Richard Garwin: Defense Adviser and Critic

The physicist whom Fermi called a genius sees a failure of rational debate on defense issues

Extraordinary ability and self-assurance are common in the brain trust that helps the Pentagon plan its secret innovations in weaponry. But in this select club, one scientist has a special reputation for technical expertise and frankness. This is Richard Garwin, a physicist whose principal occupation, as he puts it, is "inventing things" for the International Business Machines Corporation (IBM). His avocation is advising the government on how to make military and technical systems work.

Garwin struck his Faustian bargain with the military in 1950, when, barely past the age of consent, he helped build the first hydrogen bomb. Since then he has given advice on nearly every major weapons program the nation has undertaken. Reviewing this record, Garwin concedes that the government's ability to produce weapons far outruns its wisdom in deploying them, but he has no regrets about his contribution to the arms race.

"In exchange for my help," Garwin says, "I get to help steer the system, to look at its insides, and if something is terribly wrong, I can do things on the outside" to alert the public to bad ideas which he has not been able to counteract within the system.

Much of Garwin's advisory work is cloaked in military secrecy. He has gained attention, however, for several public disagreements with the Pentagon, most notably for his campaigns against the antiballistic missile system, the B-1 bomber, and the Trident submarine. He is in the limelight today because of a new campaign, conducted with his friend Sidney Drell, to reverse the decision to deploy the MX missile on land.

Garwin does not like to be characterized as a critic, yet he agrees that he is spending more and more time presenting his critiques to general audiences. His emergence as a public figure comes not so much out of disillusionment as from a frustration with what he regards as an increasingly rigid federal bureaucracy. Garwin's independence has not endeared him to the military, but the Defense Department apparently finds his advice too valuable to forgo.

More than 30 years ago Garwin became a bomb builder, just after he had earned a Ph.D. in physics from the University of Chicago. In 1950, at the age of 22, he joined the distinguished group which had gathered to design nuclear weapons at the Los Alamos Scientific Laboratory in New Mexico. The leaders included the European-born scientists Edward Teller, Hans Bethe, and Stanislaw Ulam. Teller and Ulam conceived the design of the first H-bomb, but it was the young intern, Garwin, who as much as anyone made their "Mike" design work.

The impetus that pushed Garwin into defense research came in part from the Soviets' detonation of a fission bomb in 1949, the blast that started the modern arms race in earnest. Like others, Garwin was worried about the Soviets' new power. While at Chicago, he sketched out methods for discovering precisely what nuclear secrets the Soviets had unlocked. Enrico Fermi, his mentor in graduate school, studied the paper and, according to Garwin, "said I shouldn't worry about it anymore, and also that I shouldn't write about it. It was already being done."

Fermi was returning to Los Alamos in 1949 for the first time since the war. Garwin expressed an interest in working on defense projects for the summer and asked to be recommended to the laboratory as a consultant. Fermi recognized his student's ability and agreed. According to Marvin Goldberger, another of Fermi's graduate students and now president of the California Institute of Technology, the great physicist declared Garwin to be "the only true genius I have ever met." And that, says Goldberger, was an accolade, "since Fermi was not one to praise others very freely."

Goldberger says Garwin "really knows how the physical world works. If you ask him how a car speedometer works, . . . he'll design the damn thing for you right there." On technical questions, Garwin is "almost never wrong."

The Mike shot was a cryogenic system that required liquid deuterium. "I had to do the entire cryogenic design because the low-temperature people at Los Alamos were involved in pure research and really weren't available," Garwin recalls. "I made the first sketches of the Mike object," which was tested successfully in November 1952. The design was strong enough to be used in the first airworthy bombs.

Not surprisingly, Garwin's rise was rapid. His peers say he is extraordinarily quick and able to recall great technical detail. He has a reputation for being able to construct difficult experiments with whatever scraps of material he finds in reach.

Above all, Garwin is an intense worker. "I almost never have lunch," he says. The only recreation he mentions is "fixing things around the house," which he does because it is easier than dealing with a repairman, and skiing, which he does poorly. This intensity has been passed along to the three Garwin children, who among them have collected or are working on half a dozen degrees from Harvard, Yale, and Cambridge. Garwin's daughter, who has a bachelor's degree in physics from Harvard, was in the first class of Rhodes scholars to include women. Garwin says it is a waste of time to accumulate possessions, and that it is only recently that he and his wife Lois have properly furnished their house in Scarsdale, New York.

