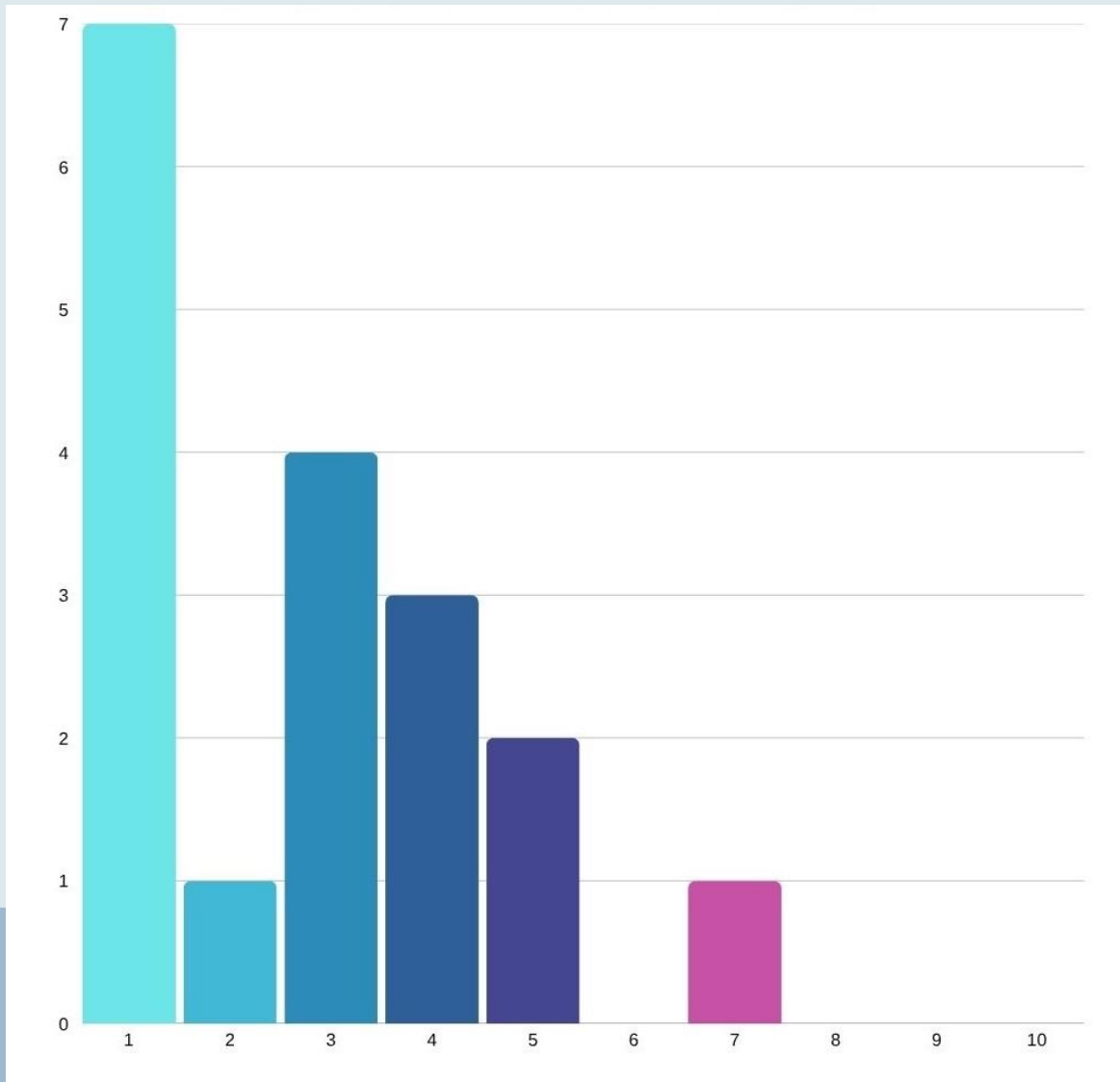


CITY BUSTING, THE NUCLEAR WEAPONS REVOLUTION, AND PRECISION GUIDANCE

A presentation by
Henry Sokolski
Executive Director
Nonproliferation Policy Education Center
www.npolicy.org
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QUESTION: ON A SCALE OF 1-10 (WITH 1 BEING NEVER AND 10 BEING FIRE AT WILL), SHOULD THE UNITED STATES EXERCISE THE OPTION OF TARGETING POPULATION CENTERS (CITIES) WITH NUCLEAR WEAPONS?



PROMISE

WHY BOTHER WITH HISTORY?



Question:

How was city busting viewed and done before and during WWII?

Answer:

Before WWII, city busting was done reluctantly and inconsistently. During WWII, it was done intentionally and brutally.

Question:

The nuclear weapons revolution: How was it first viewed? Why, initially, did developing ever larger nuclear weapons seem logical?

Answer:

The nuclear weapons revolution was first viewed as an operational extension of conventional city busting. In the '40s, '50s and early '60s, ever larger yields were deemed to be attractive for destroying ever larger portions of major cities.

Question:

Precision guidance: How did its advent constitute a counter revolution and how has it affected nuclear weapons deployments?

Answer:

Precision guidance reduced the need to rely on massive yields to destroy point targets. By the '80s, both Russian and U.S. deployed nuclear forces declined precipitously both in size and destructiveness. Both trends reduced the imperative to bomb cities.

Question:

City busting: How is its morality still an issue today?

Answer:

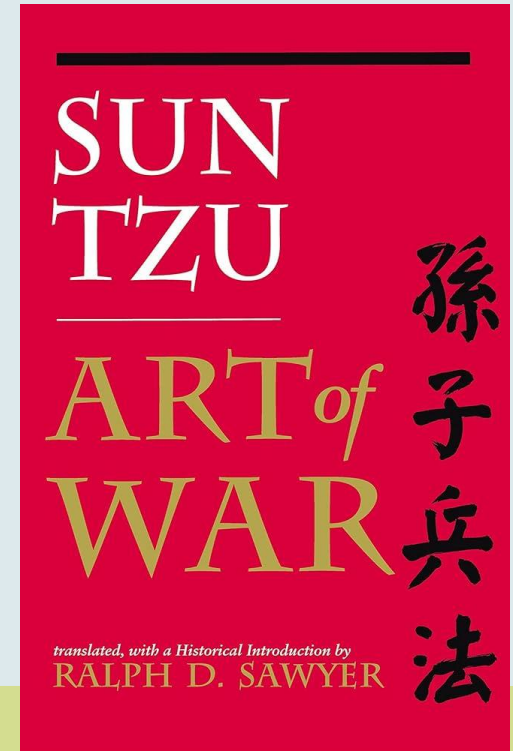
When things go badly, states can still be tempted to kill large numbers of innocents.

I. HOW WAS CITY BUSTING VIEWED AND DONE BEFORE AND DURING WWII?

UNTIL MODERNITY, MILITARY THINKERS FROWNED UPON TARGETING CITIES

Sun Tzu, *The Art of War*, 500 BC

To subdue the enemy without fighting is the supreme excellence. Thus, what is of supreme importance in war is to attack the enemy's strategy. Next best is to disrupt his alliances by diplomacy. The next best is to attack his army. And the worst policy is to attack cities.

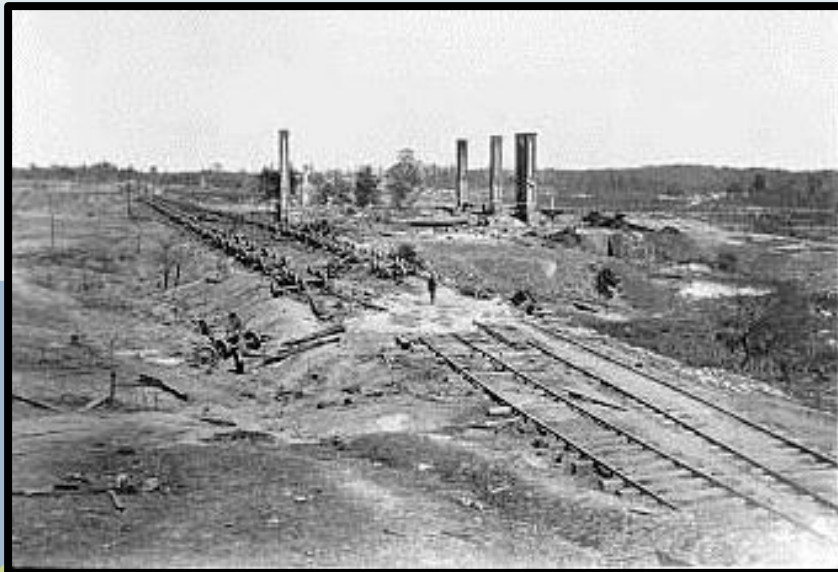


SHERMAN'S MARCH TO THE SEA:

PRECURSOR TO CITY BUSTING

ATLANTA, GEORGIA

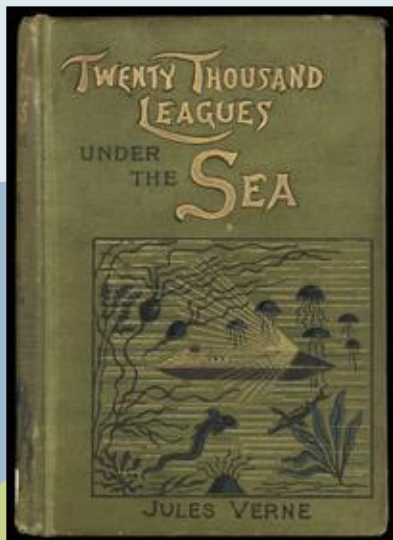
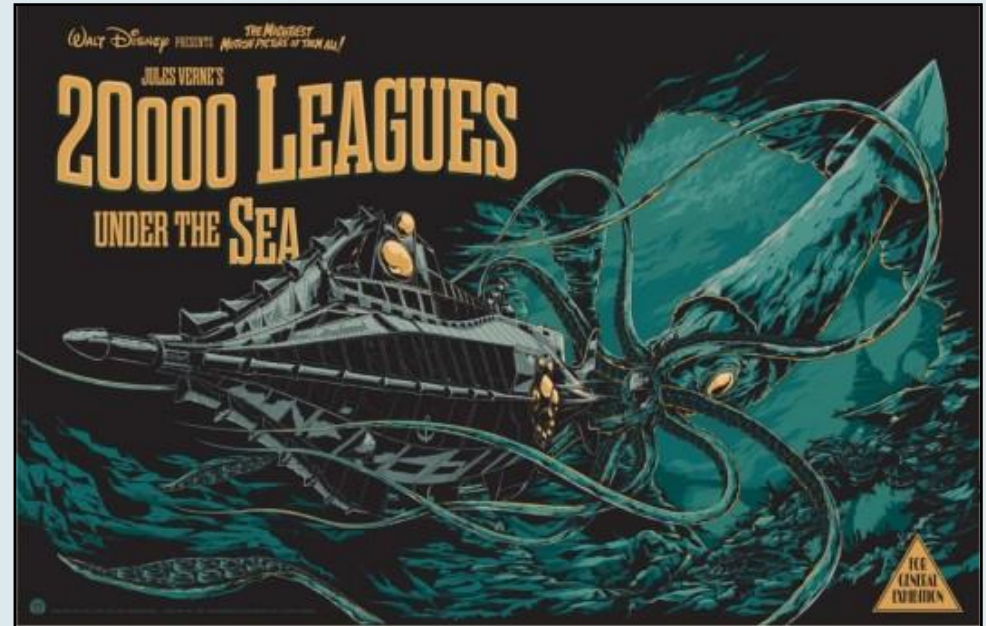
A six-month campaign
Few, if any civilians, killed
Residences, churches, and
hospitals spared



FRENCH SUBMARINE WARFARE THEORY:

FIRST MODERN MUSINGS ON STRATEGIC WEAPONRY

FRENCH NAVAL THEORY WAS CATALYZED BY J. VERNES' *20,000 LEAGUES UNDER THE SEA*



FRENCH HOPED SUBMARINES MIGHT HELP NEUTRALIZE UK & ITS FLEET BY BLOCKADE



Gymnote class



Narval

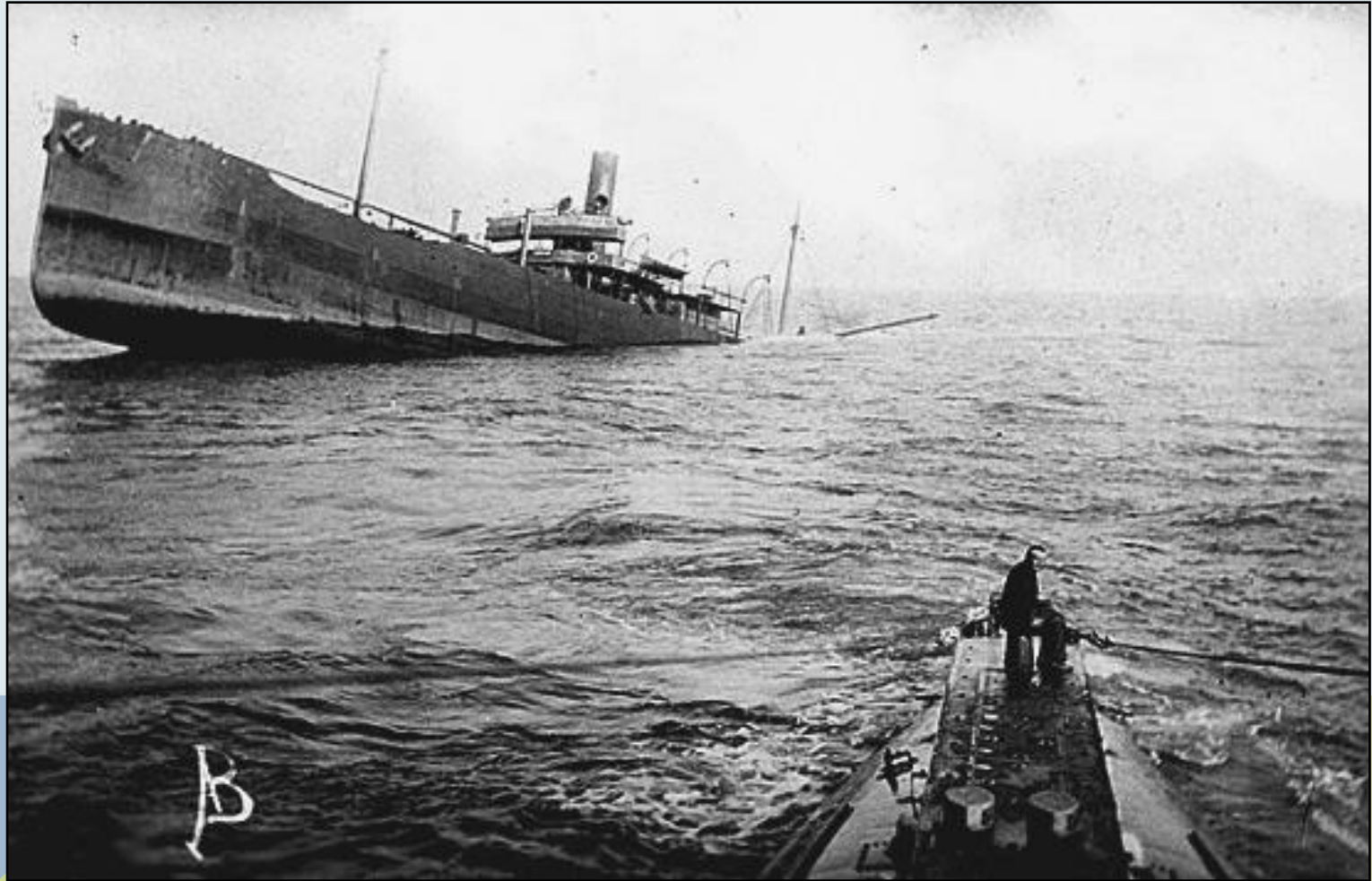


Sirene class

GUSTAVE ZEDE SUBMARINE SINKS BATTLESHIP IN 1898



GERMAN UNRESTRICTED SUB WARFARE IN WWI, THOUGH, HAD MIXED RESULTS



WORLD WAR I TRENCH WARFARE:

ITS HORRORS REKINDLED INTEREST IN ATTACKING POLITICAL
CAPITALS DIRECTLY

**BATTLE OF THE
SOMME: 1916,
300,000-plus dead, 7-
mile advance along 19
miles**



ZEPPELIN RAIDS: 1ST GERMAN ATTEMPT AT STRATEGIC AIR ATTACKS

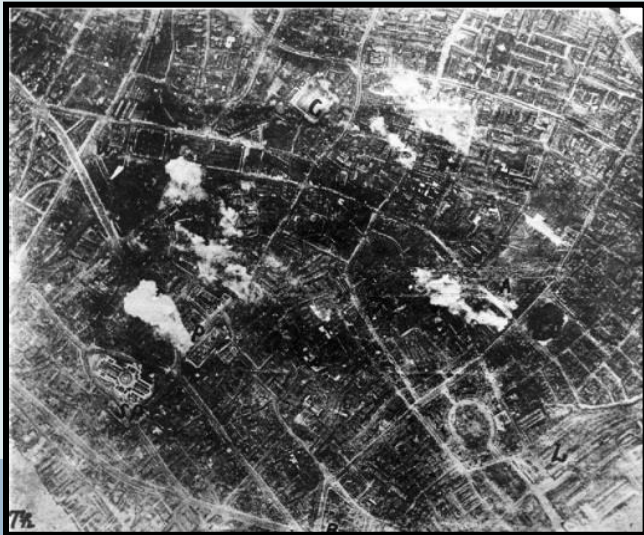


Bombs missed by miles, and, in one case, the Zeppelins missed London entirely. The Zeppelins themselves were also quite vulnerable to fighter interceptions by the Royal Air Force (RAF). Fifty-one Zeppelin raids over three years killed only 557 British.



