BRITISH, FRENCH AND CHINESE NUCLEAR ARSENALS: RESEARCH FINDINGS AND ARMS CONTROL IMPLICATIONS

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by

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The purpose of this paper is to report on the research findings contained in a new book by NRDC, *British, French, and Chinese Nuclear Weapons*, Volume V of the *Nuclear Weapons Databook* series, published in March by Westview Press, and to examine some of the arms control implications of these second tier powers' nuclear arsenals and policies.

To keep my remarks brief I have been very concise in presenting the key findings. Let us first review the major research findings about Great Britain.

* The current British stockpile has about 200 warheads of two types with a cumulative yield of approximately 35 megatons (see Table 2). Britain has the smallest operational stockpile of the three nations in the study, making it the fifth largest nuclear weapons state in the world.

* Britain has produced about 835 warheads of eight types--including 45 for the nuclear test program--over a 40-year period. This figure represents about 1.2 percent of the some 70,000 warheads that the U.S. has produced.

* The book presents the first published pictures of several types of British bombs, including the Red Beard, Yellow Sun, and WE 177.

* The warhead stockpile has remained fairly steady from the 1960s through the late 1980s--in the 300 to 350 range. In the early 1990s, the British government withdrew some naval weapons and air force bombs, reducing the stockpile to around 200. After completion of the Vanguard submarine/Trident II missile program around the turn of the century, the stockpile will return to its traditional level of around 300. An air-to-surface missile was recently cancelled.

* Britain has had a supplementary stockpile of American nuclear weapons, that at times has exceeded its own. British forces planned to use these American nuclear warheads and weapon systems to accomplish a variety of NATO missions, thus freeing themselves from developing or producing certain weapons of their own. Since 1958, these U.S. weapons have included four types of gravity bomb, two kinds of nuclear depth charge, three types of missile, two calibers of artillery shell, and two types of atomic land mine. These warheads were deployed in Great Britain, Germany, and Italy. At the peak in the late 1970s, there were almost 400 of these American warheads, earmarked for British forces. Today there are none.

* The "special relationship" with the United States has fundamentally shaped British nuclear practices and policies. This relationship has been perhaps the single most important factor in determining the kinds of nuclear programs the British have pursued and the numbers of warheads they have built. Most British warhead designs are believed to be nearly direct copies of American warheads and thus did not need a full testing program. This explains why Britain has tested only twenty-four times since moving its testing program to the U.S. Nevada Test Site in 1962.

* The book provides new details about Britain's rush to obtain the hydrogen bomb before the impending testing moratorium in 1958. The first two attempts at detonating an H-bomb in May and June 1957 fell short of expectations, even though Prime Minister Harold Macmillan claimed success. In fact, it was only in November 1957 that a successful test was achieved.

• For the first time, details are provided about the British production of an American hydrogen bomb. After successfully testing its own thermonuclear device in 1957-1958, Britain decided to produce an American bomb using American blueprints and assistance.

Now let us now turn to the key findings for France.

* The current French stockpile has about 524 warheads of four types with a cumulative yield of approximately 100 megatons (see Table 3). France has the largest operational stockpile of the three nations in the study, making it the third largest nuclear weapons state in the world.

* France has produced about 1,110 warheads of ten different types--including over 200 for the nuclear test program--over a 33-year period. This figure includes the warhead for the Hadès missile, currently in storage, and represents about 1.6 percent of the some 70,000 warheads that the U.S. has produced.

* There will be no quantitative increase in the French nuclear stockpile. After attaining a peak of around 540 warheads in the early 1990s, the stockpile will drop to about 465 by the end of the century.

* French nuclear forces exist in greater variety than the British systems. Historically these forces fell under two basic categories: the strategic weapons, structured in a "triad" of silo-based missiles, bombers, and submarine-launched missiles; and the tactical weapons, comprised of land- and carrier-based aircraft, and short-range land-based missiles. If plans for the future strategic land-based mobile missile are shelved, French nuclear forces will be structured in a dyad instead of a triad. Likewise with the tactical systems, the Army is about to abandon its nuclear role, leaving only the Air Force and Navy with nuclear weapons.