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Garwin's passion for making things work is reflected in a story told by a fellow physicist, who called it "the Garwin joke." It goes as follows. Three men—a businessman, a general, and Garwin—were sentenced to death by guillotine. First the businessman was led to the platform and asked by the executioner whether he would like to lie face

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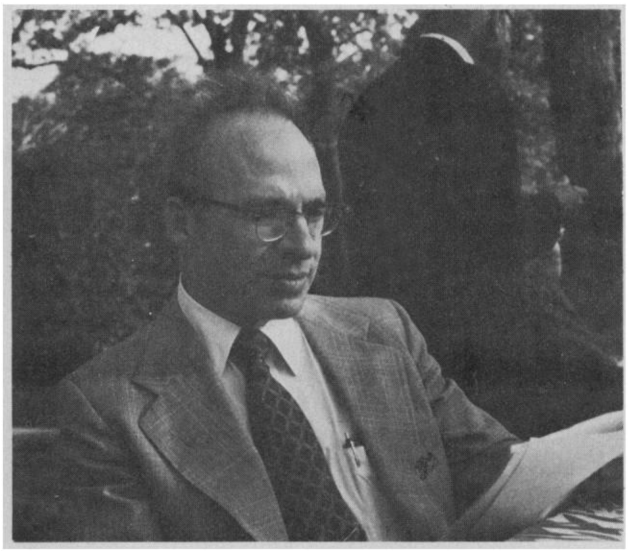

Richard Garwin

Inventor, adviser, and conscientious dissenter

up or face down. He chose face down. The executioner pulled the cord and the blade came rattling down, but jammed a few inches short of the man's neck. Impressed, the executioner said: "Obviously you were not meant to die. You may go." The general came forward, and once again the mechanism failed. Then it was Garwin's turn. He chose to lie face up. Just as the executioner reached up for the cord, Garwin called out: "Hold it, hold it! I see what your problem is."

Garwin was born in 1928 in Cleveland, the son of an electrical engineer who taught high school science. He took a B.S. degree at the Case School of Applied Science, now Case Western Reserve, and received a Ph.D. in 1949 from the University of Chicago, where he taught from 1949 to 1952. He left Chicago for the laboratories of IBM, where he is a fellow at the Thomas J. Watson Research Center in Yorktown Heights, New York. He is also on the faculty at Columbia University and Harvard's Kennedy School of Government.

In the 1950's and 1960's, he worked on a variety of tasks, including Project Lamplight, designed to strengthen domestic air defenses against Soviet bombers. Garwin eventually began to question the work because he thought the real threat would be missiles. He was told that missile defense would come later. American air defense, Garwin says, was "never more than 30 percent effective, and we did just right in abandoning it." In later years Garwin became involved in missile, aircraft, submarine, and satellite design.

In 1952 Garwin left the University of Chicago because he was impatient with particle physics, which required him to wait 6 weeks to get access to a cyclotron. He looked for areas that would allow him to move quickly and settled on low-temperature physics, superconductivity, and liquid and solid helium. He took a job in 1952 at a new laboratory that IBM was organizing at Columbia University and an adjunct position on the physics faculty. He remained there until IBM closed the lab in 1970 at the peak of the antiwar protests, and moved to the research center at Yorktown Heights.

Like others who advised the Pentagon in those years, Garwin received his share of criticism from antiwar groups—in his case, for belonging to an elite club of physicists known as JASON, formed in 1960 and named after the first Argonaut. The JASON's give technical advice to the military, and they became notorious during the Vietnam war for proposing the deployment of "McNamara's wall," a system of electronic sensors that were supposed to detect the enemy's movements in "secure" areas. This attempt to combat a guerrilla force with radio and computer technology proved a spectacular flop. Predictably, Garwin says the scheme failed because the Air Force failed to use it properly.

