CITY BUSTING, THE NUCLEAR WEAPONS REVOLUTION, AND PRECISION GUIDANCE

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QUESTIONS TO BE ADDRESSED:

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

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

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

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

BRIEF ANSWERS

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

II. The nuclear weapons revolution was an extension operationally of conventional city busting. Initially, ever larger yields seemed attractive for destroying larger portions of major cities.

III. 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.

IV. When things go badly, states may 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

SHERMAN'S MARCH TO THE SEA: MORE DISCRIMINATE THAN GENERALLY PORTRAYED

ATLANTA, GEORGIA

Field Artillery and Fire

A six-month campaign

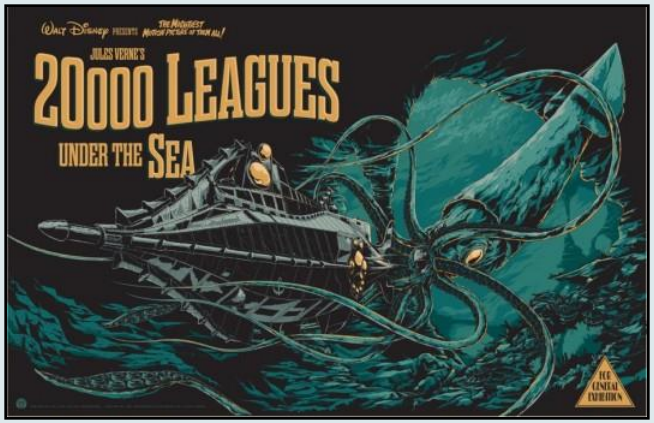
Few, if any civilians, killed

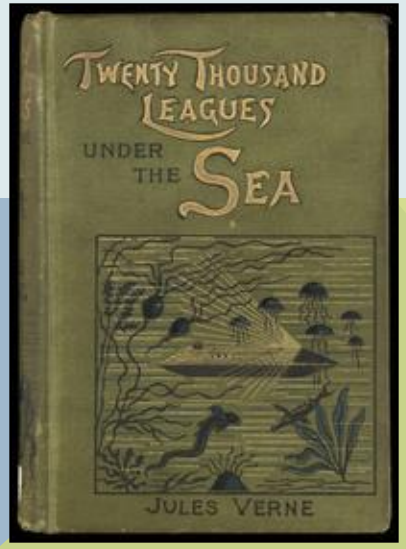
Residences, churches, and hospitals spared