* France was probably the most independent of the three nations examined in the book--developing the first generation of its *force de frappe* without any outside help--with the result that France took a longer time to achieve all of the major milestones. The extensive nuclear testing program is an indicator of the investment required to create its varied nuclear arsenal. However, over the last 20 years, the U.S. has secretly cooperated with France on the nuclear level and has aided France in the development of more advanced missile and warhead designs.

* Though France cannot test under the existing moratorium, French weapons designers continue to work on a variety of features concerning warhead safety (including the incorporation of insensitive high explosives), security (against unauthorized use), variable yields, improvements in yield-to-weight ratios, hardening, and simulation techniques.

Let us turn to the key findings for China

* We estimate that China maintains an arsenal of about 450 weapons of two basic categories with a cumulative yield of approximately 400 megatons: a deployed force of some 300 "strategic" weapons structured in a "triad" of land-based missiles, bombers, and submarine-launched missiles, and an estimated 150 tactical nuclear weapons, comprised of artillery shells and atomic demolition munitions (see Table 4).

* In stockpile size, China is currently ahead of Britain but slightly behind France, making it the fourth largest nuclear weapons state in the world.

* China has produced about 600 warheads of six different types--including 39 for the nuclear test program--over a 30-year period. This figure represents less than one percent of the some 70,000 warheads that the U.S. has produced.

* China is working on several programs to modernize its forces. These include a new bomber, several new ballistic missiles, and nuclear submarines. The speed of introducing new systems has traditionally been very slow.

* Contrary to some recent reports, we found no hard evidence to indicate a growing stockpile. In fact, China seems to be following the lead of the U.S., Russia, U.K., and France in limiting its arsenal, while it ponders the future role of nuclear weaponry in its overall security policy. A recent report states that conventional warheads are replacing nuclear ones on some DF-21 IRBMs. It also may be the case that China already has retired, or is in the process of retiring, its "tactical" nuclear weapons.

* Politically, China has tried to have it both ways. On the one hand, it succeeded in developing nuclear weapons and did become one of the "big five." On the other hand, China has

sought to be the leader of the Third World in disarmament matters and tries to underscore its sincerity by referring to its limited number of tests and modest sized arsenal.

In the second half of the paper let us turn to some issues that relate to the problem of nuclear proliferation and to arms control and see if the book helps us draw any lessons.

1. The first issue concerns the difficulty of building a nuclear weapon. How difficult was it for Britain, France, and China to develop a nuclear weapon? How difficult is it today for a nation to develop a nuclear weapon? Close study of the British, French, and Chinese experiences (as well as that of the United States and the Soviet Union) from the 1940s to the early 1960s leads me to conclude that building the bomb then was a difficult and expensive undertaking only attained with large-scale mobilization of vast sectors of the society.

There are some recent factors that suggest it may be easier to build a bomb today. It is also possible that future proliferators may not pursue even the modest sized arsenals of Britain, France, or China. A feature of the second tier has been that they also pursued delivery systems that were similar to the delivery systems of the U.S. and Soviet Union. These forces included jet bombers, ballistic missiles, and nuclear powered submarines. These programs proved costly and complicated. Third tier states of the future may forego such choices and build very limited stockpiles of a few to a few dozen nuclear weapons.

2. Why have leaders decided that they need nuclear weapons? Generally, it was because they believed that possession of them provided some measure of security against foes near and far. The dynamics of the Cold War created the basic pretext for why each of the five powers decided to obtain the bomb. Secondary rationales were often advanced about how the bomb could be influential in the conduct of certain foreign policy situations. The possession of nuclear weapons once conferred "great power" status on a nation, and perhaps not coincidentally, the five permanent members of the United Nations Security Council are also the five declared nuclear powers. What are the reasons today that leaders believe that they need nuclear weapons?

3. A research finding of the book that I think is very important, especially in thinking about the current problem of proliferation, is to appreciate the degree of collaboration and assistance that has gone on in developing the bomb. We found that proliferation started early, and has been a constant in the history of nuclear weapons development ever since. Before Pearl Harbor the British and Americans were exchanging information, and after 1943 they became intimate partners in the Manhattan Project. After the war, for many reasons, there was a falling out but from 1958 to today, the British and Americans have forged an extremely close relationship on nuclear matters.

