

mind•full: a brainsnack for future leaders with ethical appetites

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future of nuclear weapons

A single nuclear weapon can release in one micro-second more energy than all the conventional weapons used in all wars throughout history, according to the recent report of the Canberra Commission. The devastation wrought by nuclear weapons can affect people and the environment for generations. Most people are surprised to learn just how many nuclear weapons there are—the Natural Resources Defense Council estimates that in 1995 over 40,000 nuclear warheads still existed in the world's stockpiles.

China, France, Russia, the UK, and the US are the five declared nuclear weapons states. In addition, India, Israel, and Pakistan are often referred to as "undeclared" nuclear weapons states. Some critics of the *status quo* claim the current distribution of nuclear weapons is discriminatory and that the nuclear weapons states are not doing enough to reach their promised goal of disarmament. This clash between the "haves" and the "have nots" is intensifying.

Most military people agree that nuclear weapons are not useful as military weapons. Their cost is staggering—the Brookings Institution states that the US alone has spent roughly four trillion dollars on nuclear weapons since World War II. Some say that nuclear weapons have secured the peace between the two superpowers and should be kept indefinitely, especially in case a "rogue" state acquires one. Others say that nuclear weapons threaten the very existence of life on our planet and should be eliminated as soon as possible. A consensus is growing, however, that nuclear weapons stockpiles should be severely cut back. More and more people are beginning to discuss how to reach a nuclear weapons free world.

The mission of Student Pugwash USA is to promote the socially responsible application of science and technology in the 21st century. As a student organization, Student Pugwash USA encourages young people to examine the ethical, social, and global implications of science and technology, and to make these concerns a guiding focus of their academic and professional endeavors.

The **mind•full** series encourages readers to explore crucial ethical dilemmas associated with the application of science and technology.

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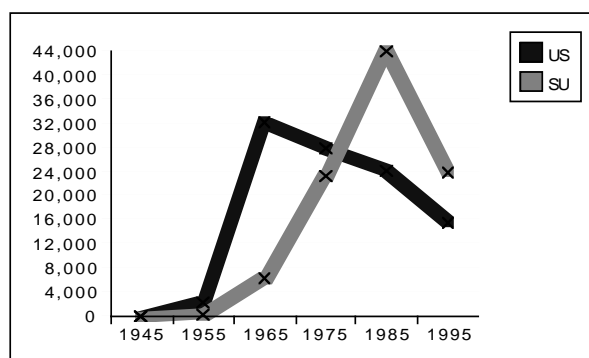
go figure!

Secrecy has made it difficult to know precise data about worldwide nuclear weapons stockpiles. During the height of the Cold War, for example, fears of a "missile gap" between the US and the Soviet Union fueled an arms race in the US in the 1960s. Later, the public learned that the perceived missile gap did not actually exist and that the US had significantly more nuclear weapons than the Soviet Union at the time. (The Soviet Union eventually overtook the US.)

Much more is known today about the US and the Russian arsenals. China, France, and the UK, however, still do not publish many details on the numbers and types of nuclear weapons they hold. Information about the nuclear weapons cooperation between the US and its British and French allies is extremely difficult to find. The undeclared nuclear states maintain even greater secrecy around their possible arsenals.

The role of non-governmental organizations has been extremely important in pursuing greater public openness in this regard. Groups like the Natural Resources Defense Council, the Stockholm International Peace Research Institute, and the International Institute for Strategic Studies have published the most widely cited figures on nuclear weapons holdings. In addition to actual numbers of warheads or launchers, other key statistics are often needed to know a state's true ability to maintain or develop nuclear weapons. These include: the number of nuclear weapons tests conducted, fissile material production and holdings, and transfers of sensitive equipment needed to develop nuclear weaponry.

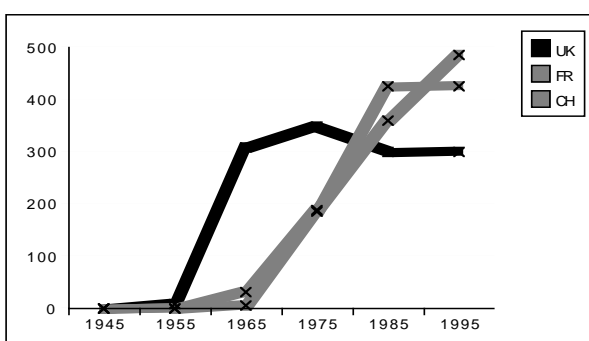
global nuclear stockpiles 1945-1995



enough

	US	SU	UK	FR	CH	Total
1945	2	0	0	0	0	2
1955	2,422	200	10	0	0	2,632
1965	32,400	6,300	310	32	5	39,047
1975	27,950	23,500	350	188	185	52,173
1985	24,209	44,000	300	360	425	69,294
1995	15,430	24,000	300	485	425	40,640

already?



