided the US would develop the hydrogen bomb, and he called for extensive rearmament. Within two years Congress quadrupled the defense budget. Thus, Summer Study proposals had an attentive audience with money to spend.

The struggle of each military service for a major strategic role that would bring it prestige and high levels of funding strongly affected Summer Studies. US policy that based defense on the threat of retaliatory strategic bombing favored the air force, and air force leaders fiercely resisted proposals that might change that policy. In contrast, the navy, excluded from strategic deterrence when its large aircraft carrier program was canceled in 1949, was eager for new ideas. Not surprisingly, it was pleased with Project Hartwell's recommendations; by adopting them the navy enhanced its defense role.

Secrecy

The Summer Study was devised as a way to keep secret information secure while dozens of people worked on it. Secrecy was also used to limit access to ideas and to manage policy debates.

President Truman used secrecy to limit debate on his 1950 decision to have the US develop the hydrogen bomb, a weapon a thousand times more powerful than either of the atomic bombs used against Japan in 1945. His decision, which strongly reinforced the doctrine of strategic deterrence, was made against the recommendations of most of the scientists then advising the government.

J. Robert Oppenheimer, the physicist who had brilliantly led the wartime effort that developed the atomic bomb at Los Alamos, chaired the AEC's General Advisory Committee, which recommended unanimously against developing thermonuclear weapons. Pictured in figure 3, Oppenheimer believed that the technology for developing fusion bombs was uncertain and that super bombs were not needed because increases in efficiency and yield had made atomic bombs sufficiently terrible. Rabi and Enrico Fermi, also mem-

bers of the General Advisory Committee, thought developing such weapons was immoral because they would be so powerful that any imaginable use would kill a huge number of civilians; in their minds, these could only be weapons of indiscriminate mass destruction. Secrecy laws prohibited the very scientists who knew the most about such weapons and their astonishing destructiveness from speaking about them. Whether the scientists thought a super bomb was immoral, impractical, strategically dangerous, or just useless and unnecessary, they could not make the case to the public, or even to Congress.

The Summer Study, however, offered a way for scientists to look for alternatives to reliance on big weapons. Rabi's moral distaste aside, many scientists thought Truman's decision to develop thermonuclear weapons made an already dangerous strategy more so. The Caltech nuclear physicist Charles Lauritsen, whose advice was much sought by all branches of the military, worried that America's defense doctrine was an all-or-nothing strategy.⁸ Like others, including his close friends Oppenheimer and Rabi, Lauritsen thought it was vital to find alternatives to huge bombs and long-range bombers so that leaders would not be cornered into launching a nuclear war. In a Summer Study, where all participants had high levels of clearance, scientists could imagine and propose new technologies and strategies to reduce reliance on weapons of mass destruction and allow America to ease off the strategic air command's (SAC's) hair trigger. For some physicists, this possibility was a strong impetus to participate.

But air force leaders who ardently believed in the efficacy of big bombers and big bombs resisted any proposals for undertakings that might diminish or displace the nation's reliance on SAC. Indeed, Oppenheimer's persistent support for ways to reduce reliance on strategic deterrence led some air force supporters to accuse him of deliberately trying to undermine US security by weakening SAC. Hostility to Oppenheimer became so great that the air force excluded him from all of its advisory panels and from access to all classified information controlled by the air force.

The air force particularly disliked the recommendations of Project Vista. This large Summer Study, held in 1951 in Pasadena, California, and managed by Caltech, considered ways to defend Europe against numerically superior Soviet forces. When Vista proposed that tactical nuclear weapons be developed for the US Army, Vista's air force sponsors argued that SAC would be weakened by diverting to tactical weapons the uranium and plutonium needed to build up SAC's stockpiles of atomic bombs. When they learned that Oppenheimer had advised Vista on tactical weapons, the air force sponsors were enraged and viewed the proposal as



Figure 4. The Science Advisory Committee of the Office of Defense Mobilization meeting in 1953 with President Dwight D. Eisenhower. Most of the men had worked on Summer Studies, many on more than one. The picture accurately conveys the scientists' high level of influence in that era. Shown from left are (standing) Emanuel Piore, Oliver Buckley, Alan Waterman, James Fisk, Detlev Bronk, Bruce Old, James Killian, David Beckler, Robert Bacher, Jerrold Zacharias, and Charles Lauritsen; (seated) Arthur Flemming, President Eisenhower, Lee DuBridge, and I. I. Rabi. Zacharias, Rabi, and Lauritsen are the Z, R, and C of ZORC discussed in the text. (Photo by Abbie Rowe, courtesy of the National Park Service.)

another attempt by Oppenheimer to undermine national security.

The air force suppressed Vista's unpalatable recommendations by refusing to accept its report. All copies were destroyed or sent to Washington, where they disappeared into the Pentagon. Because the recommendations were secret, the participants could not talk about them with non-participants. The air force's actions kept Vista's proposals from the attention of civilian policymakers and left Vista's participants and the Caltech leadership feeling bruised and unhappy. Vista had been a lot of work for much grief and little appreciation.^{8,9}

Air defense

In the case of air defense, however, the air force leadership did not get its way. Right at the start they had to give ground. To get MIT to consider doing important defense-related research, air force leaders had to sponsor Project Charles and allow it to consider air defense with a broader perspective than they wanted. The leaders welcomed the proposal to establish the Lincoln Laboratory and were pleased to continue funding the development of the Whirlwind computer as the heart of a real-time data-processing system, but they opposed building and deploying an extensive air-defense network. They thought, with some justice, that air defense was useless, that 70% of Soviet bombers would penetrate their current system, and that it was not technically feasible to improve the system much. It was essential, air force leaders argued, to avoid large efforts that would drain resources from SAC.