In addition to advising the government and IBM, Garwin has made some important contributions to basic physics. He is well known for an experiment he performed in 1957 with Leon Lederman and Marcel Weinrich at Columbia to test the theory that parity—mirror-image symmetry—is violated by subatomic particles in the presence of the weak force of the atomic nucleus. A number of groups, including one at the National Bureau of Standards led by physicist Chien-Shung Wu, were trying to test the theory. Wu's early tentative findings showed the theory to be correct and inspired Garwin and Lederman to try a different approach. They soon confirmed Wu's results, but an impressive feature of their experiment was that it was designed and executed in 4 days and was constructed of materials found in the laboratory over a weekend.

Another tour de force of experimental technique was a project, in which Garwin was a co-designer, to measure the magnetic moment of the heavy electron. Performed by a team at CERN in 1961, the extreme accuracy of the measurement showed that the current theoretical scheme for quantum electrodynamics was accurate to one part in a billion. Garwin is known as well for his vigorous challenge of the claims of University of Maryland physicist Joseph Weber that he had detected gravity waves on a pair of antennas built in the 1960's.

Garwin's particular talent is an ability to cut across disciplines and bring a breadth of knowledge to bear on technical problems. An example sometimes mentioned is his role as midwife in the birth of a new computer technique called the fast Fourier transform (FFT), a shortcut that increases a computer's efficiency by a factor of 1000 in certain analytical tasks.

More recently, Garwin and a colleague at IBM, James Levine, built a "gaze control" computer terminal that does not require manual operation. One glances at the screen, choosing commands from a list of options, and the computer understands what to do. They are also working on a "perfect resolution" display screen that will resolve images in three dimensions and in full color.

A sheaf of IBM technical disclosure bulletins lists ideas that range from the trivial to the complex. Included are an improved capacity typewriter ribbon, a tunable laser and microwave source, a scheme for tilted arrays in display devices and scanners, a plan for a new artificial kidney, and a catheter that would minimize friction against the walls of a blood vessel. In addition, Garwin is the holder or co-holder of 27 patents.

An IBM Fellow, Garwin explains, is expected to decide what is important to do and do it. That is the rule that governs his work, and although much of what he spends his time on has little to do with computers or research, IBM hardly notices. About once every 10 years, according to Garwin, someone comes along and asks him to account for his time. When that has happened, Garwin has offered to make other arrangements whenever the company thinks its investment in him is not paying for itself.

Probably the severest strain between

Garwin and IBM occurred in 1970, when Garwin was speaking against a government proposal to subsidize the development of a commercial supersonic transport plane (SST). The Nixon Administration had asked him to direct a technical review of the idea, and the results were unfavorable. The White House held the report confidential. Congress, unable to get a copy, called upon Garwin. Testifying as a citizen, he confirmed the report's finding—that a sonic boom problem over land would make the plane economically unviable—but he would not discuss the study or its technical details. There are reliable reports that this performance caused trouble for Garwin at IBM, and that one highly placed executive actually asked him to stop knocking the SST. Garwin does not care to discuss the incident, but if there was any pressure, it had no effect.

Garwin had not meant to get involved in the SST controversy but found it unavoidable. "There was a lot of skulduggery in the program," he says. Congress learned about his expertise and asked him to testify. "I looked at the government testimony and decided it was really dishonest and misleading. Really just awful. The government was concealing information and giving false information. So I said, 'Yes, I'll testify, but you can't ask me about the report.' " Congress eventually decided not to grant the SST subsidy.

The testimony came at a bad time for the President's Science Advisory Committee (PSAC), a standing group of trusted scientists from outside the government. Many members were opposed to the government's conduct of the war in Vietnam and had made their opposition known. At the same time, Garwin, Bethe, Jerome Wiesner, the now retired president of MIT, and Wolfgang Panovfsky, director of the Stanford Linear Accelerator Center, publicized a technical case against the Pentagon's plan for an antiballistic missile defense. All were distinguished members of PSAC, and Wiesner had been President Kennedy's science adviser. These public displays of independence were not well received.

Garwin and Weber's Waves

Although the existence of gravity waves is inferred from Einstein's theory of relativity, no one has ever found them. Doing so would be a major accomplishment, probably earning the experimenter a Nobel Prize. One of Richard Garwin's better known crusades was aimed at disproving a physicist's claim that he had found the elusive waves.