↑ **Source:** Natural Resources Defense Council, March 1996. <http://www.nrdc.org/find/nustock.html>. "The [1995] figures for the United States and Soviet Union/Russia include warheads with active, operational forces and retired, non-deployed warheads awaiting dismantlement and weapons in reserve. The estimate for Soviet Union/Russia is 50% active, 50% retired/reserve."

→ **Source:** NRDC. April 1996. <http://www.nrdc.org/find.nustart2.html>. Note: These figures are based on estimates and include total possible nuclear weapons stockpiles. Most figures given for nuclear forces post-START II only mention the strategic forces, since that is the focus of the Treaty.

in control or out of it ?

In recent years, a series of steps have been taken to limit the numbers of nuclear weapons in existence. These include the Strategic Arms Reduction Treaties (START I and START II), the indefinite extension of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the Comprehensive Test Ban Treaty (CTB or CTBT), and steps toward realizing nuclear weapons free zones in the South Pacific, Africa, and Latin America. Russia and the US no longer target their nuclear weapons at each other. They have decreased alert status and worked together to control fissile material. They are also dismantling thousands of nuclear weapons per year. Some nuclear weapons states have retired certain types of weapons considered most unsafe or destabilizing, including deployed tactical (shorter range) nuclear weapons.

Critics of such measures argue that these actions merely guarantee the continued existence of the "nuclear weapons club." They say that more stringent measures should be taken to commit the nuclear weapons states to a path toward nuclear disarmament, a goal that most states have committed to in the NPT.

Further measures could include a nuclear weapons convention—a comprehensive treaty that would ban nuclear weapons. Such a convention could include a ban on the production of fissile material, an agreement on no-first-use, an agreement by the nuclear weapons states not to develop new nuclear weapons, closing the test sites, and greater international controls on fissile materials. Some of the latter steps can also be taken unilaterally or through bilateral or multilateral agreements.

us and russian nuclear forces, 2003 (after start II)

	Strategic Forces	Non-Strategic Forces	Hedge/Inactive Reserve Stockpiles	Total
US	3,500	950	4,500-5,000	9,500-10,000
Russia	3,250	2,750	4,000-5,000	10,000-11,000

geek speak

Chain reaction—A self-sustaining series of nuclear fission reactions. Neutrons produced by fission cause more fission. Chain reactions are essential to the functioning of nuclear reactors and weapons.

Fissile—Capable of being split by a low-energy neutron. The most common fissile isotopes are uranium 235 and plutonium 239.

Fission—The splitting or breaking apart of the nucleus of a heavy atom like uranium or plutonium, usually caused by the absorption of a neutron. Large amounts of energy and one or more neutrons are released when an atom fissions.

Fusion—The process whereby the nuclei of lighter elements, especially the isotopes of hydrogen (deuterium and tritium) combine to form the nucleus of a heavier element with the release of substantial amounts of energy.

Highly enriched uranium—Uranium with more than 20 percent of the uranium 235 isotope, used for making nuclear weapons and also as fuel for some isotope-production, research, and power reactors. Weapons-grade uranium is a subset of this group.

Plutonium—A manmade fissile element. Pure plutonium is a silvery metal that is heavier than lead. Material rich in the plutonium 239 isotope is preferred for manufacturing nuclear weapons, although any plutonium can be used. Plutonium 239 has a half-life of 24,000 years.

Thermonuclear weapon—A nuclear weapon that uses fission to start a fusion reaction. Commonly called an "H-bomb."

Tritium—The heaviest isotope of the element hydrogen. Tritium is three times heavier than ordinary hydrogen. Tritium gas is used to boost the explosive power of most modern nuclear weapons, inspiring the term, "hydrogen bomb." It is produced in production reactors and has a half-life of just over 12 years.

Uranium—The basic material for nuclear technology. It is a slightly radioactive naturally occurring heavy metal that is more dense than lead. Uranium is 40 times more common than silver.

Weapons-grade uranium—Uranium made up of over 90 percent of the fissile uranium 235 isotope.

Source: "Closing the Circle on the Splitting of the Atom: The Environmental Legacy of Nuclear Weapons Production in the United States and What the Department of Energy is Doing About It." US Department of Energy Office of Environmental Management. January 1995.

npt (in)definitely!