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

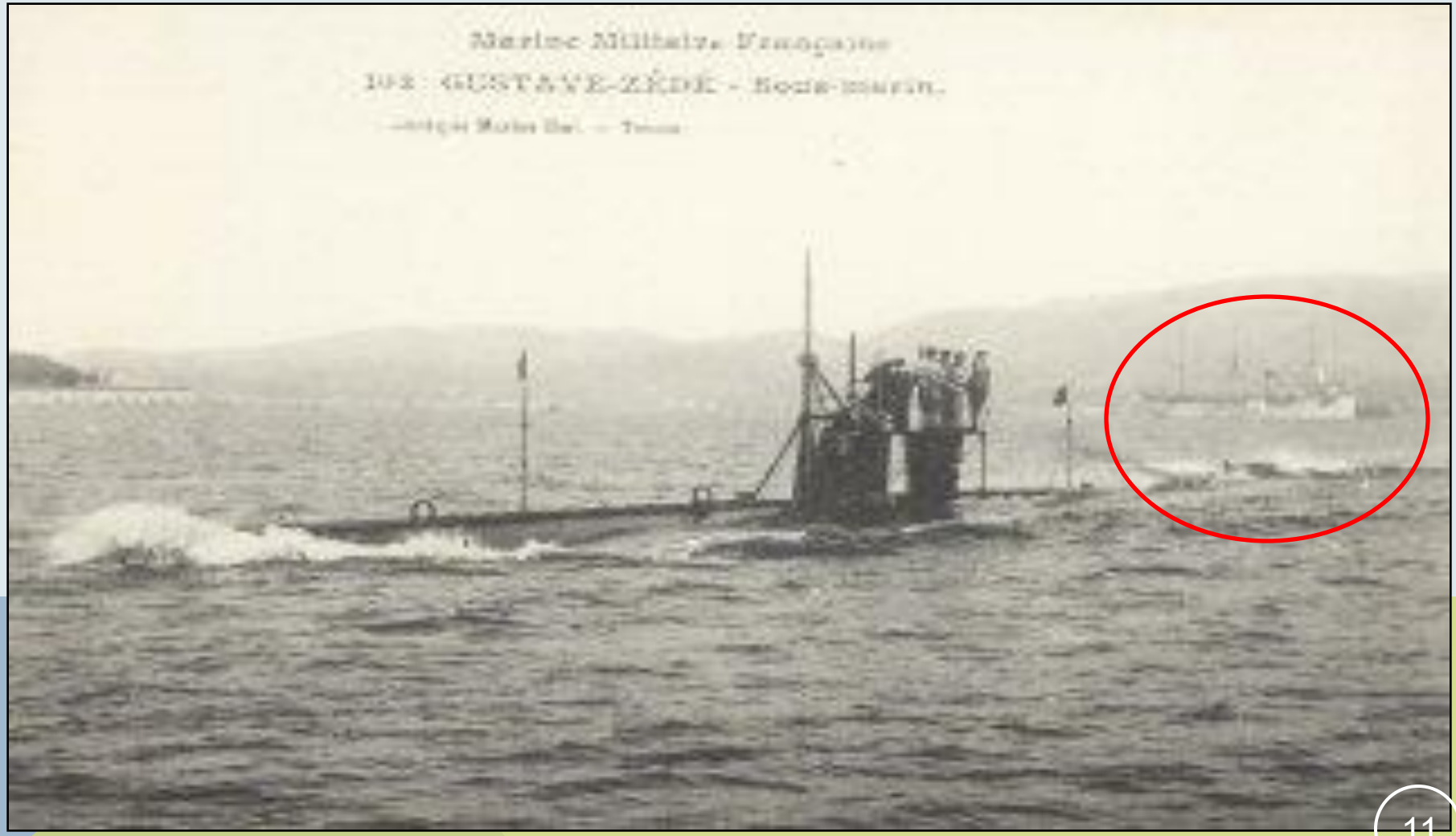
Gymnote class

Narval

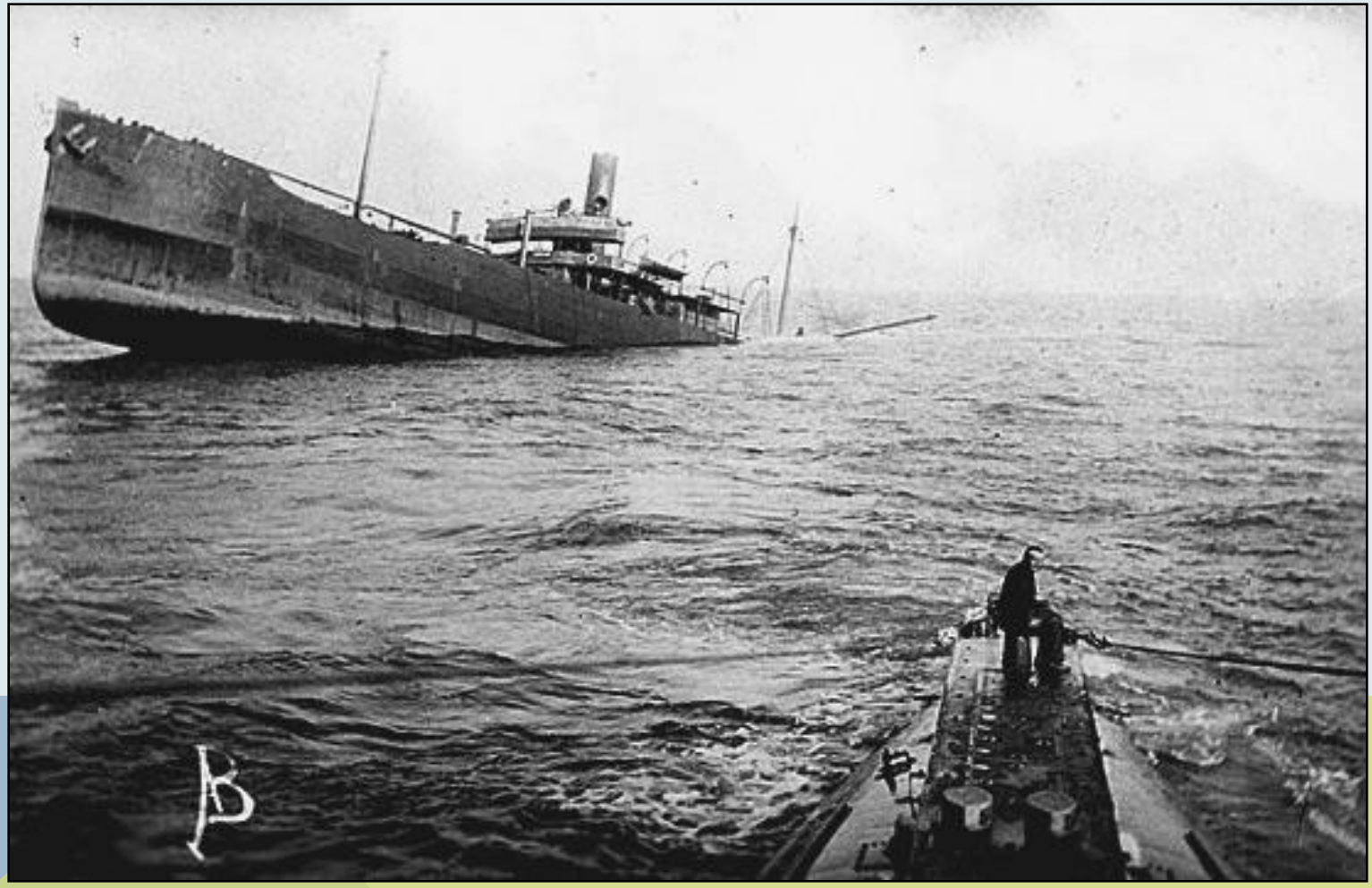
Gustave Zede class

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

PITTING MILITARY AGAINST MILITARY: BATTLE OF THE SOMME

WORLD WAR I

Trench Warfare, 4-plus months

300,000-plus dead

Produced no strategic results

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

WORLD WAR I

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

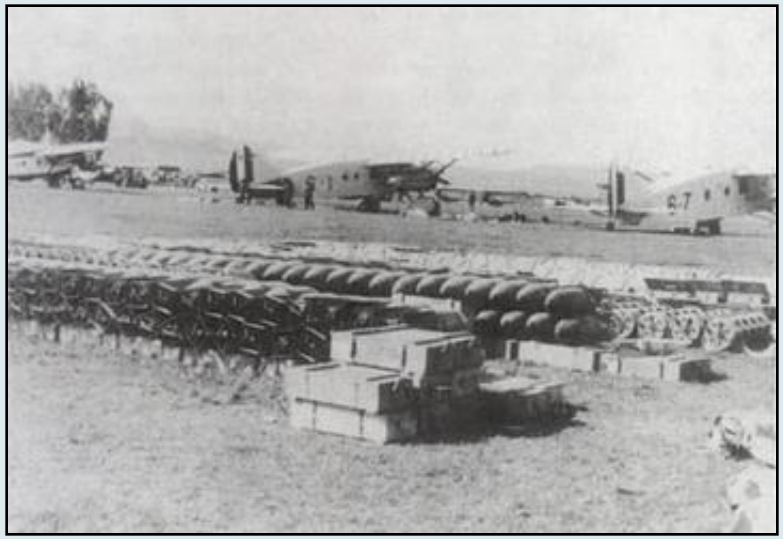
Waziristan - India's Northwest Frontier

Kurdistan

British Somaliland

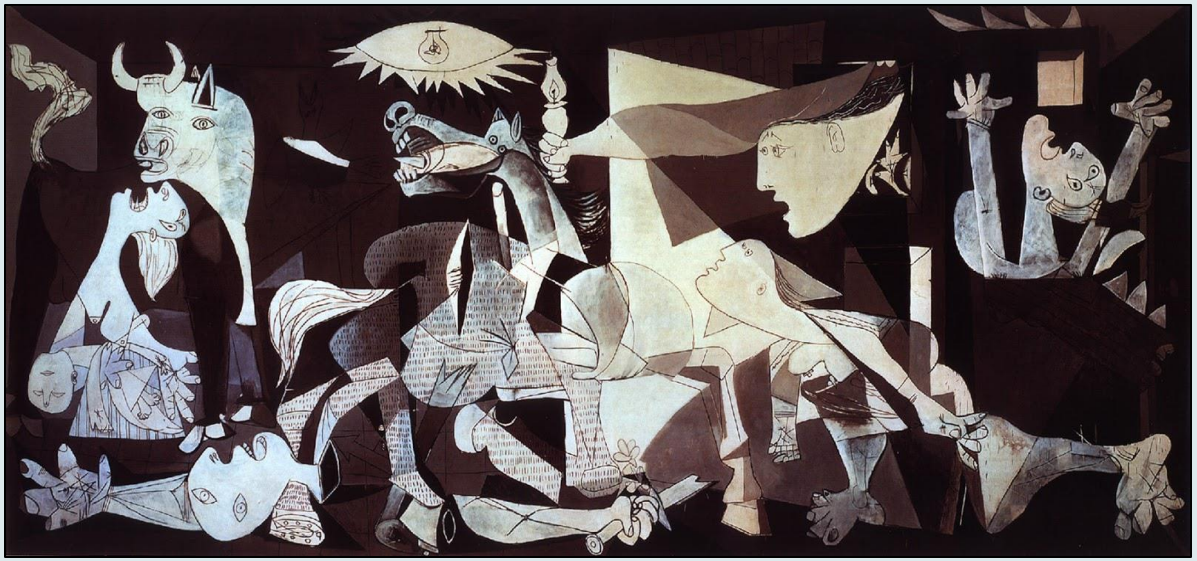
Iraq

DITTO, ITALIAN AERIAL BOMBINGS IN SECOND ITALO-ETHIOPIAN WAR



1937 GERMAN AND ITALIAN BOMBING OF GUERNICA: CLAIMED "MISTAKES"

Three quarters of the town destroyed
Casualties: 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"

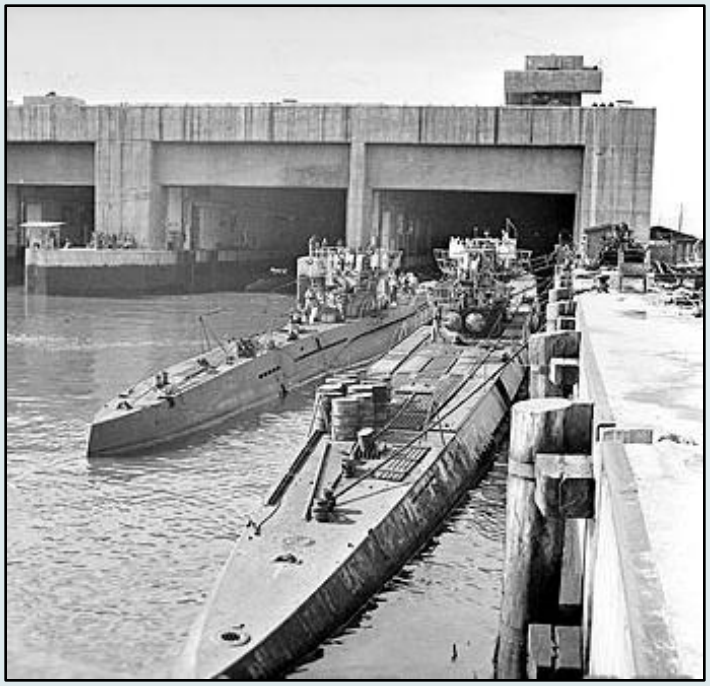
Wieluń, Poland: September 1939
Casualties: Several Hundred

Rotterdam: May 1940
Casualties: 900

Berlin: August 1940

