History of the nuclear stockpile

New details of the largely secret history of nuclear warhead production reveal that an astounding array of weapons has been created for every conceivable purpose by a gigantic, self-perpetuating system.

by Robert S. Norris, Thomas B. Cochran, and William M. Arkin

THE UNITED STATES since 1945 has manufactured some 60,000 nuclear warheads in 71 types configured for 116 weapons systems costing some $750 billion. This amounts to an average production rate of about four warheads per day for 40 years. With the current rate of spending on warhead production exceeding that of the Manhattan Project, the present stockpile of some 25,500 warheads is once again on the rise.

That the most basic facts about the stockpile are shrouded in secrecy and difficult to discover is troubling, given their importance. Absent from the voluminous literature about the nuclear age is any serious treatment of the history of the warhead stockpile. "Gadget," "Little Boy," and "Fat Man" have been the central characters in chronicles of the dawn of the nuclear era, but a history of their many successors remains to be written. Only preliminary data can be offered here, but a full analysis is likely to lead to new insights about the Cold War, the dynamics of the arms race, and features of the contemporary debate.[1]

The nuclear warhead stockpile grew slowly at first. Because of a scarcity of materials and laborious production methods there were only seven hundred by 1950. But by the mid-1950s, with the production complex in place, the stockpile began growing by thousands of warheads per year until it reached its peak in 1967 at just under 32,000. By 1970–1971 the stockpile had dipped to 27,000, then increased slightly over four years with the deployment of MIRVed Poseidon and Minuteman missiles. From 1974 it gradually declined before again starting upward in 1982.

The character of the present nuclear buildup is that huge numbers of warheads produced during the 1950s and 1960s are planned to be retired and replaced with larger numbers of new warheads. Although expenditures are at near-record highs, production rates are not. From fiscal 1984 through 1988 the stockpile will increase, under current plans, by an average of some 650 warheads per year, reaching an estimated level of over 28,000. Production rates of new warheads are in the 1,800-per-year range—five a day—with retirements at some 1,100 a year—three a day—averaging a net addition of approximately two a day.

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Stimulants to growth and diversity

Service rivalry. In the immediate aftermath of World War II, civilian and military officials were unsure of the exact role that nuclear weapons would play within the armed forces. Clarification of some issues, such as civilian control, began with the passage of the Atomic Energy Act of 1946; new agencies, offices, and bureaucracies were created. Most pronounced in defining a specific military role were the Strategic Air Command (SAC), established as a combat command of the Army Air Corps on March 21, 1946, and the Air Force, created in September 1947. This tradition of strategic bombing and the crucial role of the atomic bomb in ending World War II led Air Force and SAC generals to assume that they would control postwar atomic policy. But the other services "desperately wanted a role in the future use of weapons and strongly resented the de facto Air Force monopoly of the means of delivering such weapons."[2] By the 1960s each service had an expansive panoply of warheads, weapons, and plans.

Many warhead types have been adapted for more than one weapon system and deployed with more than one service. In 40 years the Air Force has made use of 43 warhead types, the Navy and Marine Corps 34 types, and the Army 21. Jointly, the Air Force, Navy, and Marines have deployed 29 types of bombs (18 of them thermonuclear) on 53 kinds of U.S. and Allied aircraft.

Thirty-four warhead types have been configured for 43 missile systems, including 23 surface-to-surface, six surface-to-air, six underwater-to-surface, four air-to-surface, two air-to-air, one surface-to-underwater and one underwater-to-underwater missiles. Six warhead types have been used for 13 kinds of artillery guns in five calibers. Among the more bizarre of these have been a jeep- or tripod-mounted nuclear bazooka (Davy Crockett), a nuclear torpedo (ASTOR), and four kinds of atomic land mines (atomic demolition munitions).