On May 11, 1995, the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT) was extended indefinitely, ending a contentious debate about the future of the Treaty and its contributions to disarmament. The NPT contains a bargain between nuclear and non-nuclear states. Nuclear states committed themselves to disarmament in Article VI of the Treaty. In return, non-nuclear weapons states agreed not to develop nuclear weapons themselves. The Treaty guarantees non-nuclear weapons states the right to pursue nuclear power and other non-weapons-related nuclear technologies.

Article VI of the Treaty states, "Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a Treaty on general and complete disarmament under strict and effective international control." The vote on indefinite extension was taken as part of a politically binding package including principles and objectives for non-proliferation and disarmament and an agreement to hold further meetings to enhance the Treaty's review process.

canberra commission—mission's possible!

Established in November 1995 by the Australian government, the independent Canberra Commission's mandate was to propose steps toward a nuclear weapons free world. Members of the Commission included Professor Joseph Rotblat, President of the Pugwash Conferences and 1995 Nobel Peace Prize recipient, and other senior experts from academe, government, and the military. The Commission's report was issued on August 14, 1996 and has quickly become one of the most widely cited studies on the question of how to achieve a nuclear weapons free world. Stating that "[n]uclear weapons pose an intolerable threat to all humanity and its habitat" and that "[t]he possession of nuclear weapons by any state is a constant stimulus to other states to acquire them," the Canberra Commission identified a series of steps to take toward disarmament, starting with an unequivocal commitment from the five declared nuclear weapons states to the elimination of nuclear weapons.

world court drops the gavel

On July 8, 1996, the International Court of Justice issued an advisory opinion on the legality of the threat or use of nuclear weapons. Requested by the United Nations General Assembly, the World Court opinion is seen by many as a portentous event for the future of nuclear weapons. The Court stated unanimously that "[t]here exists an obligation to pursue in good faith and bring to a conclusion negotiations leading to nuclear disarmament in all its aspects under strict and effective international control." The Court was divided on the question of whether the threat or use of nuclear weapons was legal in extreme instances of self defense, where a state's survival might be at stake.

no nukes is good nukes?

ctbt—at long last

On September 10, 1996, a special session of the United Nations General Assembly approved the long-sought-after Comprehensive Test Ban Treaty in an overwhelming vote: 158 for, 3 against, and 5 abstained. On September 24, the United States and the other four declared nuclear weapons states signed the Treaty, hopefully forever sealing one of the most contentious arms control treaties in our century.

Widespread debate continues over the Treaty's ultimate impact—many question whether it will constrain further nuclear weapons development in existing nuclear weapons states and whether it will stop other states from acquiring nuclear weapons. Some countries, led recently by India, see the CTBT as discriminatory. They say the CTBT will protect the nuclear weapons monopoly and that it does little to commit the nuclear weapons states to disarmament. Currently, India must ratify the Treaty before it enters into force. Most agree, however, that states that have already signed the Treaty will be bound to observe the Treaty until it officially enters into force.

(anything but a) conclusion

Former nuclear weaponeer Ted Taylor figures that in the brief moment after the bomb that destroyed Nagasaki was detonated, energy equivalent to a staggering 20 million kilograms of dynamite was contained in a baseball-sized sphere of plutonium. He says that nuclear weapons have brought our destructive capacity "clear off the human scale." Questions about the future of nuclear weapons will always draw us back to the central question: are weapons with this power and impact justified? The future of nuclear weapons depends on what role we think science and technology should play in creating a safer and more secure world.

How do **you** answer the **tough questions** — — — — —

It is now over fifty years since the US dropped nuclear weapons on Hiroshima and Nagasaki. The cities disappeared in a matter of seconds and many people in those areas are still suffering the long term effects of radiation exposure. Do you think facts like these make nuclear weapons different from conventional weapons? Do you think they are different from chemical and biological weapons? If yes, what responsibilities does this place on the leaders of countries that possess nuclear weapons? What responsibilities does it place on the leaders of nations that do not have nuclear weapons?

Under what circumstances, if any, do you think the United States would be right to use a nuclear weapon? If it were your decision, would you ever issue a command to launch a nuclear weapon? Do you think there is ever a legitimate reason to use nuclear weapons against a non-nuclear weapon state?



- States which do not now
- possess nuclear weapons often
- claim that if the nuclear
- weapons states are able to enjoy
- greater security because of the
- nuclear weapons, then all states
- have that right. Do you agree?
- Why or why not?