Garwin's performance in this crusade was controversial and typical of his modus operandi. He jumped into a field in which he had done no previous work, took on the field's leading scientist—Joseph Weber of the University of Maryland—in a matter of months built a device that he said was more sensitive than Maryland's, and soon claimed to have demolished Weber's findings. Some observers were shocked. One physicist says, "Most of us would like to forget about it." Weber has not retracted his reports.

The episode began with Weber's reports in 1968 and 1969 that he had detected some mysterious signals on two huge aluminum bars designed to sense gravitational radiation. Soon these pulses were being recorded many times a day. And their arrival times, Weber claimed, suggested they were coming from the center of the Milky Way.

This was heady stuff, and theorists were skeptical. Calculations soon revealed, for example, that the frequency and intensity of Weber's signals, if they were gravity waves, would have been accompanied by a very rapid destruction of matter. The galaxy seemed destined for a brief life. Theorists looked for ways to keep the galaxy together while accepting Weber's signals at face value. But soon experimental physicists began to challenge Weber. The first was J. Anthony Tyson of the Bell Laboratories. He struck a glancing blow at Weber's findings at a conference in Texas in 1972 but only succeeded in igniting smoldering polemical exchange. It was after that, says Tyson, that "Garwin decided to step in and take charge of the whole matter." According to Tyson, Garwin quickly built an antenna about 10 times more sensitive than Weber's, while Tyson was taking time to build one 100 times more sensitive.

Recalling that project, Garwin says that Weber's findings seemed "very peculiar to me. . . . He didn't have statistics to bear out some of his statements, and the more I looked at the experiment the less I believed the results." He visited Weber but decided to do an experiment of his own, rather than suggest ways of improving the data.

Using a smaller bar and a cheaper design, Garwin and a colleague at IBM, James Levine, built an antenna in 6 months that was more sensitive and capable of subtracting from its measurements most of the background thermal noise. They let the test run for a month and picked up one possible gravity wave, not handfuls every day as Weber had reported. "Undoubtedly it was a noise pulse of some kind," says Garwin.

The tensest moment in the exchange came in 1975 when Garwin confronted Weber at the Fifth Annual Relativistic Astrophysics Conference in Boston. Garwin says that he discovered through a colleague, David Douglass at the University of Rochester, who was sharing data on a confidential basis with Weber, that a computer programming error may have given Weber many of his coincidental signals. Garwin demanded that the error be publicized. When neither Weber nor Douglass would do so, Garwin stood up at the meeting and announced it himself.

Weber faults Garwin's work on many grounds. He mentions, for example, that Garwin failed to control the room temperature around the equipment and used only one bar. Weber says that he has solved most of his problems since then by ignoring the media, a category which for him includes professional journals like the *Physical Review*. Weber gave up "fighting the battle of the journals" many years ago because he found that "it has nothing to do with the peer review process that governs the distribution of funds in the United States."

Tyson's very large antenna began operating in 1973 but has detected no gravity waves, although the instrument has been run at various intervals over the last 8 years. Of Bell Laboratories' gravity antenna, he says, "I tell my boss we've got the most expensive thermometer in the world."—E.M.

When the White House was reorganized early in Nixon's second term, the President abolished the office of the science adviser and PSAC. He said they were too expensive to keep.

In abolishing PSAC the government discarded a unique analytical tool and a source of integrity, Garwin says. "The fact that PSAC has never been reconstituted is an indication that the government really believes more in expediency and secrecy than in understanding the best thing to do." The advantages of a standing committee over ad hoc advisers, according to Garwin, are first, that it can follow a variety of technical projects through the bureaucracy, bringing experience to bear on each little crisis along the way, and second, that a committee gives courage to the science adviser when he must speak unpleasant truths.

Garwin describes himself as a mild person who "hates controversy." This modest image does not jibe with accounts given by Air Force officials who have run afoul of Garwin in the controversy over the MX missile. Antonia Chayes, who was under secretary of the Air Force in the Carter Administration and called herself the lawyer for the MX, says Garwin was "very emotional" in attacking the government's plan, so much so that she was quite shaken. She also claims that he was not correct in giving a low cost estimate for the Small-sub Undersea Mobile (SUM) system, his and Drell's alternative to the desert race-track base for MX. She and Garwin had a heated exchange of correspondence in the spring of 1980.