As was no doubt intended, the competition between the two design laboratories, Los Alamos and Livermore, has stimulated stockpile growth and diversity. The former, with its longer history, has designed 53 warheads, while Livermore has designed 18. Of the 30 types in the current stockpile Los Alamos is responsible for 18 and Livermore for 12.[3]

Technological developments. From the outset technological developments have profoundly influenced the composition and size of the stockpile. An immediate postwar objective was to re-engineer the Fat Man plutonium bomb of the type dropped over Nagasaki to make production easier, but critical components were in short supply, particularly high-explosive castings and initiators. Acceptable new castings finally became available in April 1947 and were incorporated into the Mark III, and the first production model Fat Man entered the stockpile the same month. By the end of June 1947 there were 13 warheads in the stockpile, including at least nine Fat Man models stockpiled through June 30, 1946; the rest were Mark IIIs. But the Mark III was judged to be deficient as an operational weapon: it was too large and heavy, with an awkward shape and overly complex fusing and firing mechanisms. It also required lengthy assembly procedures and had aeronautical and structural weaknesses of the tail assembly.

One significant early technological improvement was the use of fissile cores made of a composite of plutonium and uranium. These cores, which used the plentiful and cheaper stocks of highly enriched uranium more effectively were stockpiled for use in Mark III bombs by the end of 1947. The next major technological innovation was the development of the levitated core. Levitation made for greater efficiency, increasing the yield by 75 percent for the same quantity of fissile material. Levitation and composite cores were tested in Operation Sandstone in April and May of 1948 and were incorporated in the Mark IV, the first mass-produced bomb to be built, starting in March 1949 and continuing in production until April 1951.

In May 1948 Los Alamos began development engineering on the Mark 5, the first lightweight (3,000-pound) bomb intended for "tactical" use. Its entry into the stockpile in May 1952 was followed closely by five additional tactical nuclear warheads including the versatile Mark 7, which served as the warhead for the Bureau of Ordnance Atomic Rocket (BOAR); a Navy depth bomb, nicknamed "Betty"; the Army's Corporal and Honest John missiles; and the first atomic demolition munition (ADM). Also in this initial flurry of tactical nuclear weapons development was the first atomic artillery shell, the Mark 9, for the Army's 280-millimeter howitzer.

In the early 1950s as part of its strategic weapons program the Atomic Energy Commission pursued parallel development of fission warheads with yields up to several hundred kilotons, and fusion warheads with yields from one to 40 megatons.[4] The principle of boosting fission weapons with deuterium and tritium was first recognized as early as November 1945. A boosted device was tested on May 24, 1951 in shot "Item" of the Greenhouse test series, producing a yield of 45.5 kilotons. Full-scale development of the B18, a high-yield fission bomb, was initiated at Los Alamos in August 1952, and the warhead entered the stockpile in July 1953. These high-yield fission warheads were retired in less than three years, being quickly replaced by the more efficient, multistage thermonuclear designs.

Attention to the specifics of the stockpile provides more detail and chronology of the beginnings of the thermonuclear era. Shot "George," on May 8, 1951, which preceded "Item," was the first significant U.S. thermonuclear reaction. The first successful test of a thermonuclear device was the 10.4-megaton "Mike" shot at Eniwetok, on October 31, 1952.

Before "Mike" two candidate warheads (the B16 and B14) entered development engineering in June and August 1952 as part of an effort to provide an emergency capability of bombs and modified B-36 bombers to deliver them.[5] In October 1953 three other thermonuclear warheads entered development engineering, the B15, B17, and B24. Just prior to the beginning of the Castle test series (with shot "Bravo" on February 28, 1954) the first thermonuclear warhead, the B14, entered the stockpile on an "emergency" basis. In March, April, and May, concurrently with the Castle series, the B16, 17, and 24 were also produced in small numbers, providing the planned-for emergency capability. Castle test results led to decisions to produce the 21-ton, high-yield (10-to-20 megaton) B17 and B24 (from October 1954 to November 1955) and the lighter, lower-yield B15 (from April 1955 to February 1957); and to cancel and dismantle the B14 and B16.