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

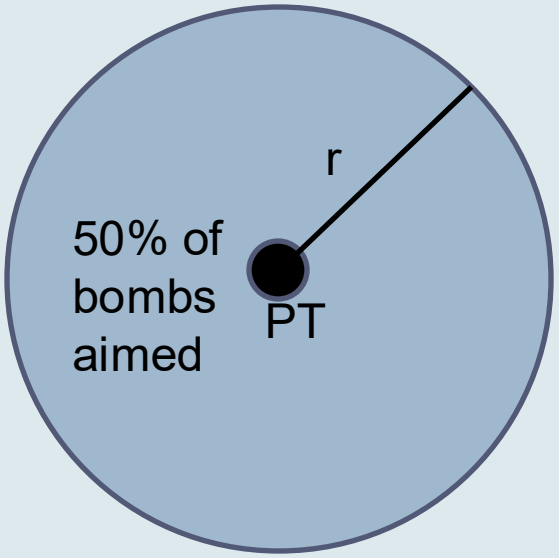
The area around this rail yard is marked by stray bombs

BUTT REPORT SPOTLIGHTS BOMBING INACCURACIES *AUGUST 1941*

- Initially, RAF Bomber Command relied on crews' claims regarding how much damage they inflicted.
- By 1941, though, the Air Ministry developed infrared cameras that could be attached to the bombers to take aerial photographs of the targets being bombed.
- Lord Cherwell, Churchill's science advisor, instructed D.M. Butt of the War Dept. Secretariat to conduct a study of RAF German bombing runs using these cameras.
- Butt compared the damage reported by the bomber crews with that shown by night-time aerial photos taken of 633 targets in June and July of 1941.
- Report revealed only 10% of the bombers flying against night-time Ruhr industrial sites found their way to within 75 square miles of their intended targets, (let alone the 1,000 yards pilots claimed). Of all the bombing operations examined, only 5% of the bombers got as close to their targets.