GOTHA RAIDS: 2ND GERMAN ATTEMPT AT STRATEGIC AERIAL BOMBING

Conventional Bombs, 857 dead



857 London residents were killed in just one year. Although 90 British fighters were employed to fend off the first Gotha raid, the Germans suffered no losses. Subsequent raids suffered some losses, forcing the Germans to shift to nighttime bombing, but it was only when the British knocked out Gotha bomber bases in counteroffensive operations across the Channel that the Gotha raids ceased.

INTERWAR AERIAL THEORISTS CHAMPION STRATEGIC BOMBING



Giulio Douhet



Hugh Trenchard



Billy Mitchell

RAF INTERWAR EXPERIENCE BACKED AIR POWER THEORIES



Waziristan - India's Northwest Frontier



Kurdistan

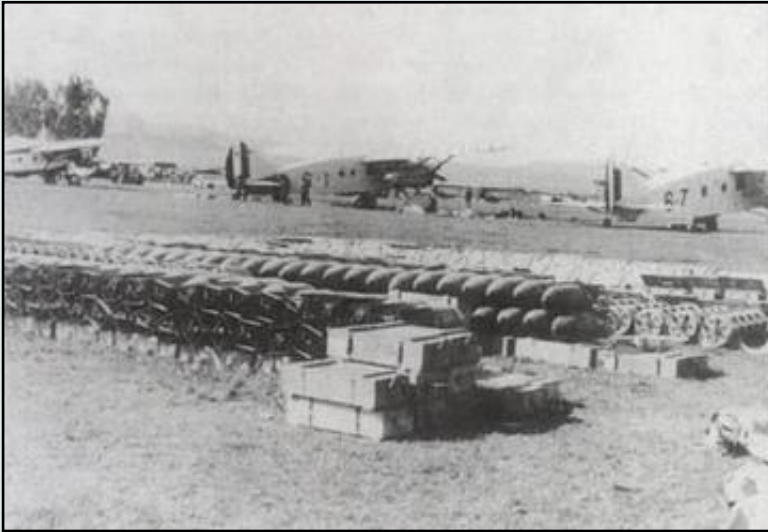


British Somaliland



Iraq

DITTO, ITALIAN AERIAL BOMBINGS IN SECOND ITALO-ETHIOPIAN WAR



1937 GERMAN AND ITALIAN BOMBING OF GUERNICA: CLAIMED “MISTAKES”

Three quarters of the town
destroyed
Deaths: 300 civilians



JAPANESE BOMBING OF CHONGQING, CHINA, 1938: FIRST INTENTIONAL AREA BOMBING

Two days of incendiary bombings
Casualties: 5,000 civilians



INITIAL WWII EXPERIENCE:

FAILED ATTEMPTS AT PRECISION BOMBING

EARLY CITY BUSTING: POLITICAL REACTIONS AND “MISTAKES”



Wieluń, Poland: September 1939
Casualties: Several Hundred

EARLY CITY BUSTING: POLITICAL REACTIONS AND “MISTAKES”



Rotterdam: May 1940
Casualties: 900

EARLY CITY BUSTING: POLITICAL REACTIONS AND “MISTAKES”



Berlin: August 1940

EARLY CITY BUSTING: POLITICAL REACTIONS AND “MISTAKES”

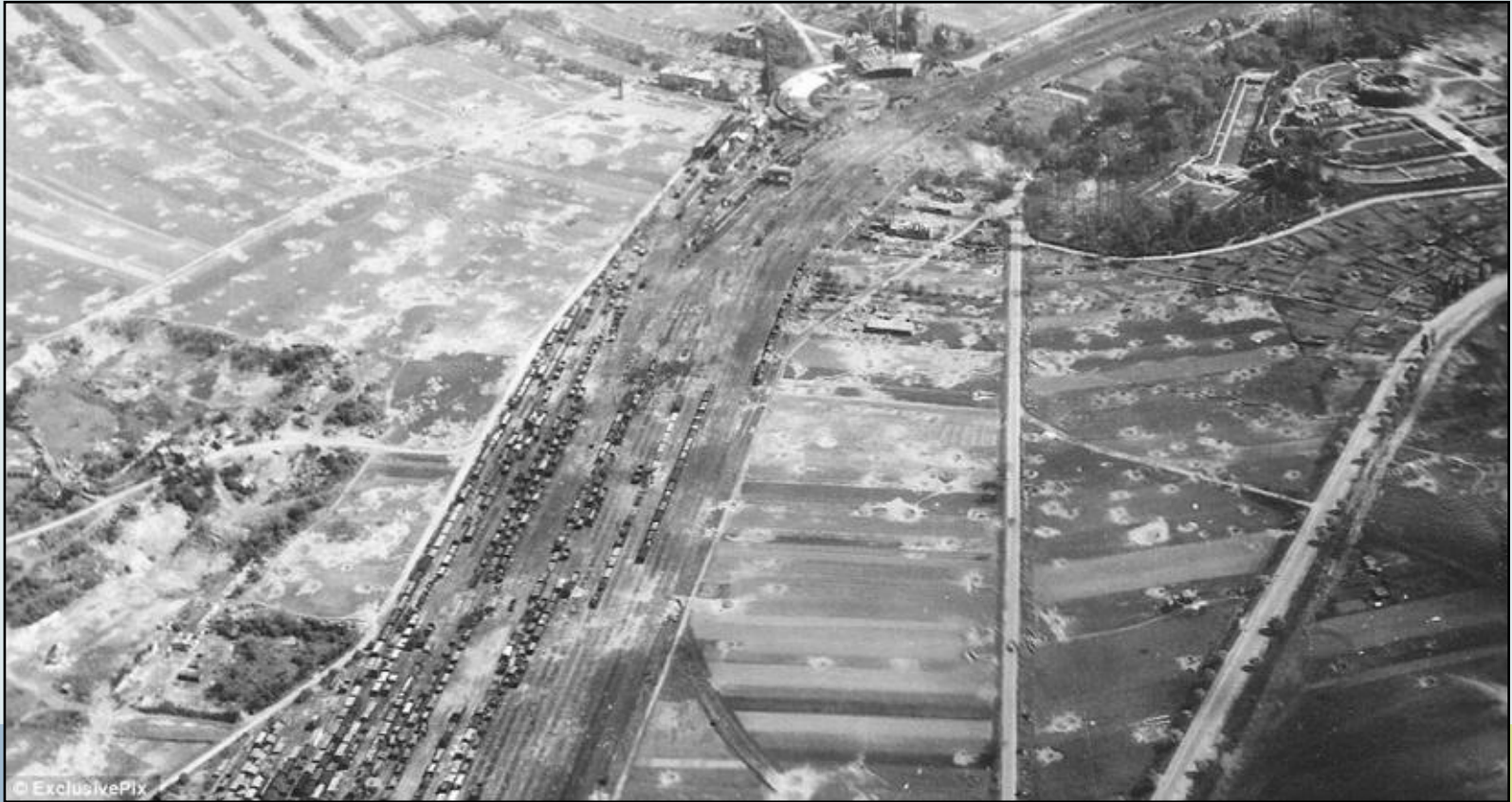


Battle of Britain: Fall 1940
Casualties: Over 30,000

INITIALLY, RAF DAY-TIME RAIDS ON DEFENDED, FORTIFIED U-BOAT PENS HAD LITTLE SUCCESS

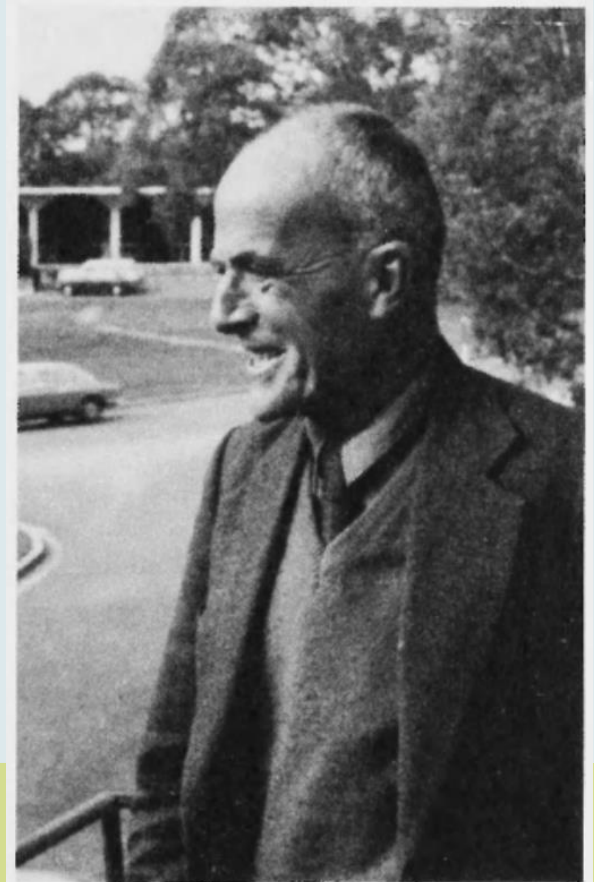
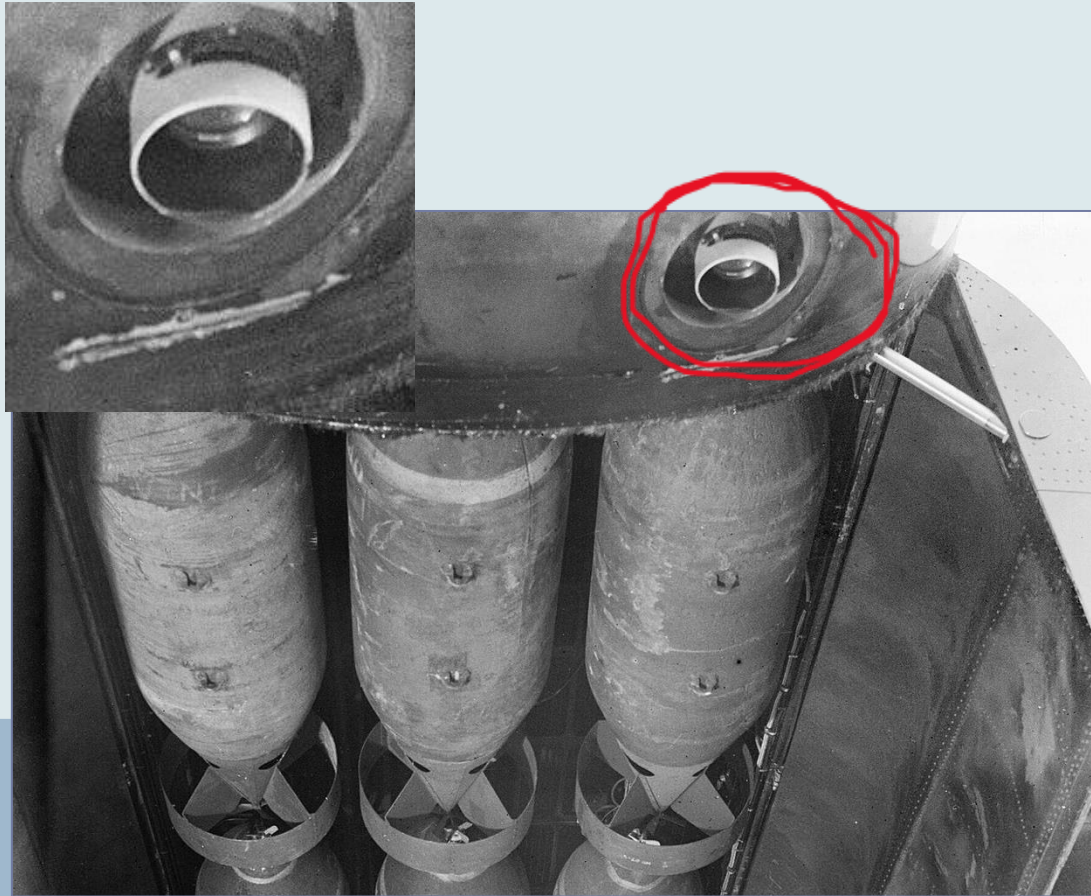


RAF NIGHT-TIME RAIDS OF INDUSTRIAL TARGETS WERE HIGHLY INACCURATE



BUTT REPORT SPOTLIGHTS BOMBING INACCURACIES

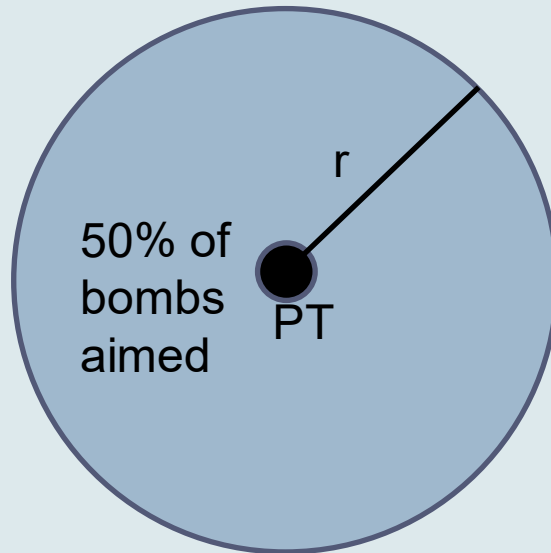
August 1941



Professor D M. Bensusan-Butt

CIRCLE OF ERROR PROBABLE (CEP): HOW WE MEASURE BOMBING AND MISSILE ACCURACY

CEP is the radius that describes a circle with the target at its center within which 50% of the bombs dropped or weapons aimed will fall.