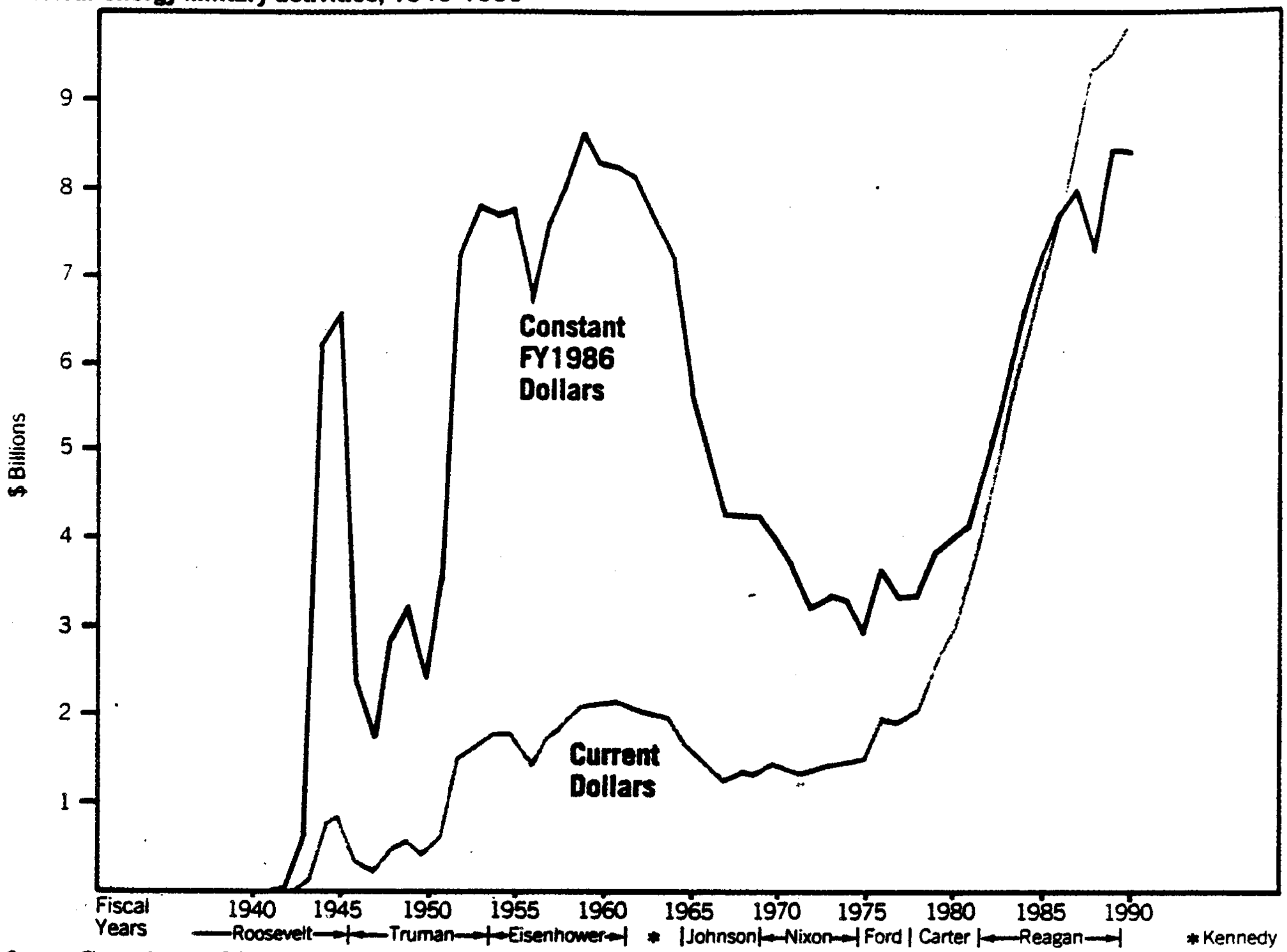
After the B21 and B36 bombs entered the stockpile, between December 1955 and April 1956, the total yield of the nuclear arsenal grew exponentially, reaching its peak, at approximately 20,000 megatons, by 1960. It is noteworthy that approximately half the megatonnage of the entire stockpile was concentrated in some 2 or 3 percent of the warheads, as evidenced by the sudden reduction of some 9,400 megatons with the retirement of B36 bombs between August 1961 and January 1962. Over the next two and a half years the megatonnage rose again by 5,400 megatons, primarily because of the production of thousands of B29s and W28s, and hundreds of B53s and W53s. From that second peak the megatonnage began a 20-year decline to its present level of approximately 5,500 megatons.