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

- **The Butt Report prompted a debate over whether to reduce the bombing effort and transfer resources to the Army and Navy or to continue the bombings as before.**

- **In response, Lord Cherwell produced another study, the "Dehousing Paper," which argued that given the RAF's limited success in destroying precise targets, the most effective use of the bombers would be to destroy German housing because it would affect German morale.**

- **The Dehousing Paper estimated that if the UK dedicated 5,000 bombers to the task, they could turn one-third of Germany's population "out of house and home" by mid 1943.**

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

WORLD WAR II

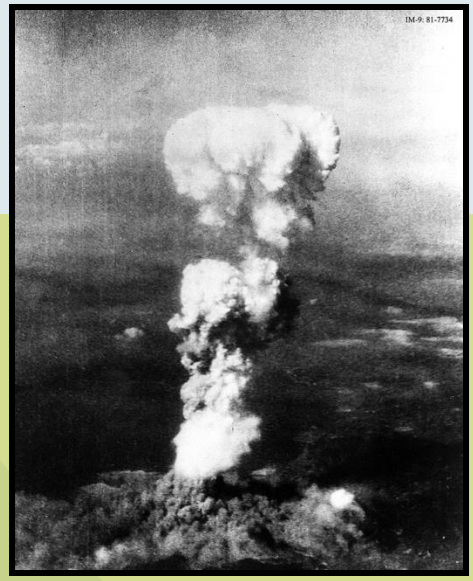
*Firebombing, **85,000-100,000** dead*

HIROSHIMA:

LOGICAL CONCLUSION OF CITY BUSTING

WORLD WAR II

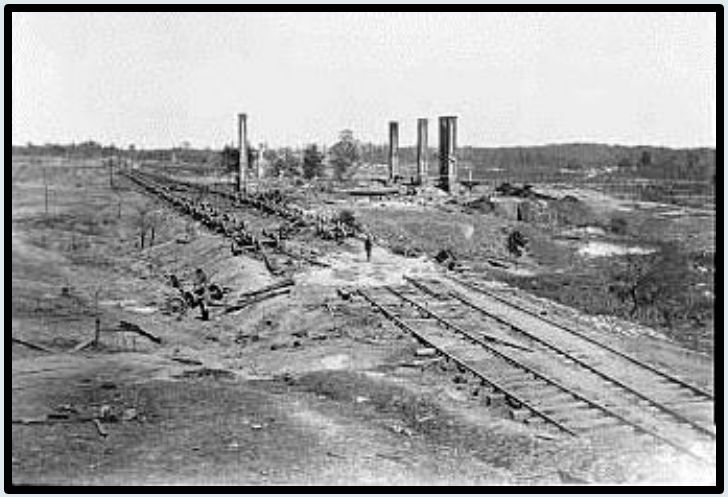
Nuclear Bomb, 90-146,000 dead by December 1945, over 200,000 by 1950



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**)

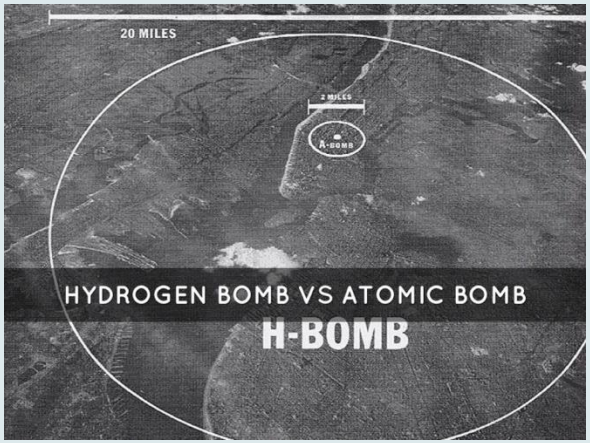
Hiroshima, WWII (took **1 second**)

FORCES REQUIRED: FIRST ARMIES THEN JUST A SINGLE BOMBER

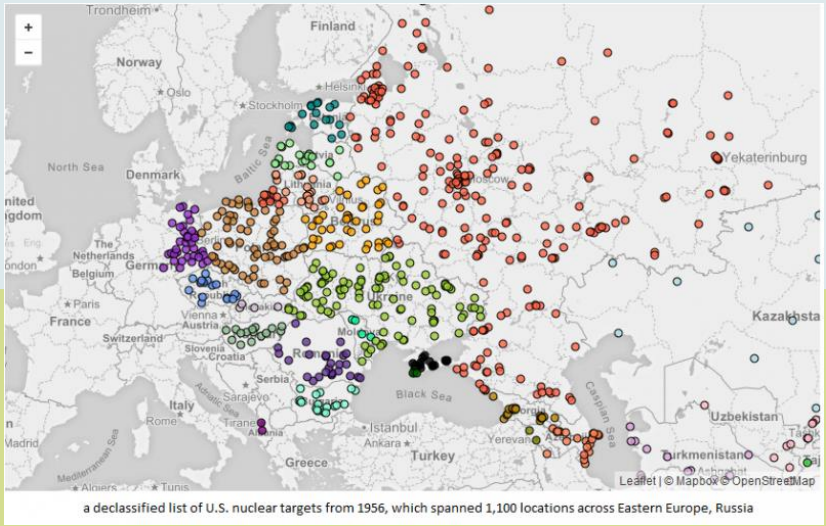
- **Battle of Atlanta**: ~75,000 troops; ~ 9,000 military casualties
- **Fire Bombing of Dresden**: >1,200 bombers, >800 fighters; 8 bombers lost
- **Fire Bombing of Tokyo:** 334 B-29 bombers; 14 bombers lost
- **Hiroshima:** One B-29; no bomber losses

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

KILLING MILLIONS OF INNOCENTS: A GIVEN WELL AFTER WWII



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



a declassified list of U.S. nuclear targets from 1956, which spanned 1,100 locations across Eastern Europe, Russia

NUCLEAR TARGETS, 1956, 1,100 LOCATIONS

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

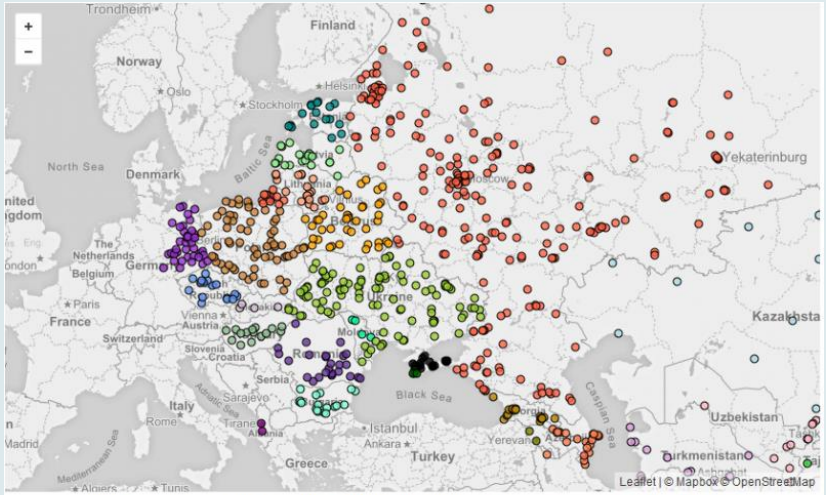
"We went over there and fought the war and eventually burned down every town in North Korea anyway, someway or another, and some in South Korea too.... Over a period of three years or so, *we killed off — what — twenty percent of the population of Korea*..."