The French were probably the most independent of the three, and consequently took a longer time to achieve all of the milestones. U.S. collaboration with the French during the Manhattan Project was marginal, though France did obtain some limited information about materials production. There were not any French scientists at Los Alamos during the war, and for a long time afterward the Americans viewed the tumultuous politics of the Fourth Republic with suspicion. There were basing agreements under NATO, and U.S. nuclear weapons were supplied to French forces, and U.S. nuclear units were based in France and its territories but a relationship of the kind that developed with the British never came to pass.

In the Chinese-Soviet case, there remain many interesting questions. The conventional account, promoted by the Chinese, suggests that their split with the Soviets in 1959-1960 gave an impetus to Chinese self-sufficiency. To argue the contrary case, the Russians apparently supplied the

Chinese with the blueprints of the major facilities that were needed to make a bomb. These included a gaseous diffusion plant, plutonium production reactors, chemical separation facilities, and much knowledge about bomb design. Without more extensive documentation from the Chinese and the Russians, it is difficult to tell at this point which argument has greater weight. Certainly the Russians gave the Chinese a head start in nuclear weapon development and saved them time. The nature of the collaboration, at least for the short time it went on, was extensive and unprecedented. The opening of Russian archives may shed further light on this issue.

A full history of the nuclear era would reveal many other examples of collaboration. Each needs to be explored to see the detailed ways in which one country has helped another. For example:

* In what ways has Israel benefitted from French and/or American help?
* In what ways did Israel help South Africa with its bomb?
* In what ways has India had help from U.S., USSR and Canada?
* In what ways has China has helped Pakistan? In what ways is it helping Iran?
* In what ways did the Soviet Union help North Korea?

4. Another issue that the book attempts to deal with is to project the future trends of the these three nations nuclear weapon programs. Contrary to what many people think, the British, French, and Chinese stockpiles have already peaked and under current plans will not increase in the future. There remains a lingering perception that their nuclear forces are about to double, triple, or quadruple in the near future. That was potentially true in the mid-1980s when there were numerous plans to modernize and expand their arsenals. But these plans did not come to pass. There was not enough money, and not enough need, as the end of the Cold War undermined the putative rationale. Weapons programs were cancelled, cutback, and stretched out.

A second common impression is, that with the once growing British, French and Chinese arsenals, and shrinking U.S.-Russian ones, arms talks among all five were more likely as they converged. As plans now stand this gap will not be closed. Even after START II is implemented, and other reductions have occurred, the combined U.S. and Russian arsenals will be ten to fifteen times larger than the combined British, French, and Chinese forces. Nevertheless, sheer numbers are not the only issue, and there appears to be no real impediment to all five powers negotiating together on various arms control issues.

In conclusion let me emphasize what I think is the real value of the book. In recent thinking about arms control there is a growing consensus that a necessary prerequisite must be "transparency," that is, the positive effort by the parties to disclose information about their forces, to engage in data exchanges, and to allow intrusive inspections, among other things. Transparency is seen as one way to build confidence and trust. Transparency is the opposite of concealment and secrecy, which often produces distrust, suspicion, and fear.

If there is to be success in future arms control agreements--such as the Comprehensive Test Ban negotiations now underway, and the Non-Proliferation Treaty review next year--basic factual information will be essential. Unfortunately, governments have been reluctant to provide much of the accurate and reliable information needed for an informed discussion on the role of nuclear weapons in today's world. We hope that this book helps to fill that void. Thank you.