PT = point target

r = radius

CEP = r

50% of bombs
aimed

THE DEHOUSING PAPER: RATIONALE FOR BOMBING INNOCENTS

MARCH 30, 1942

- **Threatened extinction of bomber command**
- **Butt Report promotes “dehousing”**
- **What this required and promise**

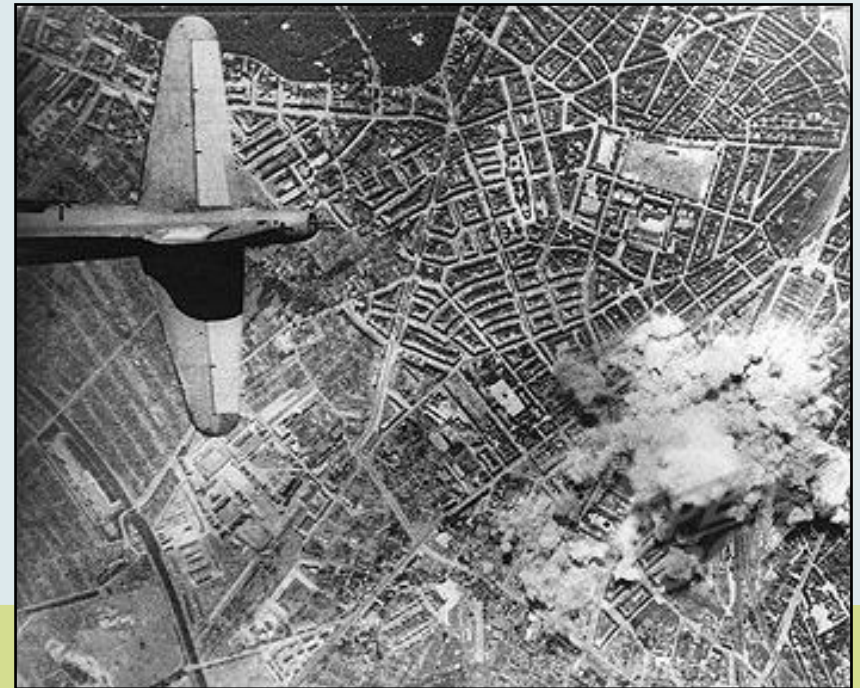
COLOGNE: FIRST 1,000-BOMBER RAID

<500 KILLED, *MAY 30-31, 1942*



OPERATION GOMORRAH: FIRE BOMBING OF HAMBURG: 40,000+ KILLED, 1 MILLION HOMELESS

JULY 24-AUGUST 3, 1943



RAID ON DRESDEN: POSTER CHILD FOR CITY BUSTING

FEBRUARY 13-15, 1945
H.E. AND INCENDIARY BOMBS



25,000 INNOCENTS KILLED AS MILITARY TARGETS





DEADLIER STILL: U.S. FIREBOMBING OF TOKYO

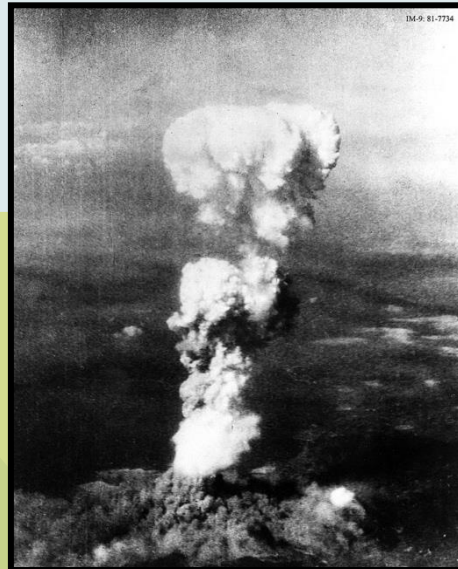
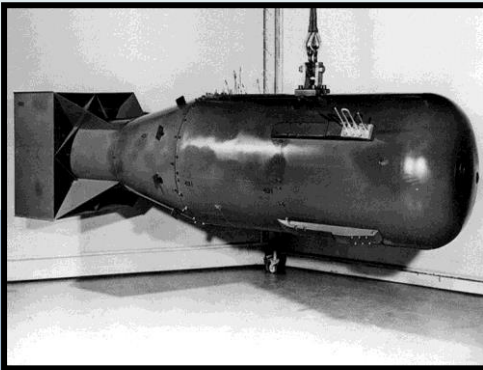
*Firebombing, **85,000-100,000** dead*



HIROSHIMA:

LOGICAL CONCLUSION OF CITY BUSTING

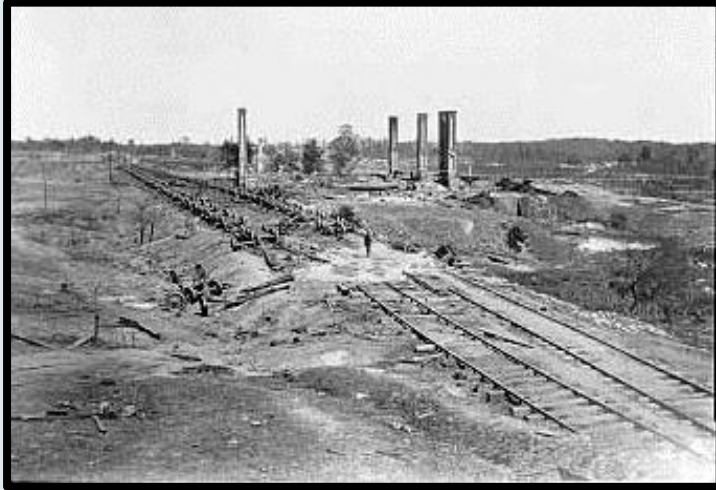
*Nuclear Bomb, 90-146,000 dead by
December 1945, over 200,000 by
1950*



II. THE NUCLEAR WEAPONS REVOLUTION:

HOW WAS THE REVOLUTION FIRST VIEWED?

DESTRUCTIVE EFFICIENCY: FROM SIX MONTHS TO A SECOND



Atlanta, Civil War (took 6 months)



Dresden, WWII (took 2 days)



Tokyo fire bombing, WWII (took 3 hours)



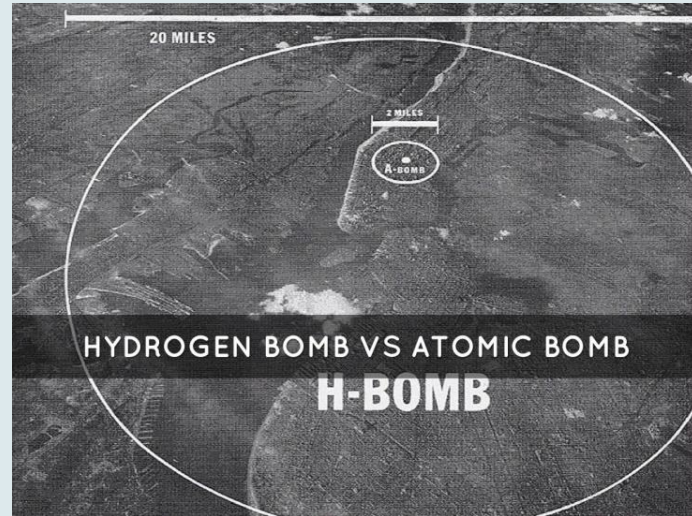
Hiroshima, WWII (took 1 second)

FORCES REQUIRED: FIRST ARMIES THEN JUST A SINGLE BOMBER

- **Battle of Atlanta:** ~75,000 troops; ~ 9,000 military casualties
- **Fire Bombing of Dresden:** >1,200 bombers, >800 fighters; 8 bombers lost
- **Fire Bombing of Tokyo:** 334 B-29 bombers; 14 bombers lost
- **Hiroshima:** One B-29; no bomber losses

**WHY, INITIALLY, DID DEVELOPING EVER
LARGER NUCLEAR WEAPONS SEEM
LOGICAL?**

KILLING MILLIONS OF INNOCENTS: A GIVEN AFTER WWII



N. Korea: U.S. dropped more bombs on DPRK than on the entire WWII pacific theater, killed 1 million or more

CURTIS LEMAY ON TARGETING CIVILIANS

“There are no innocent civilians. It is their government and you are fighting a people, you are not trying to fight an armed force anymore. So it doesn't bother me so much to be killing the so-called innocent bystanders.”

- Sherry, Michael (September 10, 1989). *The Rise of American Air Power: The Creation of Armageddon*, p. 287 (from "LeMay's interview with Sherry," interview "after the war," p. 408 n. 108). Yale University Press

“We went over there and fought the war and eventually burned down every town in North Korea anyway, someday or another, and some in South Korea too.... Over a period of three years or so, *we killed off — what — twenty percent of the population of Korea...*”

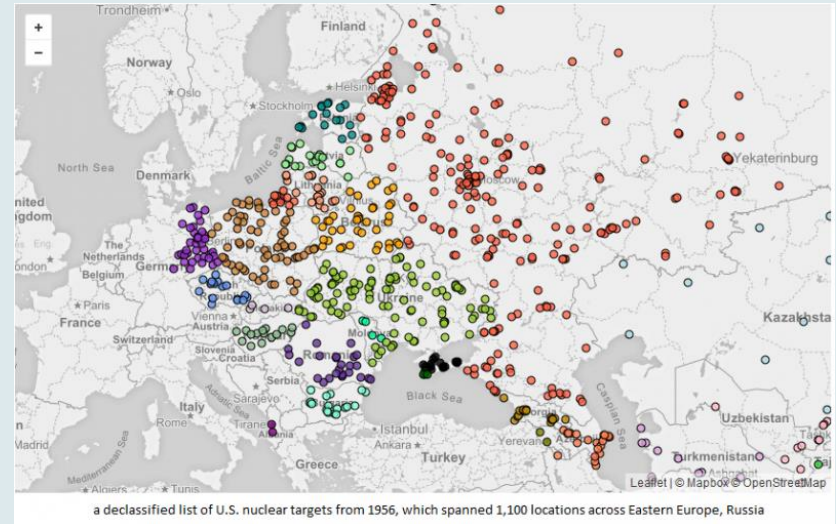
- Kohn and Harahan, eds. *Strategic Air Warfare: An Interview with Generals Curtis E LeMay, Leon W. Johnson, David A. Burchinal, and Jack J. Catton*, 88. Washington DC: Office of Air Force History, 1988. <http://www.afhso.af.mil/shared/media/document/AFD-100929-052.pdf>

EARLY COLD WAR THOUGHTS ON TARGETING CITIES

America's Strategic Air Command's Nuclear Target List in the mid 50s listed 1200 cities in the Soviet bloc

“...it seems reasonable to assume that the destruction of, say, **25 percent of [the Soviet Union's] population (55 million people) and more than two-thirds of its industrial capacity...** should serve as an effective deterrent.”

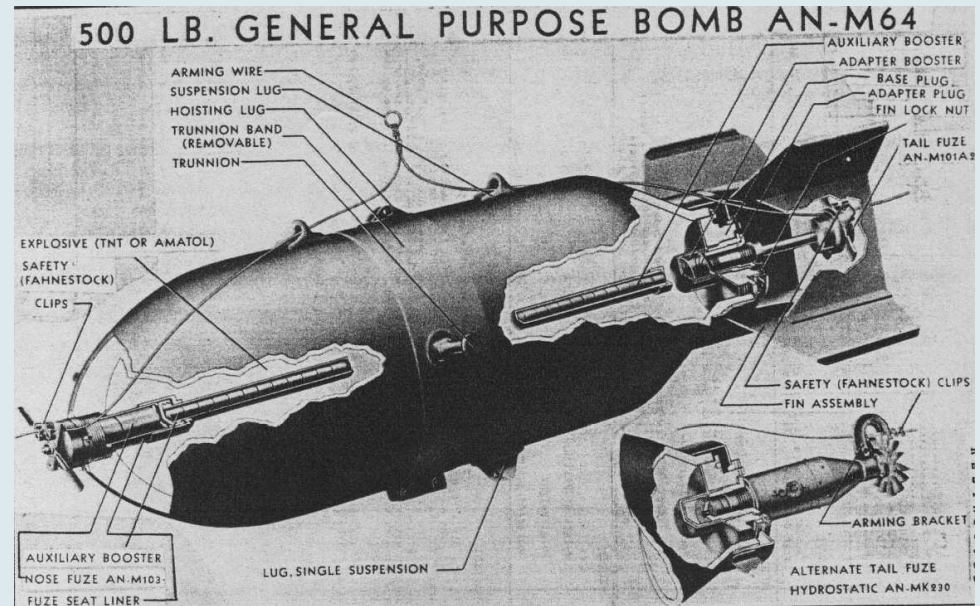
Defense Secretary McNamara
Memo to Pres. Kennedy
Nov. 21, 1962



QUANTIFYING THE NUCLEAR REVOLUTION: EARLY YEARS AND THE EXPLOSIVE INCREASE IN YIELDS

INCREASES IN MAJOR CONVENTIONAL AND NUCLEAR BOMB YIELDS: 1941 – 2020

500-lb nominal WWII bomb (which carried about 113 kilograms of high explosive)



<https://harringtonmuseum.org.uk/an-m64/>

INCREASES IN MAJOR CONVENTIONAL AND NUCLEAR BOMB YIELDS: 1941 - 2020

Grand Slam (conventional bomb)—the largest conventional bomb used in WWII. It weighed 10 metric tons (10,000 kilograms) and carried 4,090 kilograms of high explosive (0.004 kt)



[https://en.wikipedia.org/wiki/Grand_Slam_\(bomb\)](https://en.wikipedia.org/wiki/Grand_Slam_(bomb))

INCREASES IN MAJOR CONVENTIONAL AND NUCLEAR BOMB YIELDS: 1941 - 2020

MOAB (U.S. conventional bomb named Massive Ordnance Air Blast) & **FOAB** (Russian conventional bomb, named The Father of All Bombs, also a fuel air explosive device)—roughly 15-44 tons of high explosive (0.015-.044 kt)

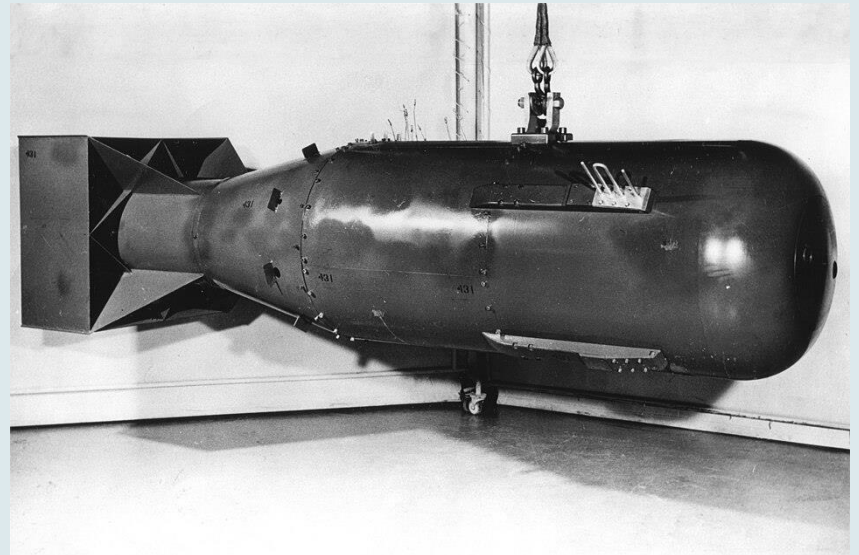


https://en.wikipedia.org/wiki/GBU-43/B_MOAB#/media/File:MOABprototype.jpg



INCREASES IN MAJOR CONVENTIONAL AND NUCLEAR BOMB YIELDS: 1941 - 2020

Little Boy (Hiroshima)—
uranium gun-barrel bomb
had a yield of
approximately 15 kt.



https://en.wikipedia.org/wiki/Little_Boy

INCREASES IN MAJOR CONVENTIONAL AND NUCLEAR BOMB YIELDS: 1941 - 2020

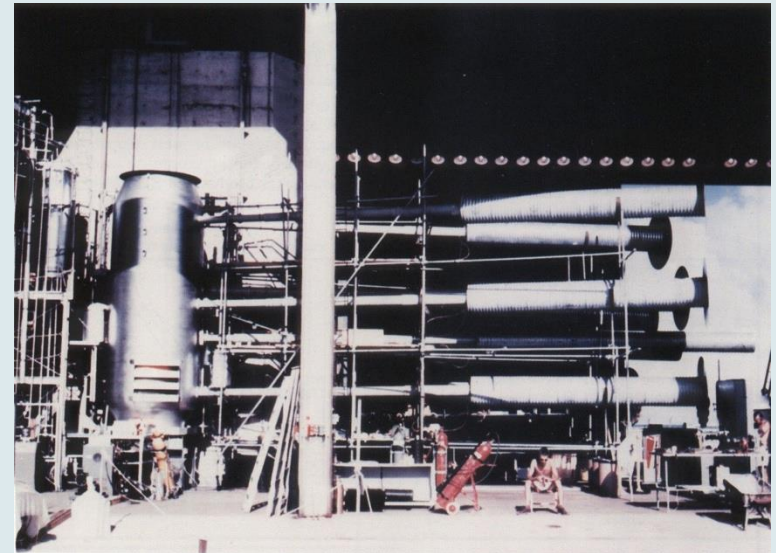
Item Shot (boosted device)—it had a yield of 45.5 kt



https://en.wikipedia.org/wiki/Greenhouse_Item

INCREASES IN MAJOR CONVENTIONAL AND NUCLEAR BOMB YIELDS: 1941 - 2020

Ivy Mike (first thermonuclear weapons test)—had a yield of 10.4 mt and led to eventual deployment of an operational bomb, the B53 that had a yield of 9 mt.