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

https://nsarchive2.gwu.edu/nukevault/ebb538-Cold-War-Nuclear-Target-List-Declassified-First-Ever/



a declassified list of U.S. nuclear targets from 1956, which spanned 1,100 locations across Eastern Europe, Russia

"…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."*

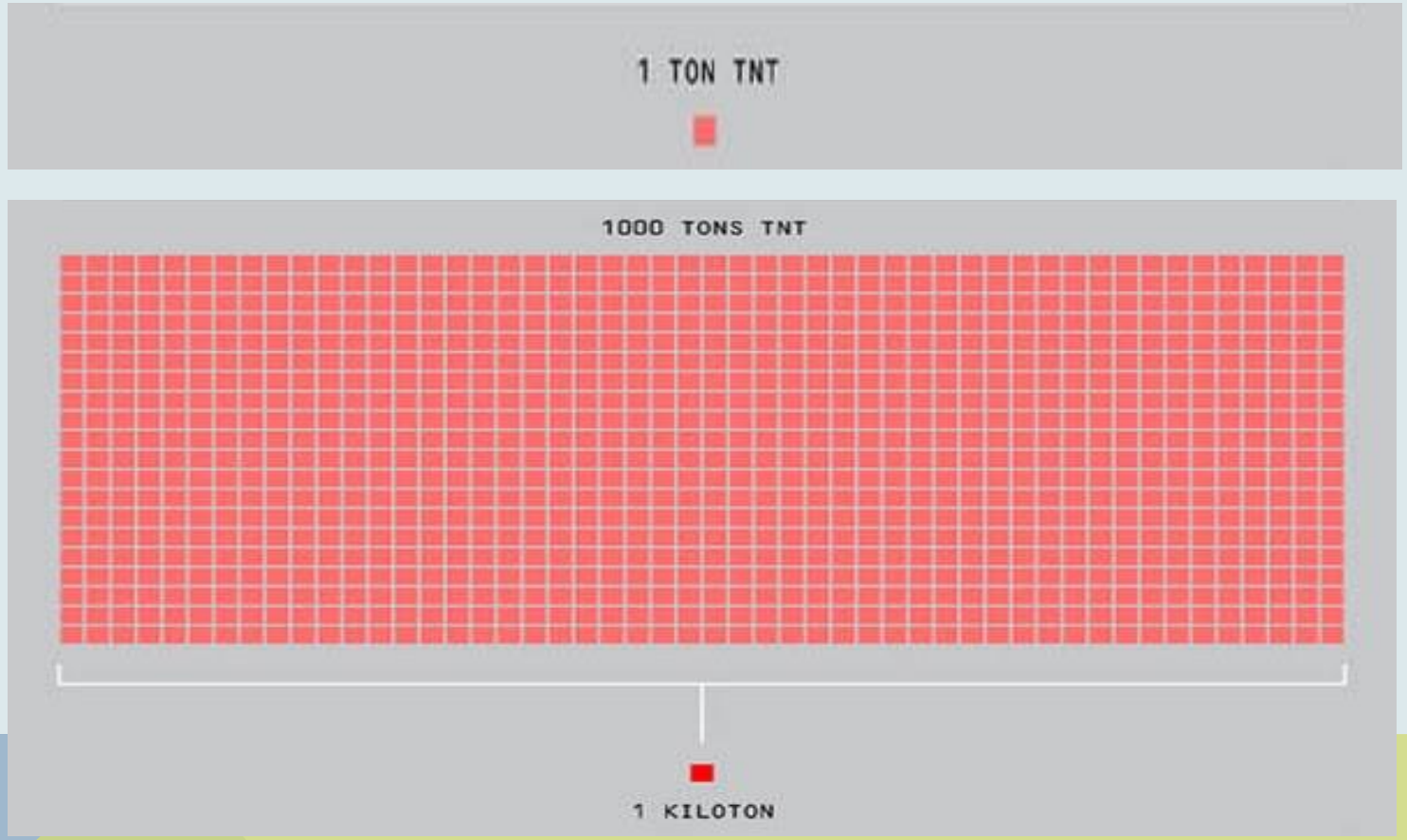
Defense Secretary McNamara
Memo to Pres. Kennedy
Nov. 21, 1962

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

INCREASES IN MAJOR CONVENTIONAL AND NUCLEAR BOMB YIELDS: 1941 - 1961

- **500-lb nominal WWII bomb** (which carried about 113 kilograms of high explosive)
- **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)
- **MOAB** (US conventional bomb named Massive Ordinance Air Blast) & FOAB (Russian conventional bomb, named The Father of All Bombs, also a fuel air explosive device)—roughly 11-44 tons of high explosive (0.011-.044 kt)
- **Little Boy** (Hiroshima)—uranium gun-barrel bomb had a yield of approximately 15 kt.
- **Item Shot** (boosted device)—it had a yield of 45.5 kt
- **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.
- **Tsar Bomba** (nonoperational thermonuclear weapon)—had a yield of 50 mt