Reagan Administration officials often imply that this decline is evidence of the "decade of neglect" and "unilateral disarmament" of past administrations. They know better. What they fail to tell the public is why and how the arsenal has in fact become more lethal and capable.

In mid-1960 the Strategic Air Command inventory included approximately 1,800 bombers to which some 6,000 bombs were allocated. As ballistic missiles came to dominate strategic forces, the number of bombers declined. Those remaining in the force were allocated a larger number of lower variable-yield bombs and new air-to-surface missiles as technological advances provided more versatility and capability. Improved guidance systems gave greater accuracy, thus allowing MIRVing and a reduction in warhead yields. During the MIRVing of the ICBMs (from mid-1970 to mid-1975) and the SLBMs (from March 1971 to September 1978) the combined megatonnage continued to decline.

Knowledge of the dynamics and composition of the stockpile may provide new insight into the principal milestones of the arms race and certain events of the Cold War. An exam-

U.S. government expenditures
Nuclear energy military activities, 1940-1990



Sources: Figures from the Office of Management and Budget; Manhattan Engineer Division; Atomic Energy Commission; Energy Research and Development Administration; and the Department of Energy.

ple of the former is a generally overlooked consequence of the "bomber gap" of the mid-1950s. Most accounts emphasize that the United States responded to its inflated estimates of Soviet bombers with a significant bomber program of its own. This is true, but what is overlooked is the great growth in nuclear air-defense weapons, including Genie and Falcon air-to-air missiles; and Nike Hercules, Bomarc, Talos, and Terrier surface-to-air missiles.

A huge infrastructure was built, and by the early 1960s the continental part alone included 2,612 interceptor aircraft, 274 Nike Hercules batteries, 439 Bomarc missiles, and hundreds of radars manned by 207,000 personnel.[6] All of this was to counter the Soviet threat of 100 propeller-driven Bear and 60 jet-powered Bison bombers. Combined production of warheads for air-defense missiles totaled some 7,000—a significant percentage of the stockpile. But no sooner had they been produced than they began to be withdrawn. The infrastructure was eventually dismantled and the warheads retired. New threats were substituted for old ones as the "missile gap" crowded out the "bomber gap."

Cost of the stockpile

The United States has spent a total of almost $82 billion on nuclear warheads ($209 billion in fiscal 1986 dollars) from 1940 through 1985 (see figure). And these amounts represent only the Department of Energy's (and predecessor agencies') share of the total nuclear weapons bill. The Department of Defense has spent an additional $650 billion ($1.7 trillion in fiscal 1986 dollars) since the end of World War II on nuclear delivery systems (missiles, planes, and so on) and other support costs.

The data show that the United States is currently spending for nuclear warheads at a greater rate than it was during the Manhattan Project.[7] From 1940 to mid-1946, the expenditure was $2.05 billion, equivalent to $16.14 billion in fiscal 1986 dollars. In budgetary terms several Manhattan Project-size programs are currently going forward. The initial research effort of the Strategic Defense Initiative (SDI) alone will double that figure. MX missile costs will be over

$30 billion, and the combined Trident submarine and missile programs could be over $100 billion, though both programs are spread over several years.

The data also show that the highest expenditure rates were attained during the first nuclear buildup, from fiscal 1952 to 1964. During this period the production complex was built to mass-produce nuclear warheads. The Manhattan Engineer District facilities at Los Alamos, Oak Ridge, and Hanford were expanded and supplemented by a second design laboratory at Livermore, California. There were also a second production reactor site at Aiken, South Carolina; a continental test site; gaseous diffusion and feed-processing plants; and specialized warhead component and assembly facilities.