Table 1
Nuclear Milestones

	United States	Soviet Union	Britain	France	China
Current number of warheads in stockpile	9,500--active 6,000--awaiting disassembly	15,000--active 15,000--awaiting disassembly	200	528	450
Peak number of warheads in stockpile/year	32,500/1967	45,000/1986	350/1975	538/1991	450/1993
Total number of warheads built	70,000 1945-1992	55,000 1949-1992	834 1952-1992	1,110 1960-1992	600 1964-1992
Number of known test explosions (end 1993)	1,027	715	45	204	39
Testing Milestones					
First fission test, type/yield	16 July 1945 Plutonium/23 Kt	29 August 1949 Plutonium/20 Kt	3 October 1952 Plutonium/25 Kt	13 February 1960 Plutonium/60-70 Kt	16 October 1964 U-235/20 Kt
First test of boosted weapon/yield	8 May 1951 Item/46 Kt	12 August 1953 Joe 4/400 Kt	1956 ?	24 September 1966 Rigel/150 Kt	9 May 1966 c. 200 Kt
First multistage thermonuclear (hydrogen bomb) test, yield	31 October 1952 10.4 Mt	22 November 1955 1.6 Mt	8 November 1957 1.8 Mt	24 August 1968 2.6 Mt	17 June 1967 3 Mt
Number of months, 1st fission bomb to 1st multistage TN	87	75	61	102	32

First airdrop explosion nuclear weapon, aircraft	6 August 1945 B-29	14 September 1954 Bear ? at Totsk	11 October 1956 Valiant	19 July 1966 Mirage IVA	14 May 1965 Hong 6
Number of known atmospheric tests (includes underwater)	215	207	21	45	23
Largest atmospheric test	28 February 1954 15 Mt	30 October 1961 50-58 Mt	28 April 1958 3 Mt	24 August 1968 2.6 Mt	17 November 1976 4 Mt
Last atmospheric test	4 November 1962	25 December 1962	23 September 1958	15 September 1974	16 October 1980
First underground test	26 July 1957	11 October 1961	1 March 1962	7 November 1961	23 September 1969
Largest underground test	6 November 1971 5 Mt	27 October 1973 2.8-4 Mt	5 December 1985 <150 Kt	25 July 1979 120 Kt	21 May 1992 660 Kt
Current test site	Nevada	Kazakhstan Novaya Zemlya	Nevada	Mururoa Fangataufa	Lop Nur (Malan)
Weapon Development Milestones					
Atomic bomb developers	J. Robert Oppenheimer Gen. Leslie Groves	Igor V. Kurchatov	William G. Penney	Gen. Charles Ailleret Pierre Guillaumat	Nie Rongzhen Liu Jie, Li Jue Deng Jiaxian
Hydrogen bomb developers	Stanislaw Ulam Edward Teller	Andrei Sakharov Yuliy B. Khariton Yakov B. Zeldovich	William Cook Keith Roberts Bryan Taylor	Robert Dautray	Deng Jiaxian Yu Min Peng Huanwu
First operational ICBM	31 October 1959 Atlas D	1960 SS-6	none	2 August 1971 S2 IRBM	August 1981 Dong Feng-5
First nuclear-powered naval vessel enters service	January 1955 *Nautilus* SSN	August 1958 *November* SSN	1963 *Dreadnought* SSN	January 1971 SSBN *Le Redoutable*	1974 *Han* SSN

First SSBN patrol with Polaris-type SLBM	15 November 1960 *Washington* Polaris A1	1968 *Yankee* SS-N-6	Mid-June 1968 *Resolution* Polaris A3T	28 January 1972 *Le Redoutable* M1 SLBM	1986 *Xia* JL-1
First MIRVed missile deployed	19 August 1970 Minuteman III	1974 SS-18/SS-19 ?	1995 Trident II	April 1985 M4A SLBM	none