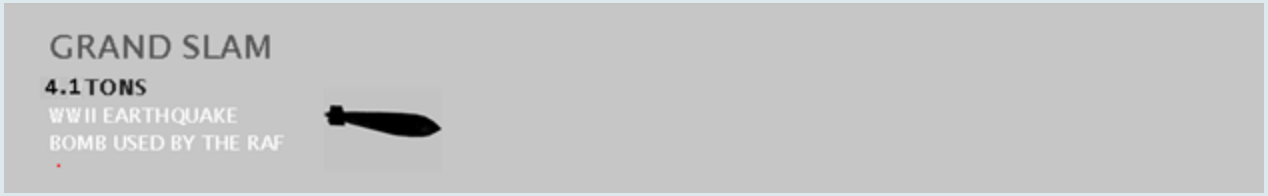
VISUALIZING A KILOTON



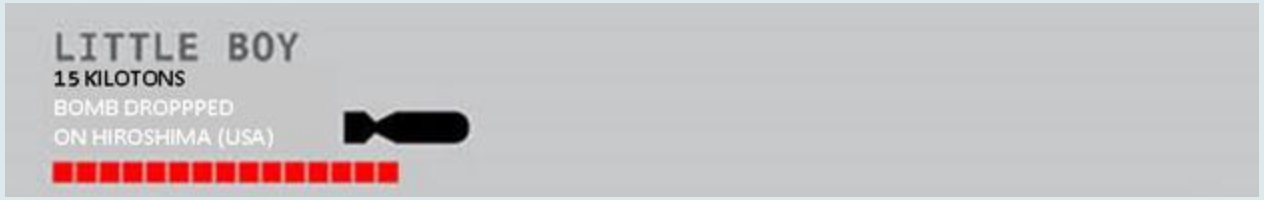
Source: Visualizing the Frightening Power of Nuclear Weapons
http://www.visualnews.com/2012/04/24/visualizing-the-frightening-power-of-nuclear-bombs