With the infusion of $24.3 billion in those 13 years, ($101.4 billion in constant fiscal 1986 dollars) the production rate and the size of the stockpile increased dramatically. The average annual production rate jumped from a range of 200 to 400 warheads per year in the early 1950s to a range of 2,000 to 6,000 warheads per year in the early 1960s. The record number of types simultaneously in production was 17 (for 23 weapons systems) occurring between June and December of 1964. By contrast, at several points between 1976 and 1979 there was only one type being produced.

Currently there are eight types in production with a total of 30 in the stockpile.[8] The first of over 1,000 W87 warheads designed at Livermore will begin production in the spring or summer of 1986; three years later the first of over 3,000 Los Alamos-designed W88 Trident II warheads will begin production. In terms of average annual budgets President Reagan's is third—only slightly behind those of Eisenhower and Kennedy, and outstripping those of Johnson, Truman, Carter, Nixon, and Ford.[9] Reagan's rates are almost double those of Carter. And when future constant-dollar conversions are done, it is possible that the Reagan budget might move into first place.

Stockpiles past and present reflect a variety of factors. Advocates of new weapons always justify them as a necessary response to present and future interpretations of "the threat." As the air-defense story shows, however, several types of warheads owe their existence to faulty interpretations.

As more of the secret nuclear history is revealed, the clearer the perspective becomes with regard to current decisions and events. Bureaucratic competition and inertia have led to nuclear warheads for every conceivable military mission, arm of service, and geographic theater—all compounded by a technological momentum that overwhelmed what should have been a more sober analysis of what was enough for deterrence. The result is a gigantic nuclear weapons system—laboratories, production facilities, forces, and so on—that has become self-perpetuating, conducting its business out of public view and with little accountability.

While there is no single key to understanding the present complex situation, a better knowledge of the stockpile can, at the very least, provoke the asking of new questions. □

1. See Thomas B. Cochran, William M. Arkin, Milton M. Hoenig, Robert S. Norris, *Nuclear Weapons Databook II, U.S. Nuclear Warhead Production* (Cambridge, Mass.: Ballinger, forthcoming).
2. Steven L. Rearden, *The Formative Years, 1947–1950: History of the Office of the Secretary of Defense* (Washington, D.C.: Government Printing Office, 1984), p. 423.
3. Lawrence Livermore Laboratory's first stockpile warheads were the W27 for the Regulus II missile (September 1958) and the B27 Navy bomb (November 1958). In addition to the 71 types deployed another 30 were cancelled or suspended before development was complete.
4. The largest U.S. test was the 15-megaton shot "BRAVO," February 28, 1954.
5. Lee Bowen, *History of the Air Force Atomic Energy Program: The Development of Weapons* (Washington, D.C.: U.S. Air Force Historical Division History, 1955; declassified with deletions June 1981), pp. 211–24.
6. House Armed Services Committee, *Continental Air Defense, Hearing* (July 22, 1981), p. 25.
7. The two peak years for the Manhattan Project were fiscal 1944 and 1945 when spending was $6.24 and $6.60 billion (in fiscal 1986 dollars). This compares with current budgets of $6.63, $7.27, $7.70, $8.06, $7.32, $8.47, and $8.44 billion for fiscal 1984–1990.
8. They are: B61 bomb, Mods 3 and 4, W76 Trident I, W79 8-inch artillery, W80 Mod 0 and 1 sea- and air-launched cruise missiles, B83 bomb, W84 ground-launched cruise missile, W85 Pershing II. The 30 types include the W66 Sprint and W71 Spartan, none of which had been retired as of Dec. 31, 1983. The most recent retirement is the W25/Genie in 1984.
9. Using constant fiscal 1986 dollars, the annual averages are (in millions): Eisenhower—$7,904; Kennedy—$7,690; Reagan—$7,552; Johnson—$4,747; Truman—$3,920; Carter—$3,834; Nixon—$3,505; Ford—$3,317.