The Nuclear Infrastructure

Assembly/disassembly plants	Pantex, near Amarillo, Texas	Nizhnyaya Tura (Sverdlovsk-45), Yuryuzan (Zlatoust-36), Penza (Penza-19)	Burghfield Royal Ordnance Factory, near Reading	Centre d'Etudes de Valduc (Cote d'Or)	Subei (Gansu), Guangyuan (Sichuan)
Plutonium production (no. of reactors)	Hanford (9) Savannah River (5)	Chelyabinsk-40 (6) Tomsk-7 (5) Krasnoyarsk-26 (3)	Calder Hall (4) Chapelcross (4) Windscale (2)	Marcoule (3) Chinon-2,-3 (2) Bugey-1 (1) Phénix (1) Celestin-1,-2 (2)	Jiuquan (Gansu) (1) Guangyuan (Sichuan) (1)
Uranium enrichment plants	Oak Ridge Portsmouth Paducah	Verkniy-Neyvinsky Krasnoyarsk Angarsk Tomsk	Capenhurst	Pierrelatte	Lanzhou, Heping (Sichuan)
Chief design labs	Los Alamos Lawrence Livermore	Arzamas-16 Chelyabinsk-70	Aldermaston	Limeil-Valenton	Ninth Academy Mianyang (Sichuan)
Current directors/ administrators	Hazel O'Leary, Sec DOE; Siegfried Hecker, LANL; Bruce Tartar, LLNL (acting)	Viktor Mikhailov, Minister of Atomic Energy and director, Arzamas-16; Evgeniy N. Avrorin, scientific director, Chelyabinsk-70	Donald Spiers, Controller of Establishments Research and Nuclear; Brian Richards, director of Aldermaston	Roger Baléras, director, Direction des Applications Militaires	Hu Renyu, director, Ninth Academy; Hu Side, deputy director

Table 2
British Nuclear Forces, 1994

Weapon System[1]	No. Deployed	Year Deployed	Range (km)[2]	Warheads: Warhead x Yield	Type	No. in Stockpile
Aircraft						
Tornado GR.1[3]	72	1982	1300	1-2 x 200/ 400-Kt bombs	WE 177A/B	100[4]
Buccaneer S2B	27	1971	1700	1 x 200/ 400-Kt bomb	WE 177A/B	
Submarine-based Missiles						
Polaris A3-TK (Chevaline)	48	1982[5]	4700	2 x 40 Kt	TK 100 (MRV)	100[6]

[1] By July 1992, the last of the U.S. nuclear warheads available for British forces (provided on a continual basis since the late 1950s) had been removed from Europe and returned to the United States--specifically, those warheads for Nimrod ASW aircraft based in Britain, and Lance missiles and nuclear artillery shells based in Germany.

[2] Range for aircraft indicates combat radius, without refuelling.

[3] At the peak in 1990, the Royal Air Force operated 11 squadrons of Tornado GR.1/1A aircraft, nine of which were nuclear-capable strike/attack variants (GR.1), and two were reconnaissance variants (GR.1A). Following the end of the Cold War, the three GR.1 squadrons based at Laarbruch, Germany, were disbanded, and other squadrons were redeployed so that the eight remaining squadrons could operate in a nuclear role. The two Tornado squadrons at RAF Marham are expected to redeploy to RAF Lossiemouth in 1993-1994, replacing the Buccaneer S2B in the maritime strike role.

[4] Britain produced a total number of about 200 WE 177 tactical nuclear bombs--including 175 of the A and B variant (for use by the RAF) and 25 of the C variant (for use by the Royal Navy). The 5-10 Kt WE 177C bomb was retired in 1992-1993. It existed in both a free-fall and depth-bomb modification, and was assigned to selected Sea Harrier FRS.1 aircraft and ASW helicopters. By June 1992, Britain had reduced by half the stockpile of aging WE 177A/B free-fall nuclear bombs held by the RAF. Consequently, we have assumed a total RAF inventory of approximately 100 bombs, including those for training and spares.

[5] The two-warhead Polaris A3-TK (Chevaline) SLBM was first deployed in 1982 and has now completely replaced the original three-warhead Polaris A-3T SLBM, first deployed in 1968.

[6] Britain produced only enough warheads for three full boat-loads of missiles, or 48 missiles, with a total of 96 warheads. In March 1987 French President François Mitterrand stated that Britain had "90 to 100 [strategic] warheads."

Table 3
French Nuclear Forces, 1994

Weapon System	No. Deployed	Year Deployed	Range (km)[1]	Warhead x Yield	Warheads Type	No. in Stockpile
Aircraft						
Mirage IVP/ASMP	18	1986	1570	1 x 300 Kt	TN 80	18
Mirage 2000N/ASMP	45[2]	1988	2750	1 x 300 Kt	TN 81	42
Land-based Missiles						
SSBS S3D	18	1980	3500	1 x 1 Mt	TN 61	18
Pluton[3]	42	1974	120	1 x 10/25 Kt	AN 51	42
Hadès[4]	[30]	[1992]	480	1 x 80 Kt	TN 90	30
Submarine-based Missiles[5]						
MSBS M4A/B	64	1985	6000	6 x 150 Kt	TN 70	96
					TN 71	288
Carrier-based Aircraft						
Super Etendard/ ASMP	24	1978	650	1 x 300 Kt	TN 81	20[6]

[1] Range for aircraft assumes combat mission, without refuelling, and does not include the 90- to 350-km range of the ASMP air-to-surface missile.