Even some of Garwin's friends say he knows more about how things work than about human institutions, and that this causes misunderstandings. A congressional expert on the MX says that he has seen Garwin rankle admirals and generals by treating them like misguided graduate students. Physicist Theodore Taylor, who also designed bombs at Los Alamos, recalls an incident in the 1960's when Garwin was asked to present a report to a distinguished panel working on the space program during the Kennedy Administration. The paper had been sent to the members beforehand. When Garwin rose, his first words were: "Briefings like this shouldn't have to be given to people who can read." The chairman was furious.

Garwin tends to ignore the unspoken rules that keep big organizations running smoothly. He ignores rank, for example. Garwin's view is that he is just trying to make the system work as it is supposed to. In a sense he is trying to fix the gadget of democratic government. Before committing the taxpayers to a multibillion-dollar arms project, Garwin says, the government should always choose from among several alternatives. Otherwise it is impossible to analyze a proposal. Yet he believes the bureaucracy's method is to ignore anything that does not mesh with its own prejudgments and to present only one idea for approval or rejection.

Even before Nixon's reorganization it was difficult to get a debate on weapons decisions. It is more difficult now that PSAC is gone. Garwin says he became so frustrated with in-house discussions that he began to present the issues to Congress. More recently, he has started talking to the press, for even Congress seems trapped by the bureaucratic momentum.

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A Garwin specialty is nuclear weaponry. It is unsettling, therefore, that one of the problems he has noticed is the increasingly difficult task of finding new targets for America's growing arsenal. "I've known several directors and vice directors of the joint strategic target planning staff," Garwin told a meeting of the Chicago Council on Foreign Relations last October, "and they tell me that during the heyday of MIRV's [multiple warheads] coming on line, they had no idea what they were going to send these things at. They had to scrounge for targets, and so they built a target list which is longer than anything which anybody would want to destroy. . . ." The fact is that the United States for several years has had more weapons than it could use effectively. Yet more warheads are being built. New rationales arise, according to Garwin, to justify adding still more targets to an overextended hit list.

The plan for basing the MX on land is one case in which a scheme has been propped up with "bizarre" logic, Garwin believes. For example, the Pentagon says the land-based MX is necessary because it alone will be able to destroy Soviet missiles in their silos. But America would fire only if the Soviets fired first. So, Garwin asks, why on earth would the Soviets, having started World War III, leave their missiles in silos to be destroyed by the MX?

Recognizing that it is difficult to alter bureaucratic prejudices, Garwin frequently starts with a given assumption and offers technical solutions that seem cheaper or less dangerous than those the Pentagon wants.

Garwin's ideas are novel, so much so that they often clash with hawkish and dovish approaches to strategic defense. An example is Garwin's proposal to answer some worries about a Soviet surprise attack simply by declaring that America would launch its missiles on warning of a Soviet attack. This policy would do away with theories of America's vulnerability, but only at a terrible cost: it would put U.S forces on a hair trigger. "It is an indication of how crazy the whole arms race is," says Princeton physicist Frank von Hippel, an arms control advocate, "that Garwin is pushed to some of these extreme arguments." It is a form of "technological hubris," says von Hippel, to trust radars and computers to make the decision that would start a nuclear war.

Garwin himself has said the United States would be best off living "securely with the knowledge of our mortality," knowing that "we can destroy ourselves, that the Soviet Union can destroy us." Trying to build the perfect defense against the threat of nuclear war may lead to bankruptcy or a dangerous escalation of military threats, Garwin told a Harvard audience in 1979.

For the past three decades, Garwin has worked behind the scenes, the range of his technical contributions known only to his peers in the military world. Garwin is appearing frequently in public now because he finds it necessary to take his arguments to a wider audience. For this new audience, the most fundamental question concerns the nature of the military planning system that has brought about such a change in one of the nation's senior defense scientists. The most important shift in his outlook, Garwin says, is that he has grown more pessimistic about the ability of America's government to use its power and wealth rationally and ensure its own survival as a democracy.

—Eliot Marshall