<https://www.atomicarchive.com/history/hydrogen-bomb/page-13.html>

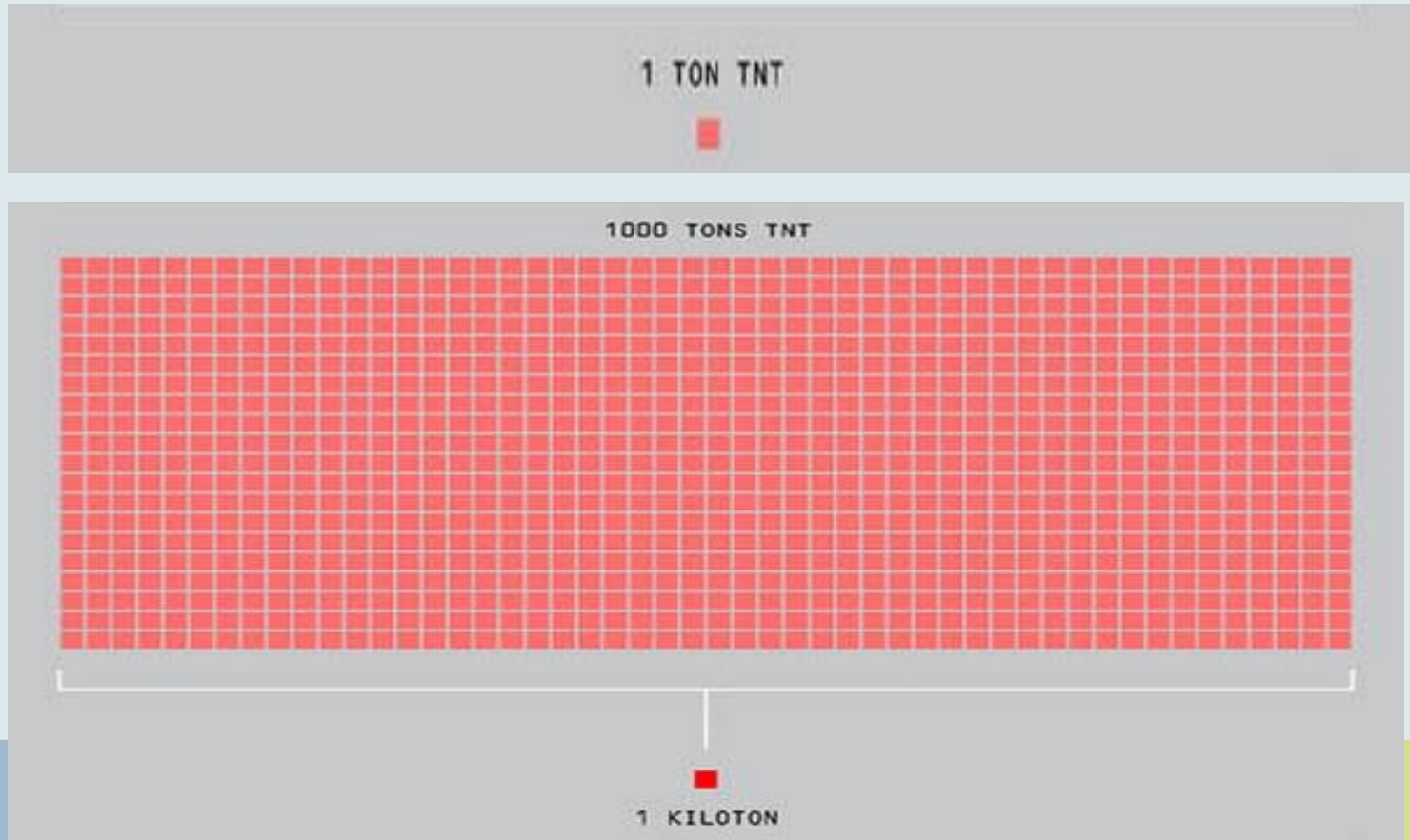
INCREASES IN MAJOR CONVENTIONAL AND NUCLEAR BOMB YIELDS: 1941 - 2020

Tsar Bomba
(nonoperational
thermonuclear
weapon)—had a yield
of 50 mt



https://en.wikipedia.org/wiki/Tsar_Bomba

VISUALIZING A KILOTON



Source: Visualizing the Frightening Power of Nuclear Weapons

<http://www.visualnews.com/2012/04/24/visualizing-the-frightening-power-of-nuclear-bombs>

VISUALIZING YIELDS OF SPECIFIC MUNITIONS

~4.1 tons =
0.0041 kilotons

GRAND SLAM
4.1 TONS
WWII EARTHQUAKE
BOMB USED BY THE RAF



44 tons =
0.044 kilotons

BOMB



15,000 tons =
15 kilotons

LITTLE BOY
15 KILOTONS
BOMB DROPPED
ON HIROSHIMA (USA)



45,500 tons =
45.5 kilotons

ITEM SHOT
45.5 KILOTONS
BOOSTED FISSION WEAPON
TEST (USA)



CONTINUED

ITEM SHOT

45.5 KILOTONS
BOOSTED FISSION WEAPON
TEST (USA)



ITEM SHOT

45.5 KILOTONS

BOOSTED FISSION WEAPON

TEST (USA)



45,500 tons =
45.5 kilotons

IVY MIKE

10,400 KILOTONS
FIRST FUSION DEVICE
TEST (USA)



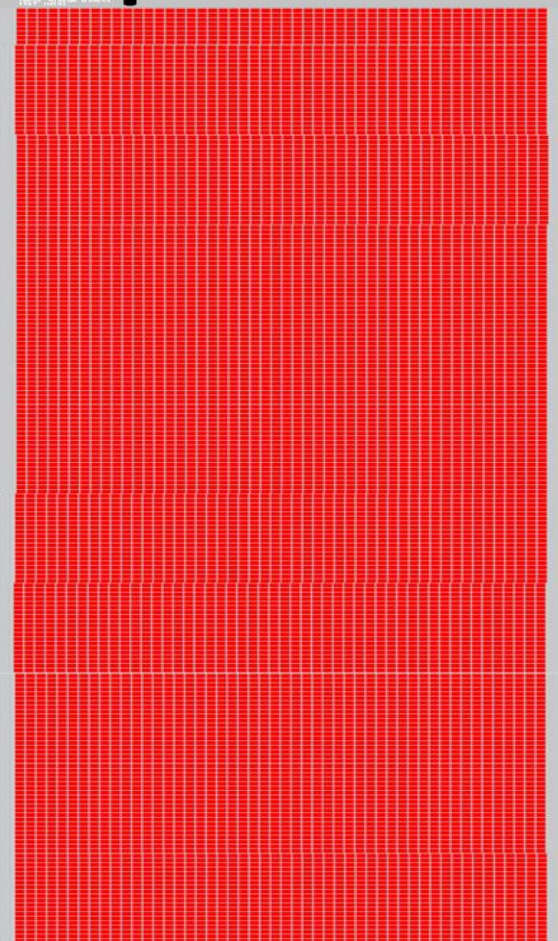
IVY MIKE

10,400 KILOTONS

FIRST FUSION DEVICE

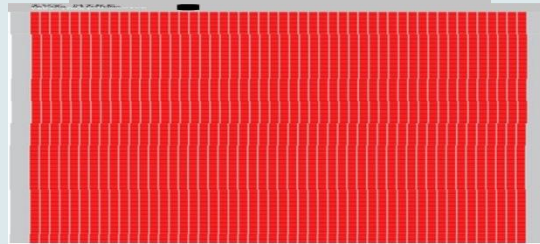
TEST (USA)

10,400,000 tons =
10,400 kilotons =
10.4 megatons



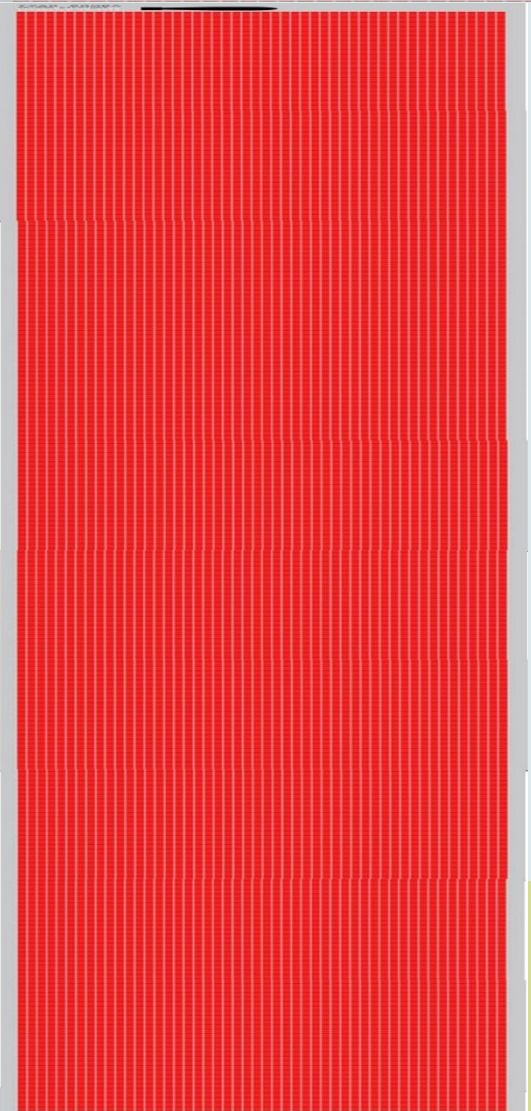
CONTINUED

IVY MIKE
10,400 KILOTONS
FIRST FUSION DEVICE
TEST (USA)



10,400,000 tons =
10,400 kilotons =
10.4 megatons

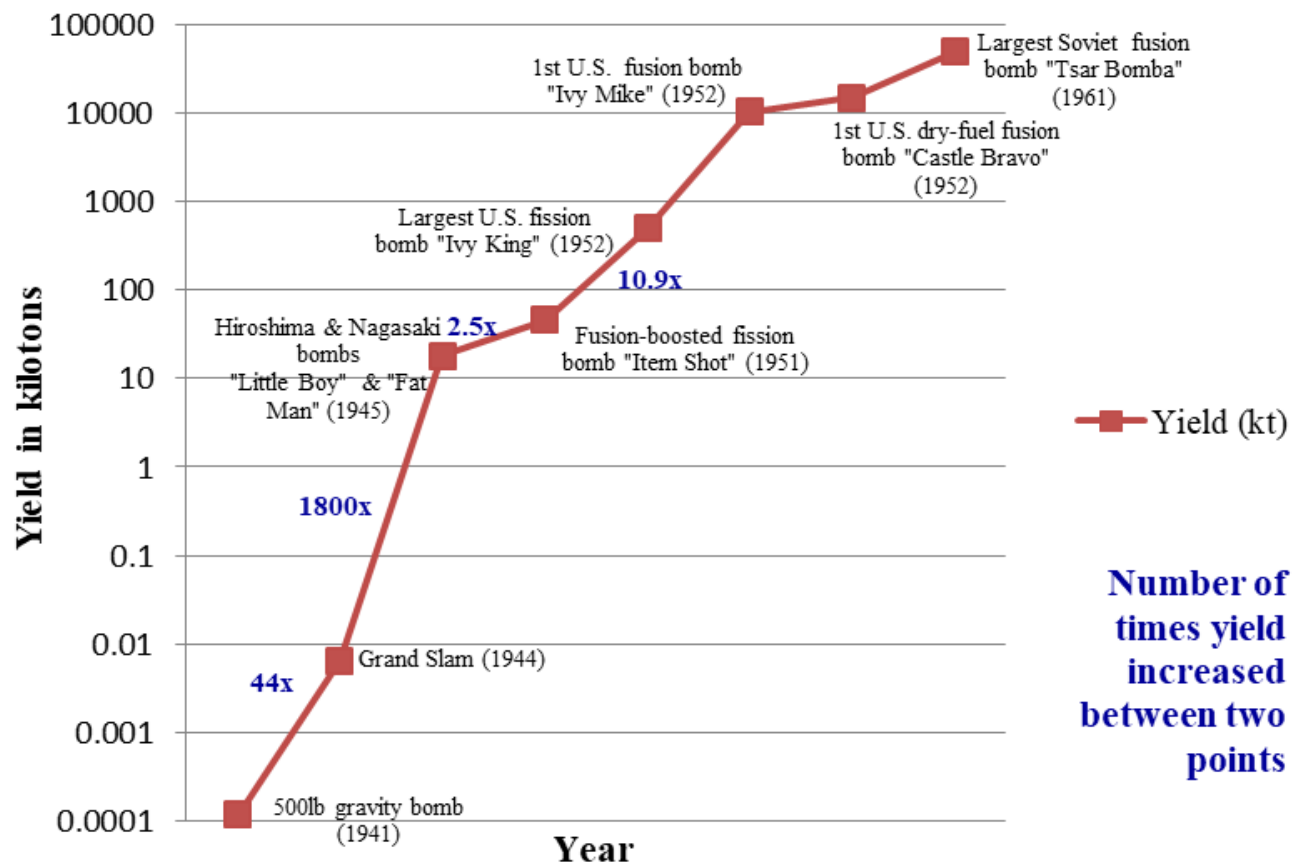
TSAR BOMBA
50,000 KILOTONS
LARGEST BOMB EVER
DETONATED (RUSSIA)



50,000,000 tons =
50,000 kilotons =
50 megatons

LOGARITHMIC PORTRAYAL OF INCREASING YIELDS: 1941-1961

Revolution in Weapons' Yield



Scaling this logarithmic chart:

Grand Slam 10 ft

Little Boy 15,000 ft where an airplane flies



Tsar Bomba 19,000 miles, which is beyond where our GPS satellites fly



HOW YIELD RELATES TO BLAST/LETHAL AREA

BLAST EFFECTS: 1.7 PSI

1 psi

Light damage to all structures, and light to moderate damage to ordinary houses, will occur within this ring.