[2] Only 45 (three squadrons) of the 75 Mirage 2000N aircraft have nuclear missions.

[3] The Pluton was totally withdrawn from service by the end of 1993. The table assumes three regiments of the original five (with 35 launchers and 70 warheads).

[4] Although the first regiment was activated at Suippes in eastern France on 1 September 1991, the plan to deploy Hadès was shelved soon after and the missiles and warheads were placed in storage. The program had an original goal of 60 launchers and 120 missiles and was eventually cut to 15 launchers and 30 missiles.

[5] Upon returning from its 58th and final operational patrol on 5 February 1992, SSBN *Le Redoutable* was retired, along with the last MSBS M20 missiles. The remaining five submarines are capable of carrying the MSBS M4A/B missile. Though there are 80 launch tubes on the five SSBNs, only four sets of SLBMs were bought, and thus the number of TN 70/71 warheads in the stockpile is assumed to be 384, probably with a small number of spares.

[6] The Super Etendard achieved a nuclear capability in 1981 with the AN 52 bomb, and eventually all three squadrons were capable of carrying this free-fall bomb. From April 1989, the Super Etendard began receiving the ASMP missile, and by mid-1990 24 aircraft (two squadrons) were capable of carrying the ASMP. The third squadron relinquished its AN 52s (and thus its nuclear role) in July 1991.

Table 4
Chinese Nuclear Forces, 1994

Weapon System Type	No. Deployed	Year Deployed	Range (km)	Stages	Payload (kg)	Warheads Warhead x Yield	No. in Stockpile	Comment
Aircraft[1]								
H-5 (B-5)	30	1968	1200	na	2000	1 x bomb		Beagle
H-6 (B-6)	120	1965	3100	na	4500	1-3 x bombs	150	Badger
Q-5 (A-5)	30	1970	400	na	1500 ?	1 x bomb		
H-7	0	1994?	?	na	?	1 x bomb		
Land-based Missiles[2]								
DF-3A/CSS-2	50	May 1971	2800	one	2150	1 x 3.3 Mt	50	liquid/mobile
DF-4/CSS-3	20	Nov 1980	4750	two	2200	1 x 3.3 Mt	20	liquid/silo/rollout
DF-5A/CSS-4	4	Aug 1981	13,000	two	3200	1 x 4-5 Mt	4	liquid/caves
DF-21/CSS-6	36	1985-1986	1800	two	600	1 x 200-300 Kt	36	solid/mobile
DF-31	0	late 1990s	8000	three	700	1 x 200-300 Kt	?	solid/land
DF-41	0	c. 2010	12,000	three	800	MIRV	?	replace DF-5
Submarine-based Missiles[3]								
JL-1 (CSS-N-3)	24	1986	1700	two	600	1 x 200-300 Kt	24	solid/09-2, 09-3
JL-2 (CSS-N-4)	0	late 1990s	8000	three	700	1 x 200-300 Kt	?	solid/09-4
Tactical Weapons								
Artillery/MLRS/ADMs		mid-1970s	--	--	--	low Kt	150	--

[1] All figures for bomber aircraft are for nuclear-configured versions only. Hundreds of aircraft are also deployed in nonnuclear versions. Aircraft range is equivalent to combat radius. Assumes 150 bombs for the force, with yields estimated between 10 Kt and 3 Mt.

[2] The Chinese define missile ranges as follows: short-range, less than 1000 km; medium-range, 1000-3000 km; long-range, 3000-8000 km; intercontinental range, over 8000 km. The nuclear capability of the M-9 is unconfirmed and not included.

[3] Two JL-1 SLBMs are presumed to be available for rapid deployment on a single Golf-class test submarine (SSB).