Do you think it is possible to achieve world wide nuclear disarmament? If you were the US president, what situation would need to exist in the world before you would order destruction of the final US nuclear weapon?

Nuclear weapons development, production, and testing often inflict long-lasting damage on the environment and the people exposed to these environmental hazards. Do you think a government is responsible for funding clean up and care for these "by-products" of its nuclear program? In terms of priority, do you think clean up is more or less important than developing new weapons?



Whose responsibility is it to seek nuclear disarmament—politicians, citizens, non-governmental organizations, or the scientific community? Do you think scientists have a special responsibility since without their knowledge the weapons could not be created? Do you think scientists should sign a pledge, as former weapons designer Hans Bethe and others have urged, to refuse to work on nuclear weapons programs? Why or why not? Under what circumstances would you consider working on a nuclear weapons program?

How much information do you think nuclear weapons states should make available to the public? Are there distinctions on the type of information they should publish—numbers of weapons, capabilities of those weapons, intended targets, research and development plans, strategies for their potential use, details on accidents involving nuclear weapons, etc.?



Nuclear power plants often produce materials needed to develop nuclear weapons. The Non-Proliferation Treaty guarantees non-nuclear weapons states the right to rely upon nuclear power. Do you think the low cost energy these plants provide is worth the risk that the fissile material might be used by a state seeking to possess a nuclear weapon?



As previously mentioned, one study done by the Brookings Institution states that the US alone has spent roughly \$4,000,000,000,000 on nuclear weapons since the beginning of the Manhattan Project. Do you think this financial commitment has helped to create a culture of confrontation and suspicion, or do you think it made peace between the superpowers possible? Do you think this level of funding has had an effect on society in other ways? If it were your choice and you had limited money, would you fund the nuclear weapons program, loans for people to attend college, AIDS research, or alternative energy research?

Some people say that the US must develop a defensive system to protect the nation against a nuclear attack. While broad-based ideas like President Reagan's Strategic Defense Initiative have been sidelined, some are pushing now for technologies to defend against more limited attacks. Do you think this is a worthwhile use of limited government resources? Do you think it is worth causing significant conflict with Russia over existing treaties?



in depth

- *Acronym Reports*, Rebecca Johnson (editor)—very detailed reports on both the CTBT and the NPT extension debates in Geneva. A nerd's delight. Available in the US from the British American Security Information Council, 1900 L Street, NW, Suite 401, Washington, DC 20036. Tel: 202-785-1266. Fax: 202-387-6298. E-mail: basicusa@igc.org. BASIC also produces studies on nuclear weapons and has a newsletter that gives updates on international developments. In Europe, contact Disarmament Intelligence Review: e-mail acronym@gn.apc.org.
- *Blueprint for a Nuclear Weapon-Free World*, Eddie Conçalves and Martin Jones—less "establishment" than the others listed here. Includes a forward by Professor Rotblat. CND has an amazing legacy for those interested in citizen efforts to ban the bomb. FYI: their logo is commonly used in the US today as the "peace" symbol. Campaign for Nuclear Disarmament, August 1996. 162 Holloway Road, London N7 8DQ, UK. Tel: 44-171-700-2393. Fax: 44-171-700-2357. E-mail: cnd@gn.apc.org. Web: <http://www.mcb.net/cnd/>.
- *Dark Sun: The Making of the Hydrogen Bomb*, Richard Rhodes—great resource on the H-bomb project. New York: Simon and Schuster, 1995.
- *An Evolving US Nuclear Posture: Second Report of the Steering Committee, Project on Eliminating Weapons of Mass Destruction*, General Andrew J. Goodpaster (USA, ret., chair)—see how the center is moving toward a consensus on the need for a nuclear weapons free world. A must read if you are serious about this stuff. Henry L. Stimson Center, Report No. 19, December 1995. 21 Dupont Circle, NW, Suite 500, Washington, DC 20036. Tel: 202-223-5956. Fax: 202-785-9034. Available on the Web: <http://www.clark.net/pub/stimson/>.
- *The Making of the Atomic Bomb*, Richard Rhodes—the definitive history of the development of atomic weapons, all 886 pages of it! Thankfully available in paper back. Simon and Schuster, New York, 1986.
- *Making Weapons, Talking Peace: A Physicist's Odyssey from Hiroshima to Geneva*, Herbert F. York—a frank narrative on the development of York's career, from student to the head of Livermore Laboratory to arms control negotiator. Basic Books, New York, 1987. York's other books are also worth reading.
- *A Nuclear Weapon-Free World: Desirable? Feasible?* Jack Steinberger, Bhalchandra Udgaonkar, and Joseph Rotblat (editors)—the Pugwash Conferences' book that some say led to the formation of the Canberra Commission. Available in paperback. San Francisco: Westview Press, 1993.
- *Proliferation: Threat and Response*, Office of the Secretary of Defense—the US government's summary of proliferation concerns. April 1996. ISBN 0-16-048591-6.
- *Report of the Canberra Commission on the Elimination of Nuclear Weapons*—read it! read it! read it! Canberra, Australia: National Capital Printers, August 1996. ISBN 0 642 25090 1. Available on the Web: <http://www.dfat.gov.au/dfat/cc/cchome.html>.
- *Star Warriors: A Penetrating Look into the Lives of the Young Scientists Behind Our Space Age Weaponry*, William Broad—a readable and thought-provoking look into the pressures a group of young people faced in working on nuclear weapons programs at Lawrence Livermore National Lab. New York: Simon and Schuster, 1985.
- "Worldwide Nuclear Abolition," Theodore Taylor—this article contains Taylor's quotes used in the conclusion to this *mind•full*. *Waging Peace Bulletin*, Volume 6, Number 2, Summer 1996. See also Taylor's longer piece, "Nuclear Power and Nuclear Weapons," *Global Security Study* No. 22, July 1996. Both are available from the Nuclear Age Peace Foundation, 1187 Coast Village Road, Suite 123, Santa Barbara, CA 93108-2794. Tel: 805-965-3443 Fax: 805-568-0466 E-mail: napf@napf.org.