1.7 psi peak overpressure

Source: <http://meyerweb.com/eric/tools/gmap/hydesim.html?inpyield=1000>
and <https://nuclearsecrecy.com/nukemap/>
Photo and caption source: [The Effects of Nuclear Weapons - Glasstone and Dolan | Chapter V](#)

BLAST EFFECTS: 2.6 PSI

2 psi

Damage to ordinary houses, and light to moderate damage to reinforced concrete structures, will occur within this ring.



2.6 psi peak overpressure

Source: <http://meyerweb.com/eric/tools/gmap/hydesim.html?inpyield=1000>
and <https://nuclearsecrecy.com/nukemap/>
Photo and caption source: [The Effects of Nuclear Weapons - Glasstone and Dolan | Chapter V](#)

BLAST EFFECTS: 5 PSI

5 psi Complete destruction of ordinary houses, and moderate to severe damage to reinforced concrete structures, will occur within this ring.



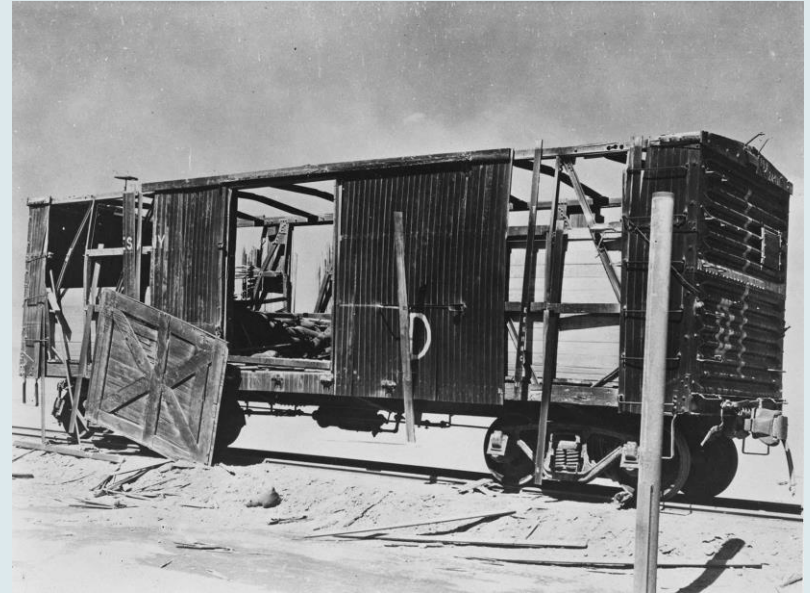
5 psi peak overpressure

Source: <http://meyerweb.com/eric/tools/gmap/hydesim.html?inpyield=1000>
and <https://nuclearsecrecy.com/nukemap/>
Photo and caption source: [The Effects of Nuclear Weapons - Glasstone and Dolan | Chapter V](#)

BLAST EFFECTS: 6 PSI

7 psi

Severe damage to complete destruction of reinforced concrete structures, such as skyscrapers, will occur within this ring.



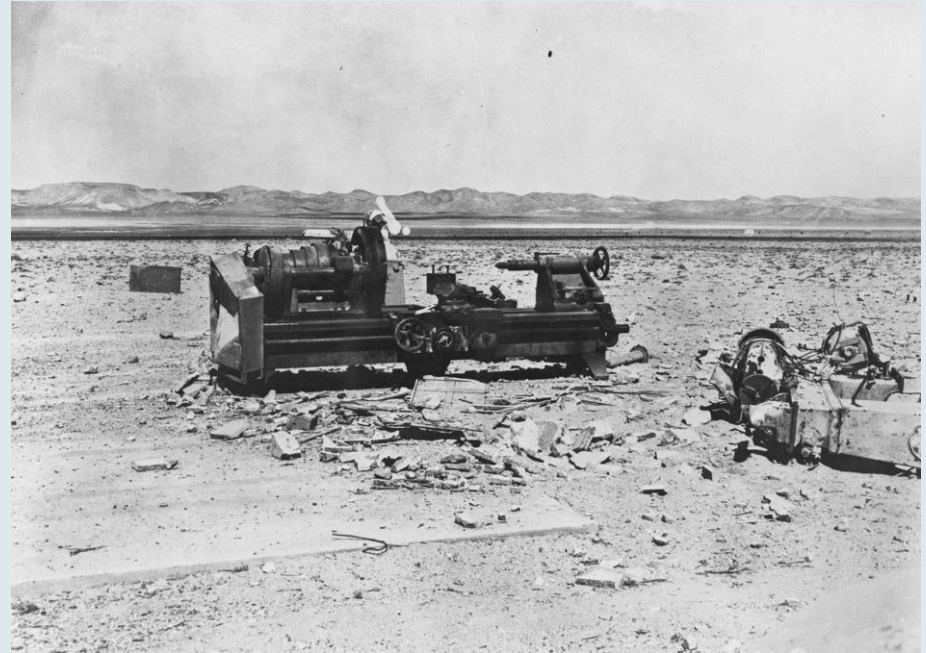
6 psi peak overpressure

Source: <http://meyerweb.com/eric/tools/gmap/hydesim.html?inpyield=1000>
and <https://nuclearsecrecy.com/nukemap/>
Photo and caption source: [The Effects of Nuclear Weapons - Glasstone and Dolan | Chapter V](#)

BLAST EFFECTS: 7-15 PSI

Complete destruction of reinforced concrete structures, such as skyscrapers, will occur within this ring. Between 7 psi and 15 psi, there will be severe to total damage to these types of structures.

15 psi



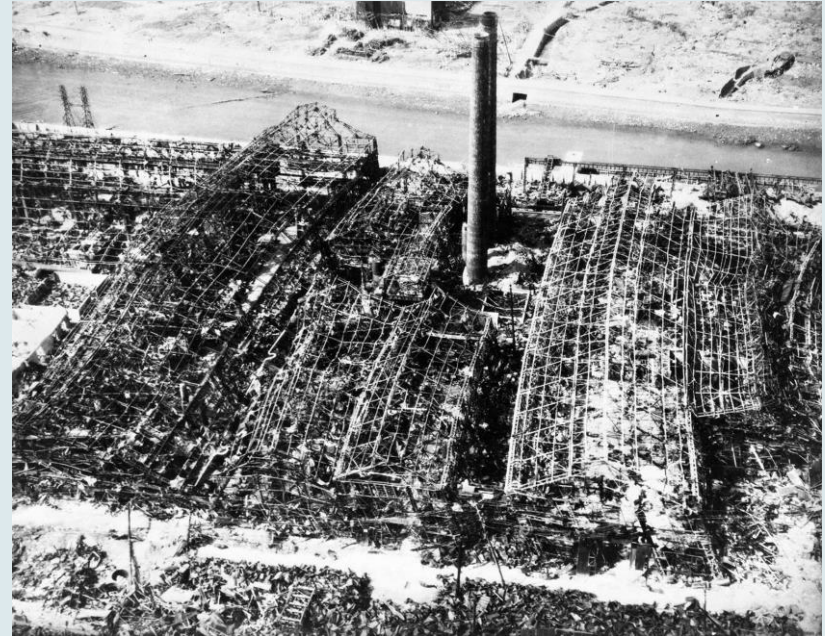
10 psi peak overpressure

Source: <http://meyerweb.com/eric/tools/gmap/hydesim.html?inpyield=1000>
and <https://nuclearsecrecy.com/nukemap/>
Photo and caption source: [The Effects of Nuclear Weapons - Glasstone and Dolan | Chapter V](#)

BLAST EFFECTS: 20 PSI

20 psi

Heavily built concrete buildings are severely damaged or demolished; fatalities approach 100%.

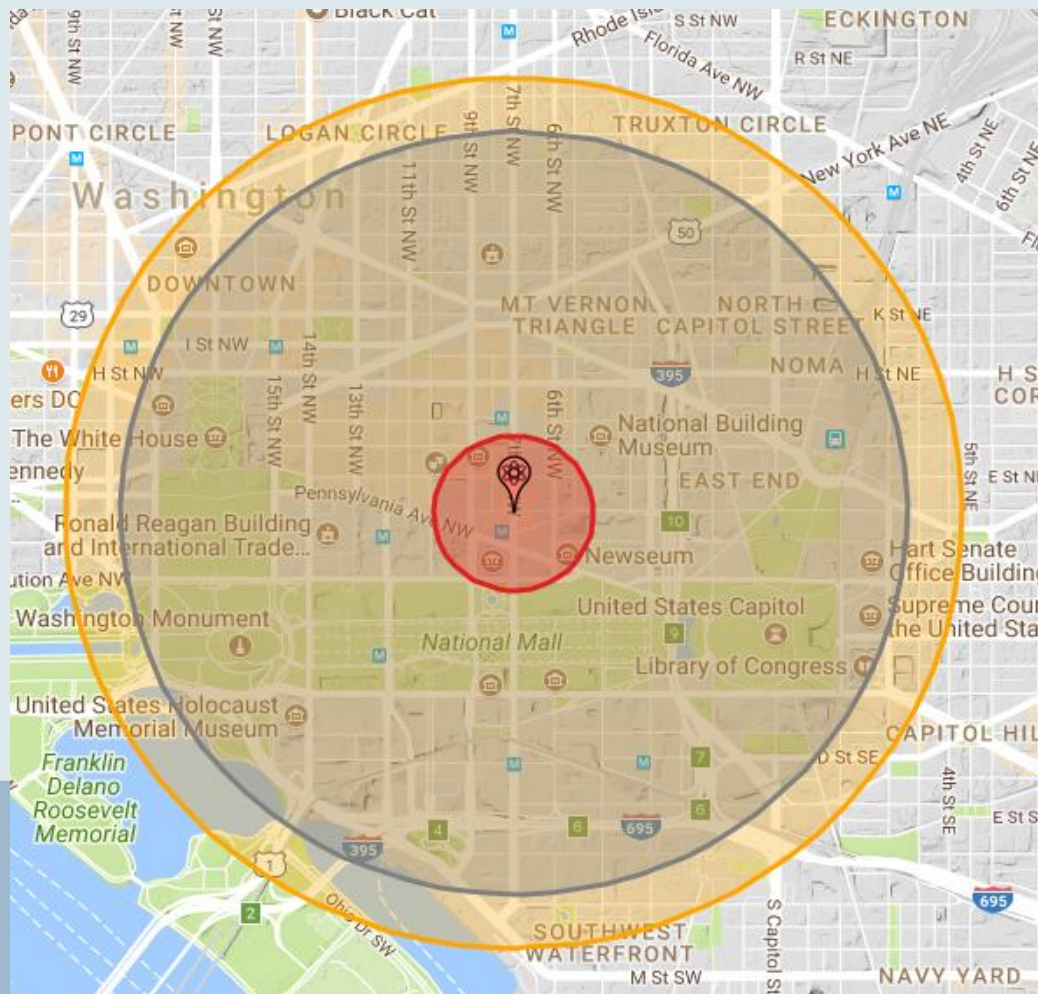


20 psi peak overpressure

Source: <http://meyerweb.com/eric/tools/gmap/hydesim.html?inpyield=1000>
and <https://nuclearsecrecy.com/nukemap/>
Photo and caption source: [The Effects of Nuclear Weapons - Glasstone and Dolan | Chapter V](#)

BLAST AREA

HIROSHIMA FISSION BOMB (15 KT), AIR BURST, 3,000 FT



Estimated fatalities:

120,550

Estimated injuries:

168,800

In any given 24-hour period, there are on average 535,169 people in the light (1 psi) blast range of the simulated detonation.

Effect radii for 15 kt airburst

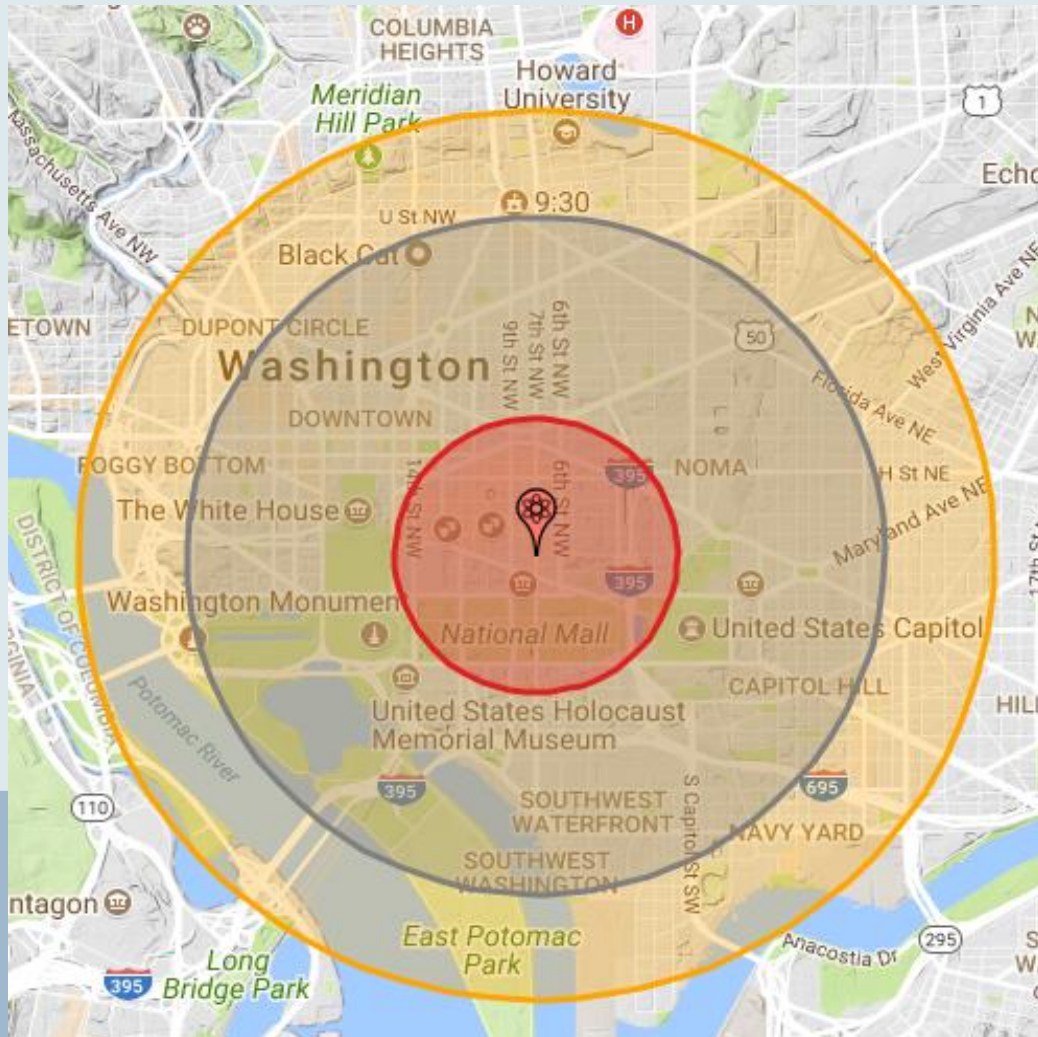
 Air blast radius (20 psi): 340 m (0.36 km²)

 Air blast radius (5 psi): 1.67 km (8.78 km²)

 Thermal radiation radius (3rd degree burns):
1.91 km (11.4 km²)

BLAST AREA

ITEM SHOT FIRST BOOSTED-FISSION DEVICE (45.5 KT)



Estimated fatalities:

165,290

Estimated injuries:

287,600

In any given 24-hour period, there are on average 817,953 people in the light (1 psi) blast range of the simulated detonation.