VISUALIZING YIELDS OF SPECIFIC MUNITIONS

~4.1 tons =
0.0041 kilotons



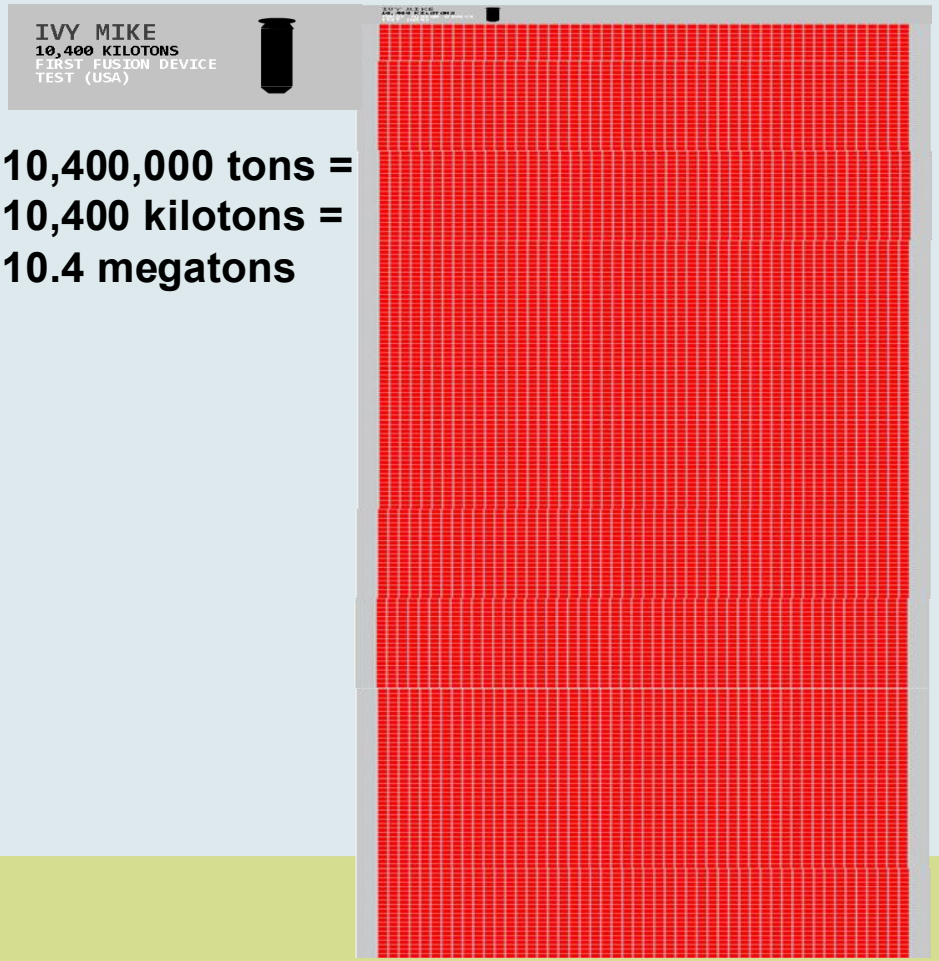
15,000 tons =
15 kilotons



45,500 tons =
45.5 kilotons

CONTINUED

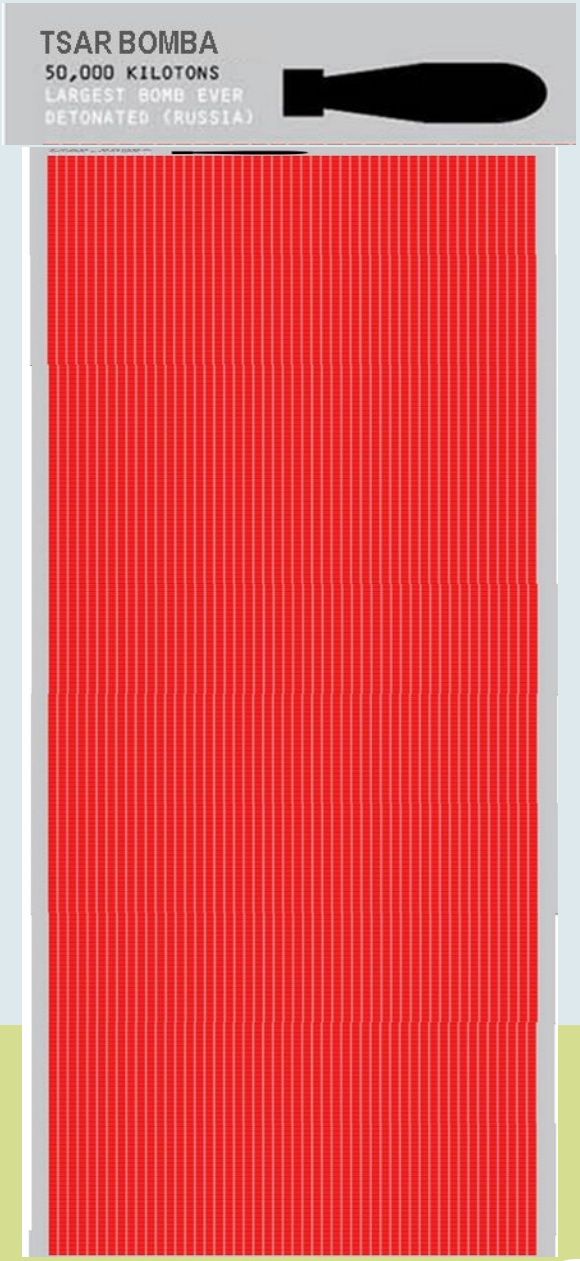
45,500 tons =
45.5 kilotons



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

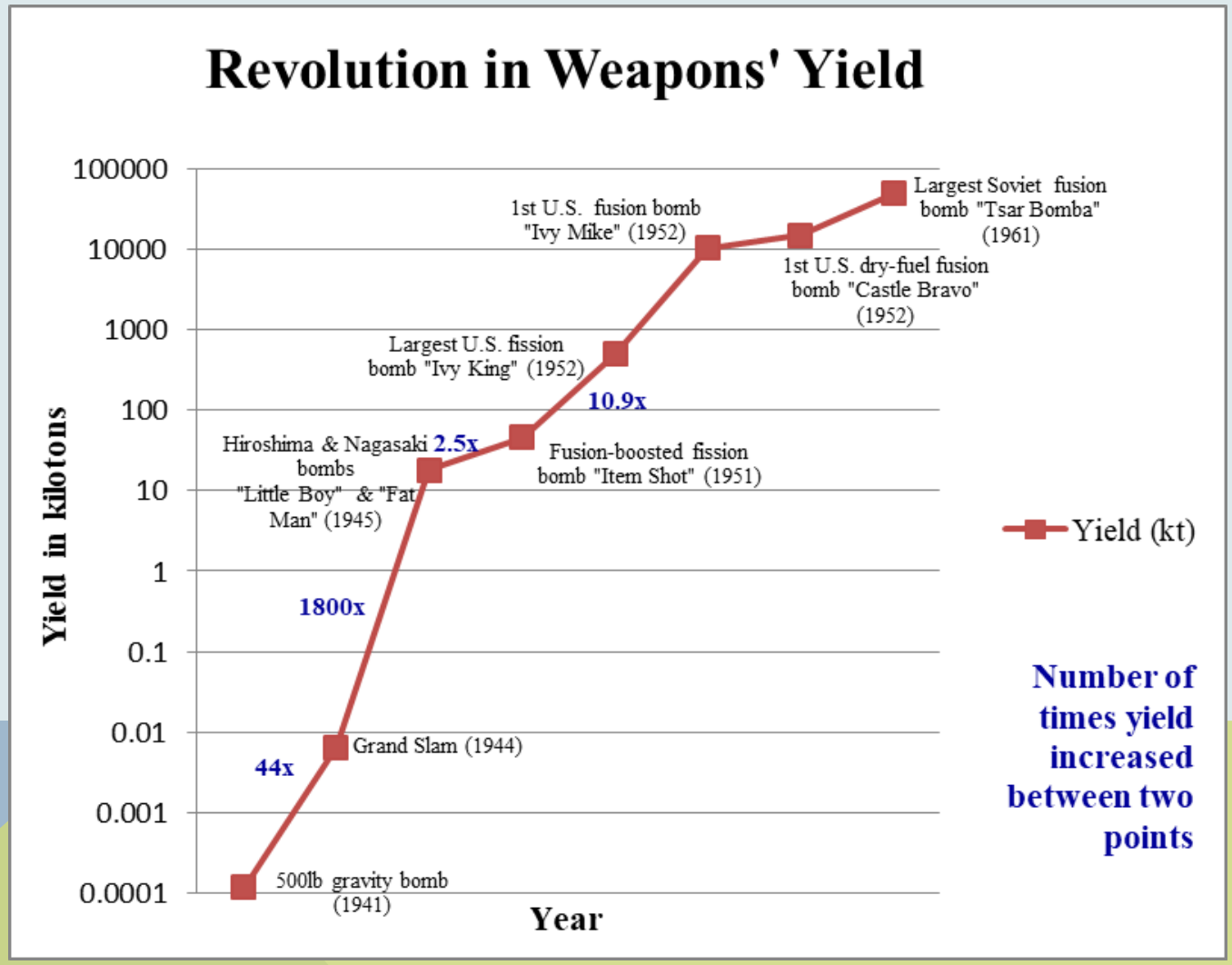
CONTINUED

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



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

LOGARITHMIC PORTRAYAL OF INCREASING YIELDS: 1941-1961



HOW YIELD RELATES TO BLAST/LETHAL AREA

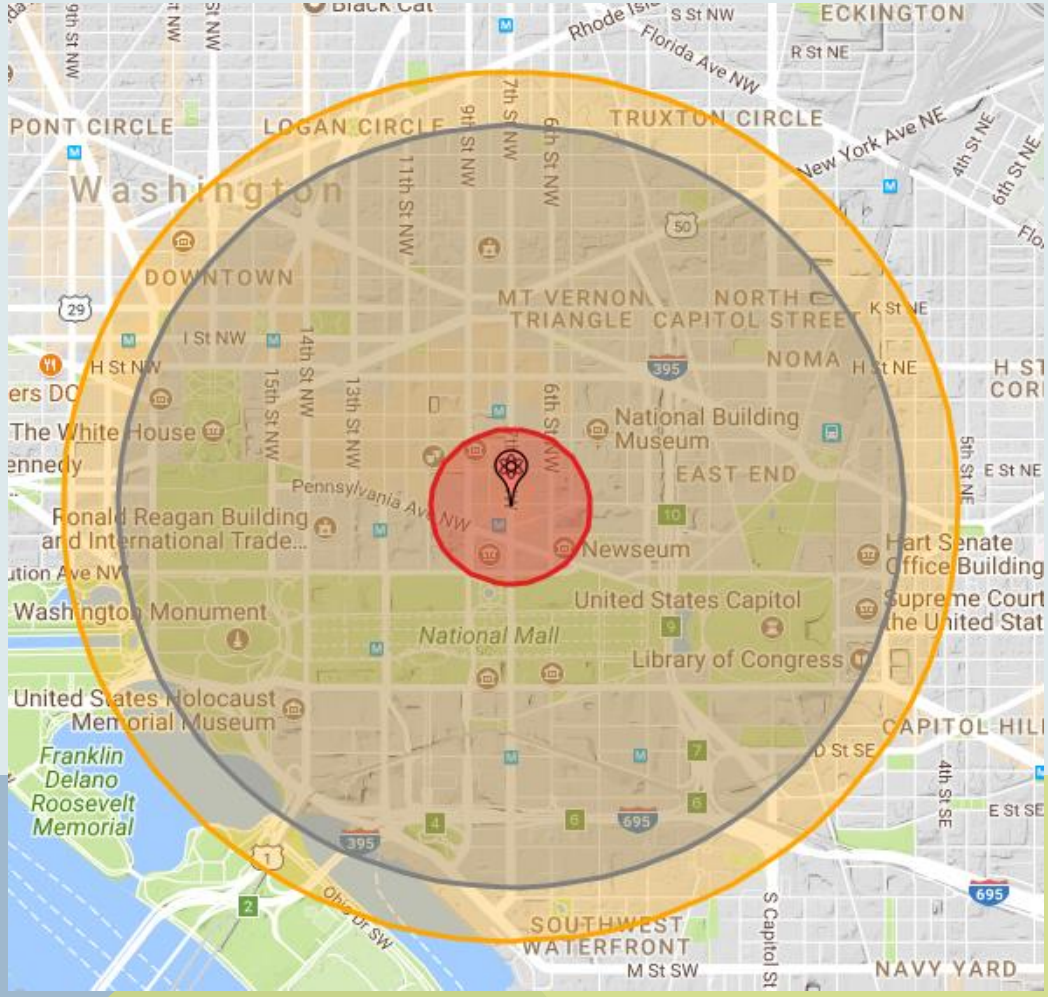
BLAST EFFECTS: ABOVE 2 PSI IS SIGNIFICANT