However, a significant group of physicists, among them Zacharias, Oppenheimer, Rabi, Lauritsen, and Lloyd Berkner, were convinced that useful air defense was feasible. They thought the recent discovery that radio waves could be transmitted over long distances by reflecting them from the

E layer of the ionosphere would permit reliable long-range radio communications in the Arctic. Believing it was now technically possible to operate radar stations in the Arctic, the physicists undertook a concerted effort to build a strong case for what would become the DEW Line.

Berkner, experienced in radio physics, was an ardent and persuasive proponent of the DEW Line. In 1951 he became the first president of Associated Universities Inc, an organization created to run the new Brookhaven National Laboratory. Shortly afterward, AUI agreed to administer Project East River, a Summer Study held in the winter of 1951–52 to examine problems of civil defense. Both Berkner and Rabi participated in the study, which concluded that civil defense could be useful only with several hours' advance warning of an attack. That much advance warning was possible only with radar stations in the Arctic.

To further build the case for an extensive air-defense system, Zacharias, supported by Oppenheimer, Rabi, Lauritsen, Berkner, and others, arranged for a special ad hoc Summer Study at the Lincoln Lab during the summer of 1952 to expand on ideas from Project Charles. The participants worked hard to generate convincing evidence that air defense was feasible and would be effective. They recommended that construction of test stations for the DEW Line begin at once.

Although suspicious of the motives and hostile to the ideas of the Lincoln Summer Study Group, the air force sponsors could not handle proposals for an air-defense system the way they handled Vista's proposal for tactical nuclear weapons for the army. For one thing, there were air force officers whose mission was to defend the continental US, and they were receptive to ideas that would help them do their job. For another, American political leaders were feeling intense pressure to offer the public alternatives to passive despair in the event of an atomic bomb attack. The idea of a radar shield was likely to have wide political and public appeal if it became known.

And it did become known. In May 1952, Joseph and Stewart Alsop, widely read newspaper columnists of the day, publicized both the possibility of a useful defense against air attack and the air force's opposition.¹⁰ The Alsop brothers clearly knew, at least in a general way, what Project Charles had proposed. More important, Berkner circumvented the air force. He carried the Lincoln group's ideas to the State Department and the National Security Resources Board in Washington, DC. The result was that—even before it had been transmitted to the air force—the Lincoln group's report reached the National Security Council. At the end of 1952, President Truman signed the NSC directive ordering construction of the DEW Line.¹¹ After President Eisenhower confirmed that decision, the air force had no choice but to go along. As Zacharias said much later, "Air defense was finally sold to Truman over the dead body of the air force."¹²

Most members of the Lincoln Summer Study Group felt they had done something worthwhile. Able to see the defense possibilities of novel technologies that were not apparent to air force staff because of their limited technical competence, the scientists had forced the air force to improve America's security by deploying a state-of-the-art defense against attack by Soviet bombers. A smaller group of members, among them Zacharias, Oppenheimer, Rabi, and Lauritsen (three of whom are pictured with Eisenhower in figure 4), also believed that good air defense made a major contribution to American security by reducing the pressures for preemptive nuclear war.

These four men paid a price for their success. Some mil-

itary and civilian leaders accused them of meddling in policymaking and of working beyond their authority and outside their areas of expertise. Air force leaders supplied information to journalist Charles J. V. Murphy to write an anonymous article that appeared in a 1953 issue of *Fortune*. It pinned the ominous-sounding acronym ZORC on Zach, Oppie, Rab, and Charlie and accused ZORC and Berkner of hijacking the Lincoln Summer Study Group and warping it to ends that weakened the nation's offensive forces (meaning SAC).¹³ Resentment of scientists' efforts to affect policy played a significant role in the 1954 AEC hearings that stripped Oppenheimer of his clearance and excluded him from all further government consulting. In those hearings Zacharias, Oppenheimer, Rabi, and Lauritsen were questioned closely and hostilely about their roles in Project Vista and in the Lincoln Summer Study Group.

Relevance

To shape a comprehensive vision of homeland security, the US needs the ingredients of Zacharias's prescription for an effective Summer Study: Focus on a large problem—homeland security surely qualifies; look at the problem broadly—including, for instance, energy issues; involve the best people from a variety of disciplines, from policy sciences to natural sciences; and bring them together for a long enough time to become well acquainted with each other and master the problem. But perhaps this modern Summer Study should be organized outside the government—to avoid muzzling the deliberations with requirements of secrecy and to leave participants free to reach out to a receptive body of policymakers.

To begin, the National Academies might seek private money to fund a select group of policy scientists, physical scientists, life scientists, computer scientists, and business and political leaders to identify major threats to homeland security and propose possible technologies and strategies to moderate those threats. Private funding would free the group from many vested political interests. National Academies sponsorship would help recruit the interdisciplinary group needed for today's problems. All we need is a Zacharias to lead.

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