Effect radii for 45.5 kt airburst

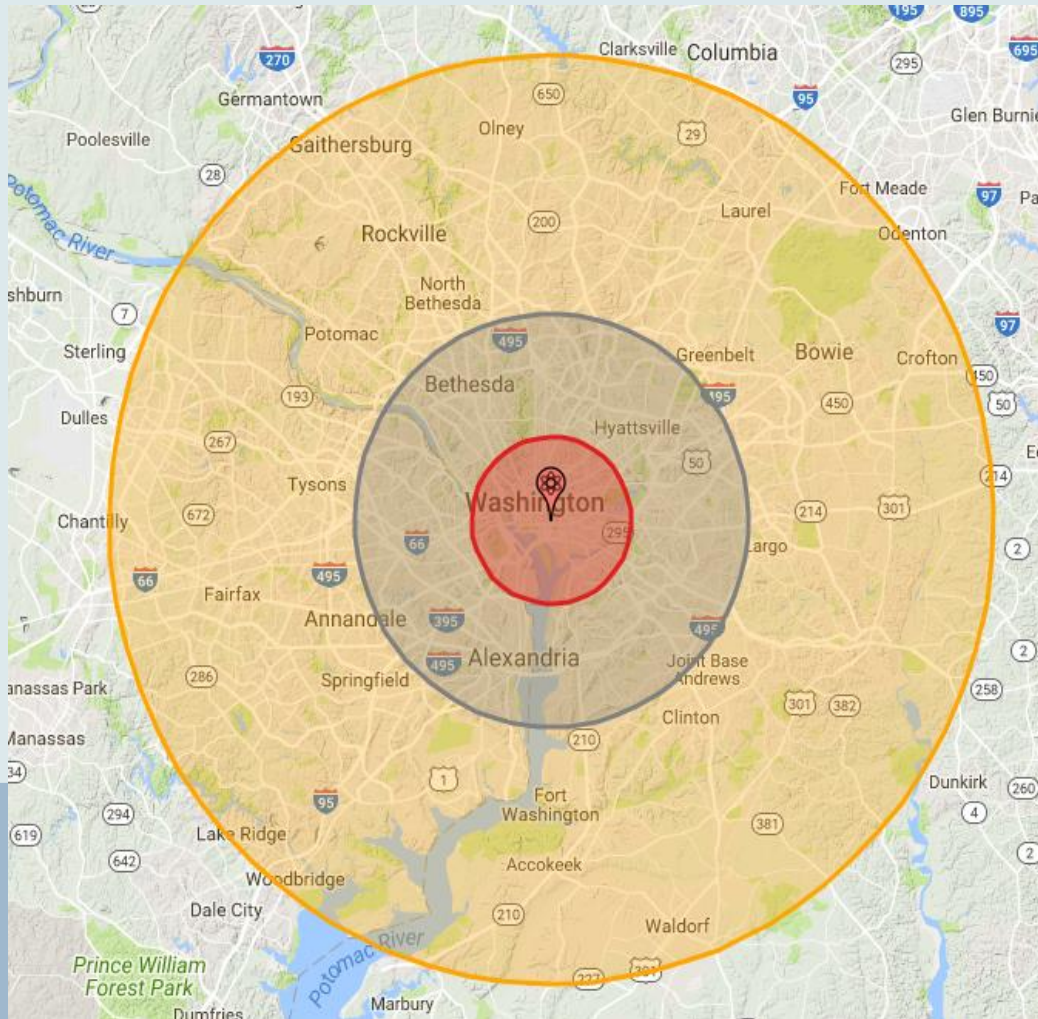
 Air blast radius (20 psi): 340 m (0.36 km²)

 Air blast radius (5 psi): 2.48 km (19.4 km²)

 Thermal radiation radius (3rd degree burns): 3.261 km (33.5 km²)

BLAST AREA

IVY MIKE FIRST U.S. THERMONUCLEAR TEST (10,400 KT OR 10.4 MT)



Estimated fatalities:

1,018,800

Estimated injuries:

942,190

In any given 24-hour period, there are on average 3,298,741 people in the light (1 psi) blast range of the simulated detonation.

Effect radii for 10.4 mt airburst

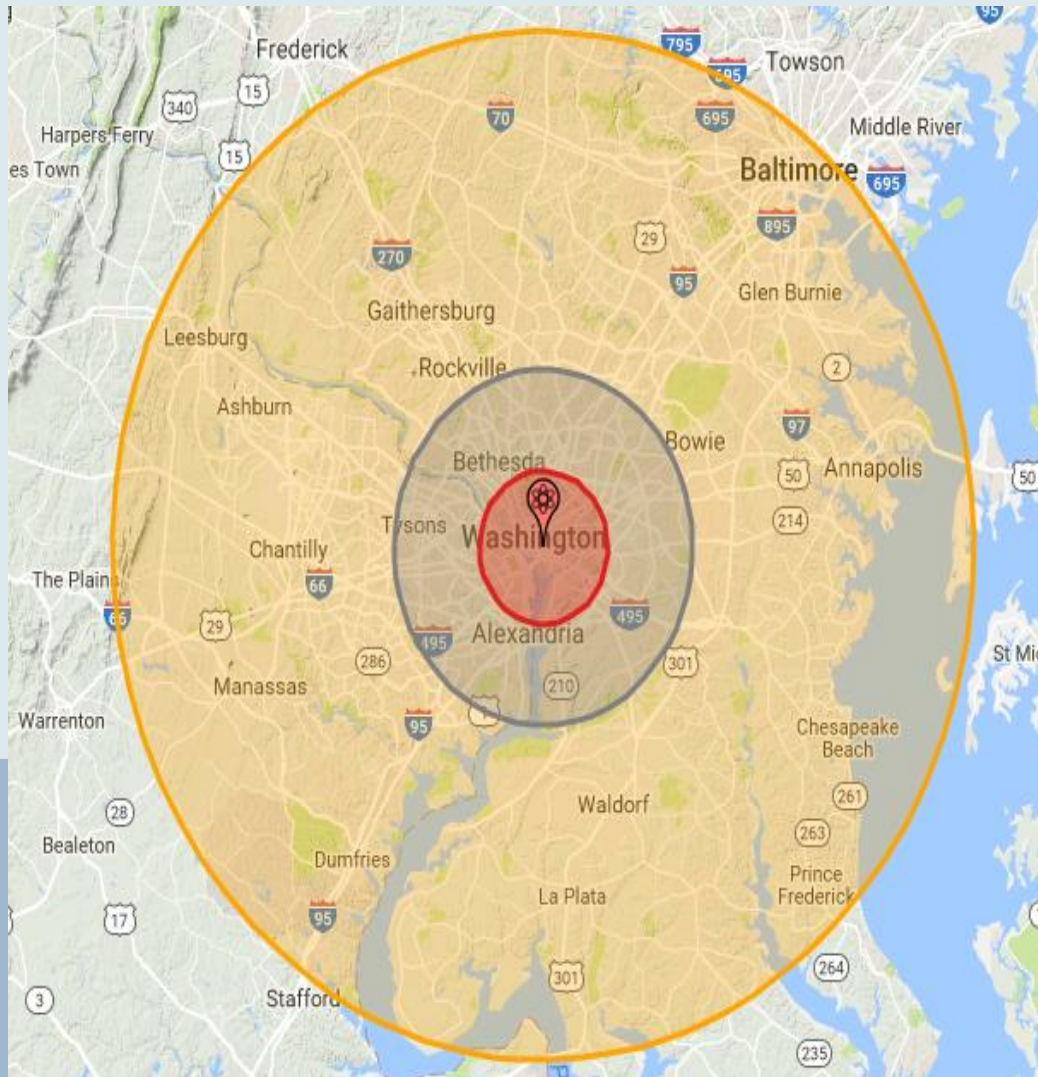
 Air blast radius (20 psi): 6.16 km (119 km²)

 Air blast radius (5 psi): 15.2 km (725 km²)

 Thermal radiation radius (3rd degree burns): 34.1 km (3,660 km²)

SURFACE BLAST AREA

TSAR BOMBA LARGEST SOVIET THERMONUCLEAR BOMB
(50,000 KT OR 50 MT)



Estimated fatalities:

1,830,780

Estimated injuries:

1,391,640

In any given 24-hour period, there are on average 5,160,603 people in the light (1 psi) blast range of the simulated detonation.

Effect radii for 50 mt airburst

 Air blast radius (20 psi): 8.91 km (249 km²)

 Air blast radius (5 psi): 20.7 km (1,350 km²)

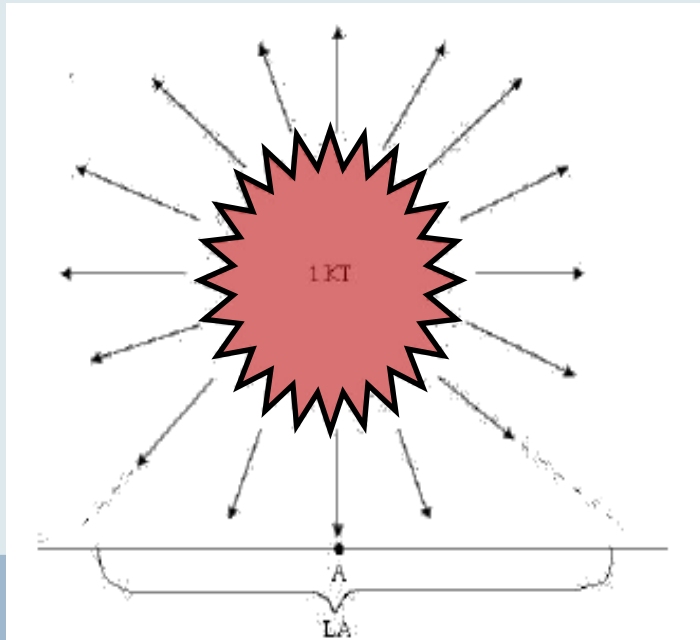
 Thermal radiation radius (3rd degree burns):
60 km (11,300 km²)

QUALIFYING THE NUCLEAR REVOLUTION:

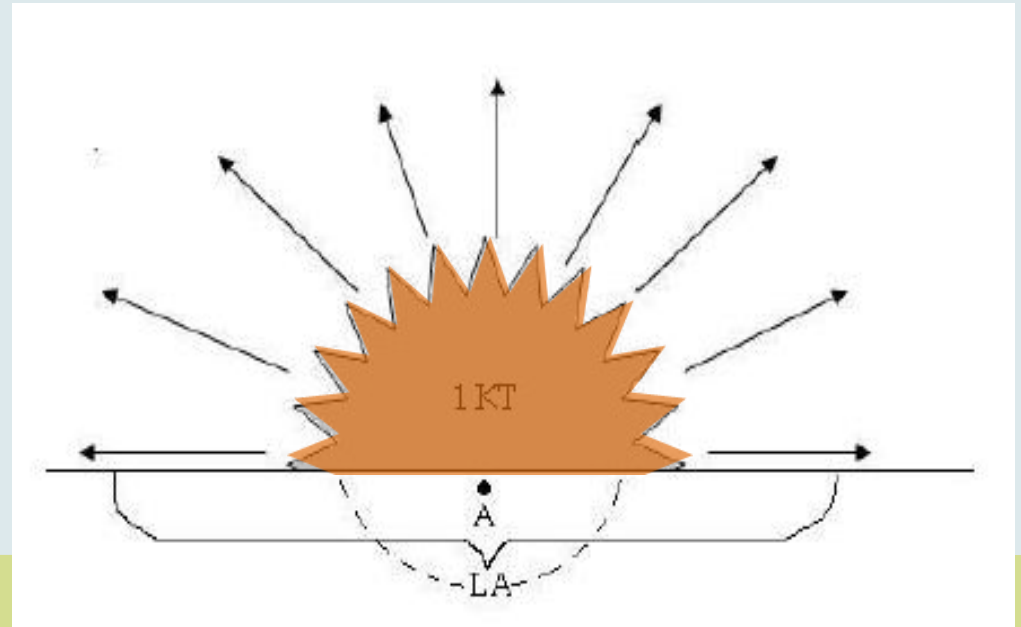
LETHAL AREA AND ITS RELATION TO YIELD

**LETHAL AREA: ONLY A FRACTION OF A
NUCLEAR BOMB'S YIELD IMPACTS THE
TARGET**

Lethal Area describes a circle of a given amount of damage caused by a weapon's blast. Energy from a large explosive is released as a sphere, as a result much of it is both released in the air and “overkills” the target. Therefore, increasing the yield of the weapon does not directly increase the lethal area.



AIR BURST



GROUND BURST

HOW NUCLEAR YIELD RELATES TO LETHAL AREA

The radius of the lethal area of a nuclear weapon is proportional to the cube root of the weapon's yield, or $y^{1/3}$.

If $1,000=X$, the cuberoot of 1,000 is a number that multiplied times itself times itself that equals 1,000. That number is 10.

EXAMPLE:

$$\text{Lethal Radius (LR)} = \text{Constant} \times y^{1/3}$$

For a 1kt weapon:

$$\text{LR} = 1^{1/3}$$

$$1^{1/3} = \sqrt[3]{1}$$

$$\text{LR} = \sim 1\text{km}$$

For a 1,000kt (1mt) weapon:

$$\text{LR} = 1,000^{1/3}$$

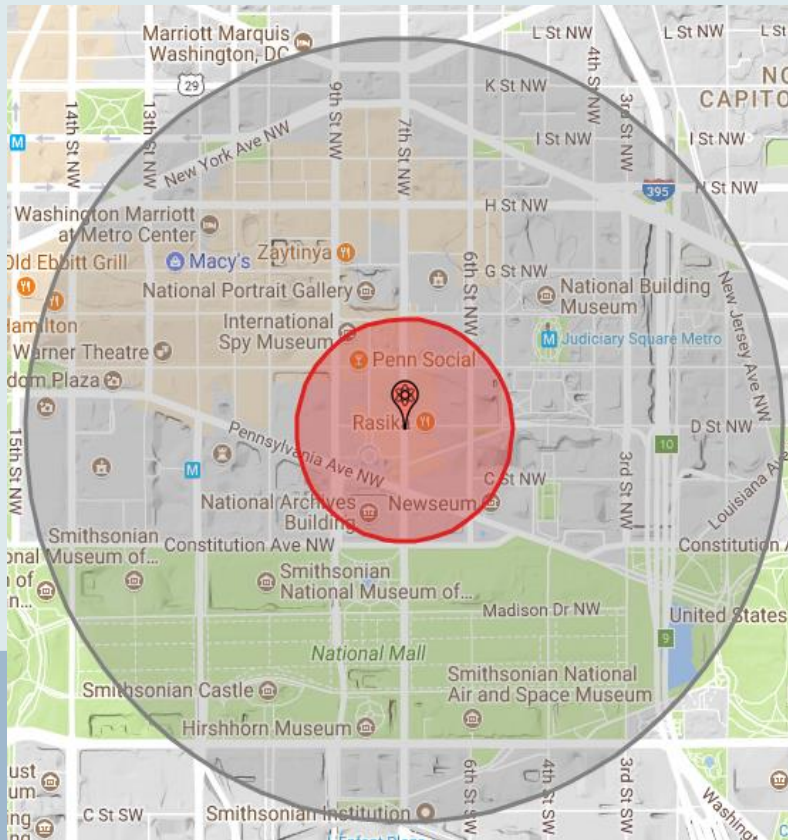
$$1,000^{1/3} = \sqrt[3]{1,000}$$

$$\text{LR} = \sim 10\text{km}$$

AS A RESULT:

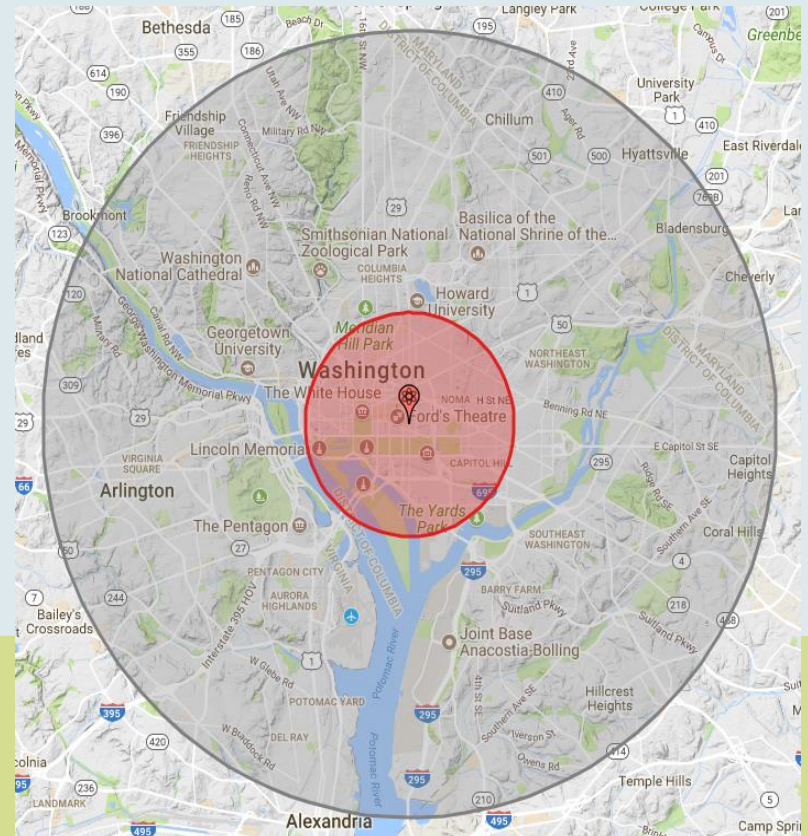
Increasing the yield of your weapon 1,000 fold, for example from 1kt to 1mt, only increases the lethal radius 10 fold.

1kt Yield Air Blast



- Air blast radius (20 psi): 280 m (0.25 km²)
- Air blast radius (3 psi): 0.99 km (3.08 km²)

1,000kt (1mt) Yield Air Blast

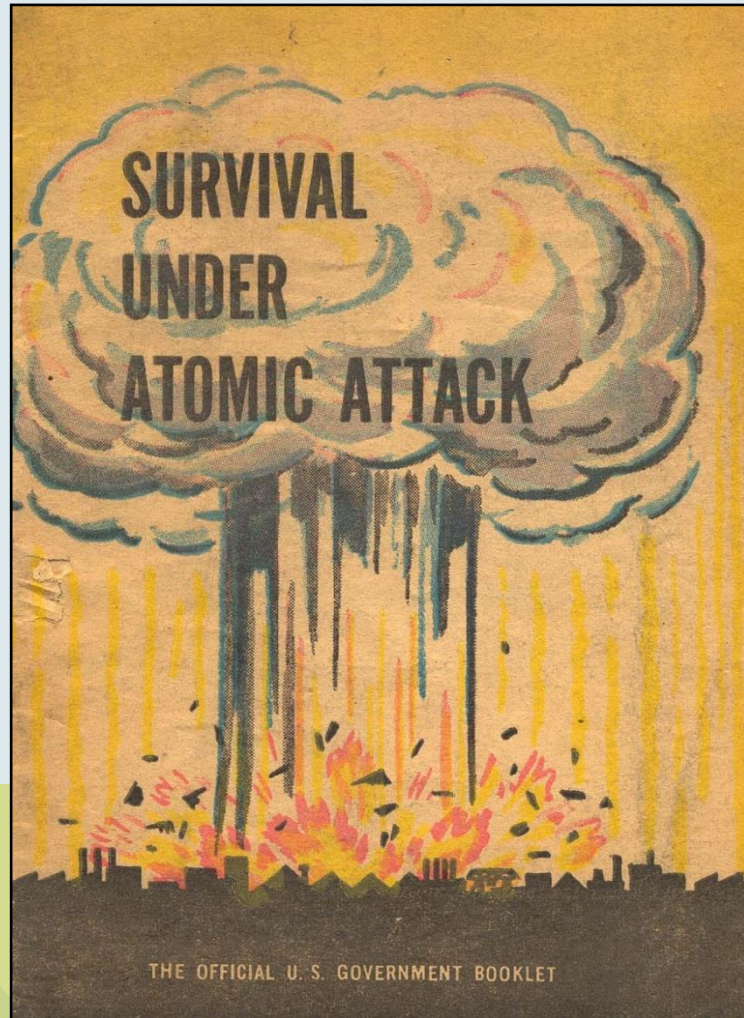


- Air blast radius (20 psi): 2.82 km (25 km²)
- Air blast radius (3 psi): 9.91 km (308 km²)

U.S. CIVIL DEFENSE OFFICIALS USED BLACKETT'S ARGUMENTS

“Doubling bomb power does not double destruction”

“...if there were a bomb 100 times as powerful, it would reach out only a little more than $4\frac{1}{2}$, not 100 times as far.”



“Beyond 2 miles, the explosion will cause practically no deaths at all.”

“At Nagasaki, almost 70 percent of the people a mile from the bomb lived to tell their experiences.”

III. PRECISION GUIDANCE: A COUNTER-REVOLUTION

HOW HAS IT AFFECTED NUCLEAR WEAPONS DEPLOYMENTS?

PRECISION GUIDANCE, WHICH DATES BACK TO WWI AND WWII, SLOWLY OFFERED MILITARY ALTERNATIVES

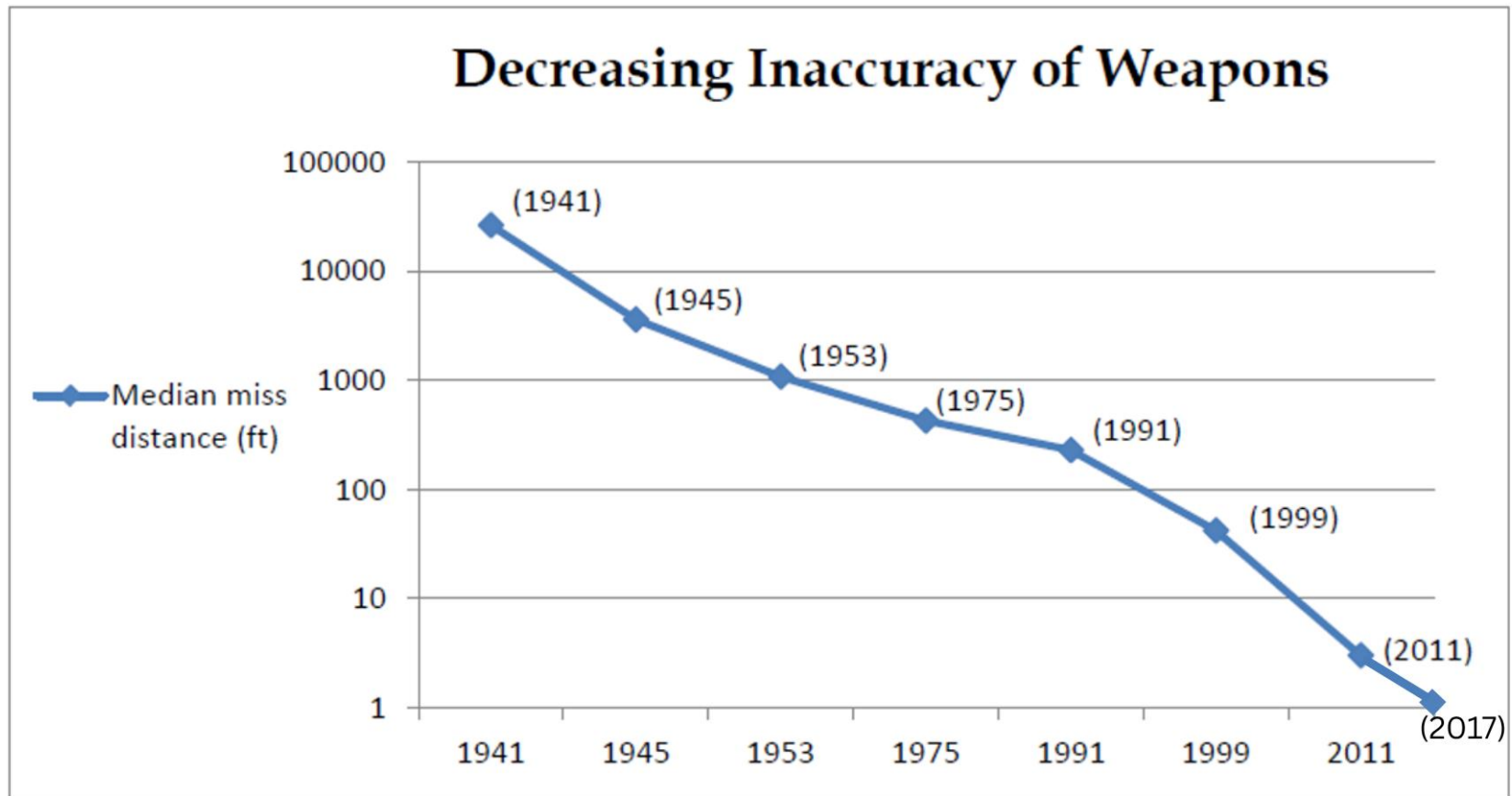


AT, 1916



ASM-N-2 Bat, 1944

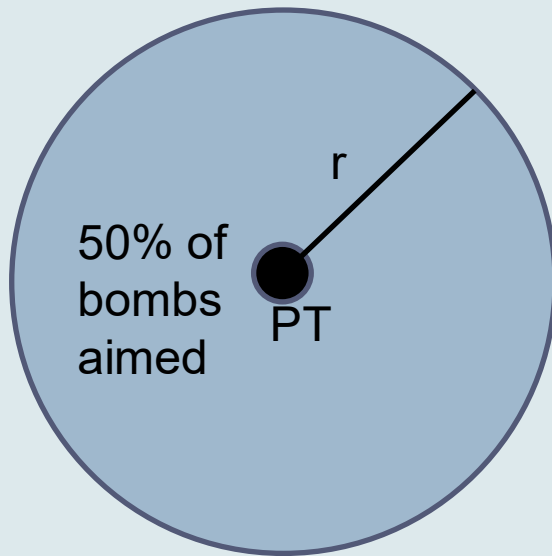
AIMING INACCURACIES, 1941-2017: AT LEAST A THOUSAND-FOLD REDUCTION



26,400 ft in 1941 vs roughly 2 ft today

CEP REVISITED

CEP is the radius that describes a circle with the target at its center within which 50% of the bombs dropped or weapons aimed will fall.



PT = point target

r = radius

CEP = r

50% of bombs
aimed

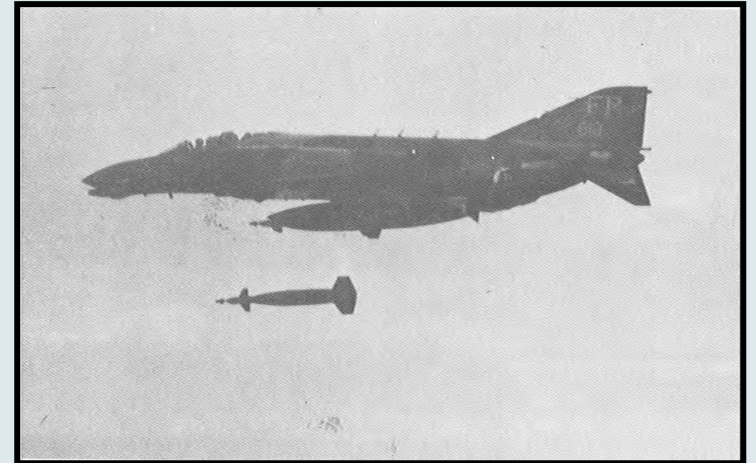
**INCREASING AIMING ACCURACY
DRAMATICALLY REDUCES THE NUMBER
OF NUCLEAR WEAPONS NEEDED TO
DESTROY A POINT TARGET**

- For a probability of destruction (P_k) of $\geq 90\%$ with a 1kt yield weapon with a lethal area (LR) of 1km
- If CEP is 10km then 333 weapons are required
- If CEP is 1km then four weapons are required
- If CEP is .5km then one weapon is required

APRIL 27, 1972: 1ST CLEAR, PRACTICAL OF PRECISION GUIDED MUNITIONS (PGMS)

Laser-guided bombs, delivered by eight bombers

Previous efforts to destroy the bridge entailed over 800 failed sorties



Thanh Hóa Bridge

TODAY, WITH PRECISION GUIDANCE, INNOCENTS NEED NOT SUFFER



**R9X “The Flying Ginsu”,
Syria**
February 2017

BOMBING ACCURACIES 1945 - 2017: FEWER SORTIES, GREATER EFFECTS



1500 B-17 sorties
9000 bombs (250#)
One 60' x 100' target
W.W.II



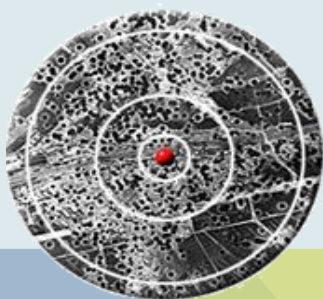
30 F-4 sorties
176 bombs (500#)
One Target
Vietnam