on screen

- *The Day After Trinity*—a documentary (and CD ROM) that focuses on the scientists working on the Manhattan Project.
- *The Day After*—a Cold War classic that will send shivers down your spine.
- *Dr. Strangelove*—because no list of nuclear films would be complete without it.
- *Fat Man, Little Boy*—a Hollywood version of the Manhattan Project, explores the human side of working on the bomb.

cyberspace

top pick

Monday Lobby (a weekly meeting of peace and security organizations in Washington, DC. This Web site lists events on Capitol Hill, Monday Lobby Web resources, and internship and job openings in these groups. It also provides links to various organizations involved with Monday Lobby. Extremely well-linked to other non-profits, government sources, and political Web sites. Check it out!—<http://www.fas.org/pub/gen/mlg/>

surf the net in a new way**best of the rest**

- Arms Control and Disarmament Agency (great primary sources)—<http://www.acda.gov/>
- The Bulletin of the Atomic Scientists (articles on disarmament and the Nuclear Notebook series—a widely cited source for stats on nuclear stockpiles)—<http://neog.com/atomic/index.html>
- The Canberra Commission on the Elimination of Nuclear Weapons—<http://www.dfat.gov.au/dfat/cc/cchome.html>
- Department of Energy—<http://www.doe.gov>
- NGO Committee on Disarmament (links to NGO and UN sites, good updates on campaigns and treaties)—<http://www.igc.apc.org/disarm/>
- Stimson Center (excellent links to other sites, information on disarmament research)—<http://www.clark.net/pub/stimson/>
- The US Nuclear Weapons Cost Study Project, Brookings Institution (great stats on the true cost of nuclear weapons)—<http://www.brook.edu/fp/projects/nucwcost/weapons.htm>
- Center for Nonproliferation Studies, Monterey Institute of International Studies (great databases on nuclear proliferation)—<http://cns.miis.edu/>
- Natural Resources Defense Council (Nuclear Resources Web page contains analyses and fact sheets)—<http://www.nrdc.org/>

check it out!

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but wait, there's more!

- **mind•full: a brainsnack for future leaders with ethical appetites.** International weapons trade, emerging infectious diseases, access and the Internet, and the public's role in science issues available upon request. Upcoming issues in fall 1996 will address: water quality and availability, and alternative energy sources.
- **Jobs You Can Live With: Working at the Crossroads of Science, Technology, and Society.** The fifth edition of the Student Pugwash USA internship directory. It highlights organizations that work to promote the ethical use of science and technology and provides suggestions on how to go about the internship and job search (available fall 1996).
- **The Global Issues Guidebook.** A student-authored discussion and classroom resource on science, technology, and society issues.
- **Pugwash.** The chapter newsletter.
- **Chapter Organizing Guide.** Provides chapter members with an A to Z guide to getting a campus-based chapter up and running.
- **Tough Questions.** Student Pugwash USA's newsletter.

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