1 F-117 sortie
2 bombs (2000#)
Two Targets/Sortie
Desert Storm



1 B-2 sortie
16 bombs (2000#)
16 Targets/Pass
All Weather



PRECISION GUIDANCE MADE RELIANCE ON LOWER YIELD WARHEADS POSSIBLE

1962: Titan II W53 warhead **9 mt**



1985: Pershing II W85 **5 kt**

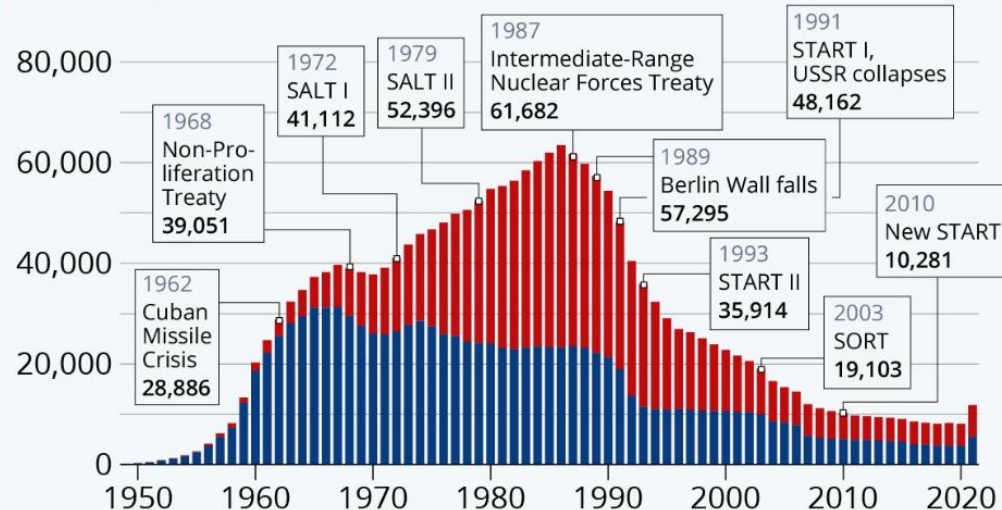


**...AS WELL AS MAJOR REDUCTIONS IN
TOTAL U.S.-RUSSIAN ARSENAL
WARHEADS & MEGATONNAGE**

How U.S. And Russian Nuclear Arsenals Evolved

Estimated stockpiled nuclear warhead count by year*

■ USA ■ USSR/Russia

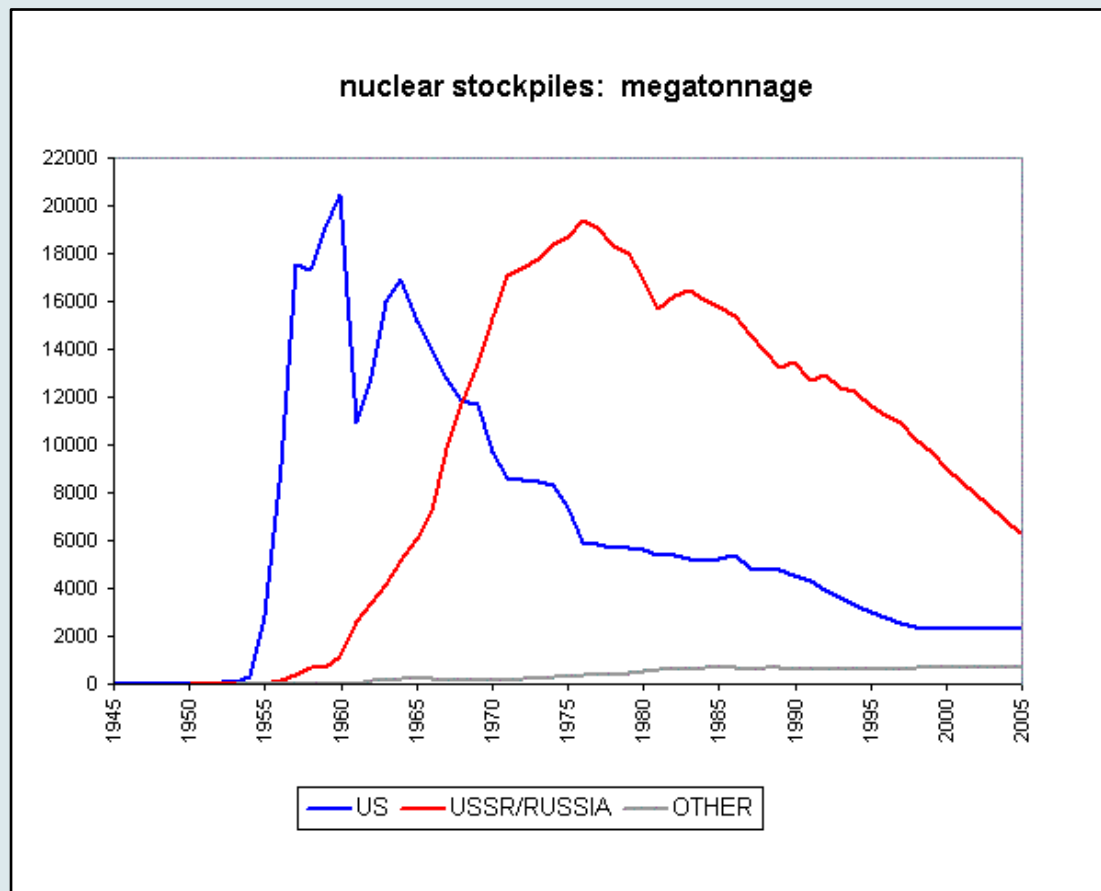


* Excludes currently deployed warheads. Refers to active/inactive warheads in military custody and earmarked for future use.

Source: Federation of American Scientists



statista



<http://www.johnstonsarchive.net/nuclear/nwhmt.html>

IV. CITY BUSTING: ITS MORALITY IS STILL AN ISSUE TODAY

THE PRINCIPLE OF PROPORTIONALITY

“[A]n attack which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, **which would be excessive in relation to the concrete and direct military advantage anticipated”** *violates the principle of proportionality.*

Art 51 (5)(b)

Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), 8 June 1977.

TARGETING CITIES TO MAKE FURTHER REDUCTIONS

“....the British have forsaken military targets and will achieve deterrence by threatening, explicitly or implicitly, to destroy the enemy’s cities, industrial centers, and communications...

It would appear that all the nuclear powers will have to follow the United Kingdom if or as they move toward a world without nuclear weapons.*The shift from military to civilian targeting, which seems barbaric, thus may be a feature of the path to ‘global zero’* along with the phased, verified elimination of nuclear weapons.”

Harold Smith and Raymond Jeanloz, “Britain Leads the Way to Global Zero,” *Arms Control Today*, December 2010. (Emphasis added)

A REAL QUESTION FOR U.S. POLICY UNDER OBAMA

“A much steeper reduction, to around 500 warheads total, was debated within the administration but rejected, sources said. *Known as the ‘deterrence-only’ plan, it would have aimed U.S. warheads at a narrower range of targets related to the enemy’s economic capacity* and no longer emphasized striking the enemy’s leadership and weaponry in the first wave of an attack.... *Obama...‘decided we did not need to do deterrence-only targeting now,’ but did not rule it out.*”

R. Jeffrey Smith, “Obama Administration Embraces Major New Nuclear Weapons Cut,” *Center for Public Integrity*, February 8, 2013. (Emphasis added)

STILL A QUESTION TODAY WITH IRAN

Hypothetical Scenario:

- Iranians strike U.S. aircraft carrier conventionally, killing 2,403 Americans

Polled Response:

- 59.1% of Americans willing to nuclear bomb Tehran, killing 2 million civilians
- 63.1% of Americans willing to conventionally bomb Tehran, killing 100,000 civilians

Study by Scott Sagan and Benjamin Valentino, "Revisiting Hiroshima in Iran" 2017

WHAT WILL WE TARGET IF OR WHEN WE RUN OUT OF MILITARY TARGETS?



Government
political control
systems, killing
possibly no one?



Hitler's Bunker

OR

Government
Leadership
killing possibly
one?



Cities, killing millions?



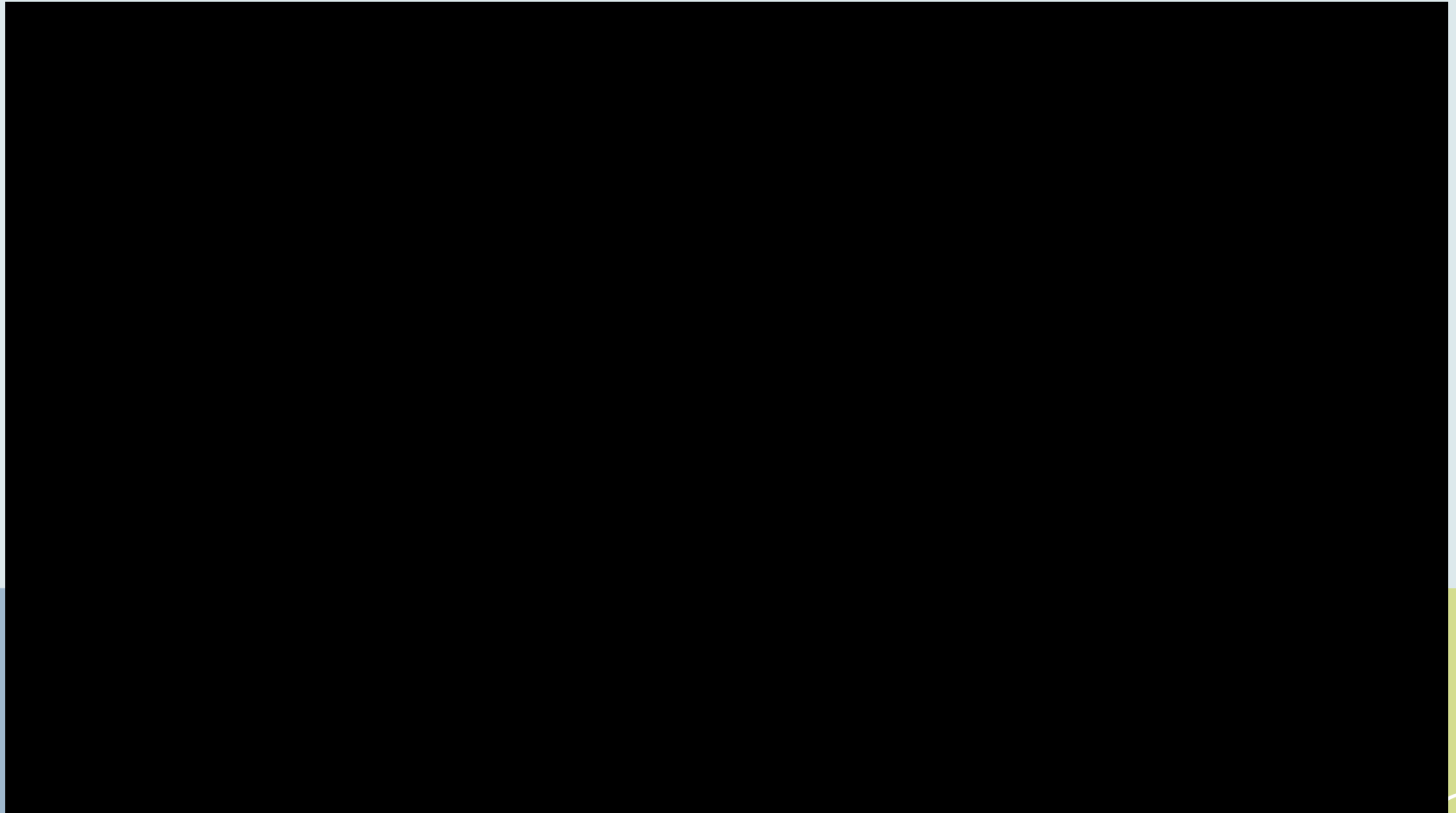
"Sympathetic"
targets,
impacting
thousands?

WHICH IS A WAR CRIME, WHICH IS A LEGITIMATE “PROPORTIONAL” ACT OF MILITARY “ADVANTAGE”?

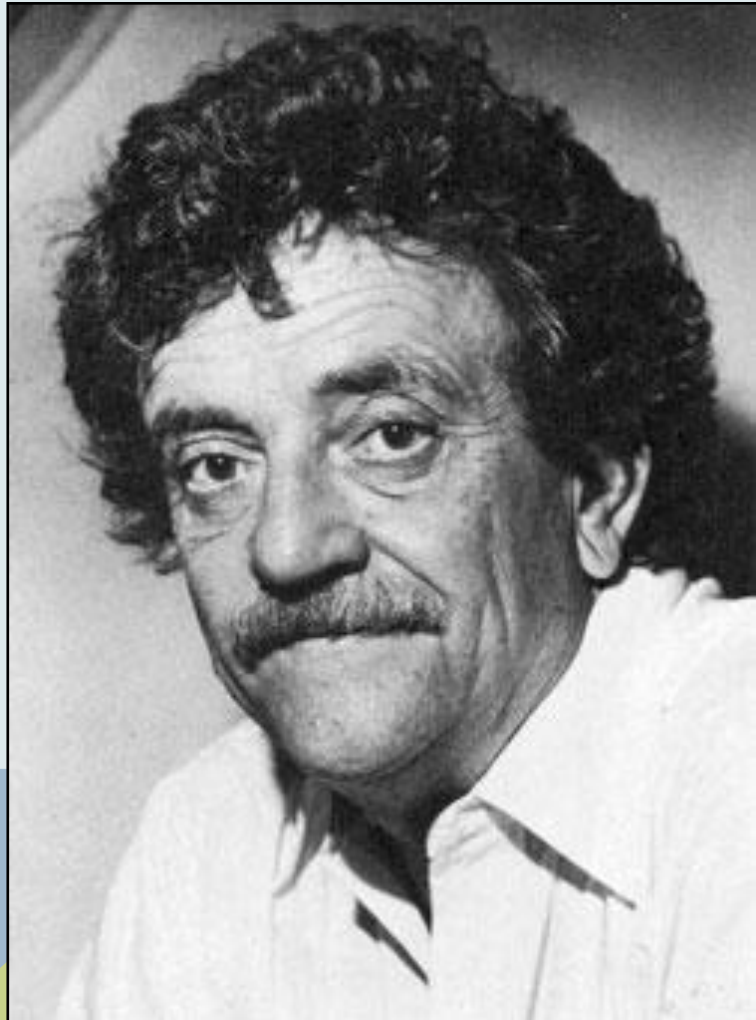


ADDITIONAL SLIDES

VALUE OF “STATIONARY” TARGETS (FROM 21:49 -- 22:56)



FIREBOMBING OF DRESDEN A CENTRAL EVENT IN *SLAUGHTERHOUSE-FIVE*, BY KURT VONNEGUT



YIELD

- **Yield = The amount of energy released by a weapon when detonated.**
- **Nuclear weapon yields are expressed as the amount of TNT needed to achieve the same energy discharge.**
- **The detonation of a nuclear weapon with a yield of one ton (i.e., .001 kilotons, or kt) = the energy released by the detonation of 1,000 kilograms (kg) of TNT.**
- **The detonation of a nuclear weapon with a yield of one kiloton (1 kt) = the energy released by the detonation of one million (1,000,000) kg of TNT.**
- **The detonation of a nuclear weapon with a yield of one megaton (mt) = the energy released by the detonation of one billion (1,000,000,000) kg of TNT.**

INCREASES IN BOMB YIELDS: 1941-1961

Weapon Description/Name	Yield (kt)	Year
WWII high explosive (H.E.) 500-lb bomb	~0.000117	1941
Largest WWII H.E. bomb (Grand Slam)	~0.0041	1944
Hiroshima pure fission bomb (Little Boy)	15	1945
First U.S. boosted-fission device (Item Shot)	45.5	1951
First U.S. thermonuclear weapons test (Ivy Mike)	10,400	1952
Largest Soviet thermonuclear bomb (Tsar Bomba)	50,000	1961

EXAMPLE:

If you increase your weapon's yield 1,000 fold, from 1kt to 1mt, you do not increase the lethal radius 1,000 fold (which would suggest a lethal radius that would reach from Washington, D.C. to Chicago) but only 10 fold (from downtown Washington, D.C. to Bethesda, MD).

$$\text{Lethal Radius (LR)} = \text{Constant} \times y^{1/3}$$

For a 1kt weapon:

$$\text{LR} = 1^{1/3}$$

$$1^{1/3} = \sqrt[3]{1}$$

$$\text{LR} = \sim 1\text{km}$$

For a 1,000kt (1mt) weapon:

$$\text{LR} = 1,000^{1/3}$$

$$1,000^{1/3} = \sqrt[3]{1,000}$$

$$\text{LR} = \sim 10\text{km}$$

PROBABILITY OF DESTROYING A TARGET (P_K) INCREASES DRAMATICALLY AS YOU INCREASE AIMING ACCURACIES

- Aiming accuracy depends on the relation of $\frac{LR}{CEP}$
- So, for a weapon with a LR of 1km:
- If CEP is 2km = $P_K \sim 16\%$
- If CEP is 1km = $P_K \sim 50\%$
- If CEP is .5km = $P_K \sim 94\%$

DISTINGUISHING BETWEEN CIVILIAN AND MILITARY TARGETS

“In order to ensure respect for and protection of the civilian population and civilian objects, the Parties to the conflict shall at all times distinguish between the civilian population and combatants and between civilian objects and military objectives and accordingly shall direct their operations only against military objectives.”

Art 48

Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), 8 June 1977.