20 psi	Heavily built concrete buildings are severely damaged or demolished; fatalities approach 100%.
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.
7 psi	Severe damage to complete destruction of reinforced concrete structures, such as skyscrapers, will occur within this ring.
5 psi	Complete destruction of ordinary houses, and moderate to severe damage to reinforced concrete structures, will occur within this ring.
2 psi	Severe damage to ordinary houses, and light to moderate damage to reinforced concrete structures, will occur within this ring.
1 psi	Light damage to all structures, and light to moderate damage to ordinary houses, will occur within this ring.

Source: http://meyerweb.com/eric/tools/gmap/hydesim.html?inpyield=1000 and https://nuclearsecrecy.com/nukemap/

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.

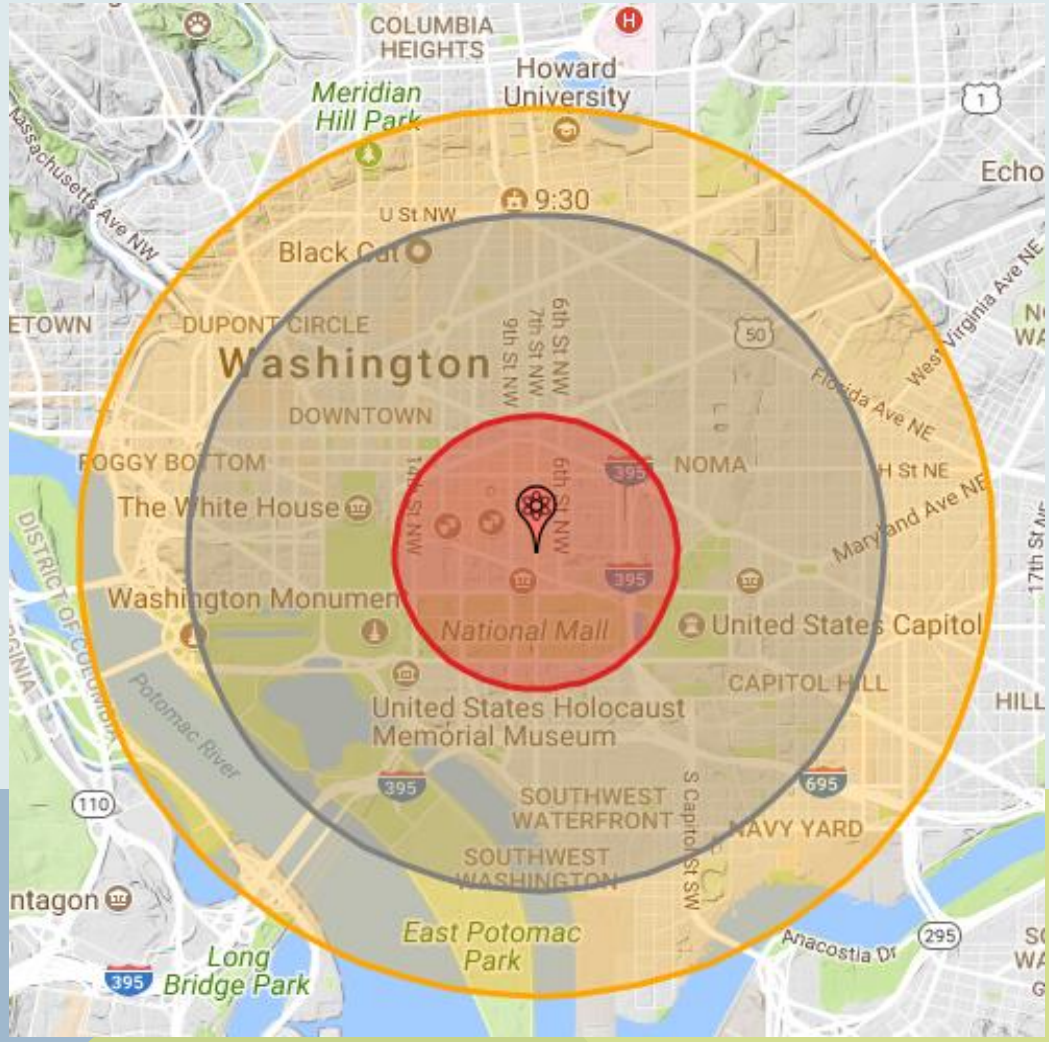
Effect radii for 15 kt airburst

- Air blast radius (20 psi): 340 m (0.36 km^2)
- Air blast radius (5 psi): 1.67 km (8.78 km^2)
- Thermal radiation radius (3rd degree burns): 1.91 km (11.4 km^2)

Source: https://nuclearsecrecy.com/nukemap/

BLAST AREA

ITEM SHOT: FIRST BOOSTED-FISSION DEVICE (45.5 KT)



Estimated fatalities:
165,290

Estimated injuries:
287,600

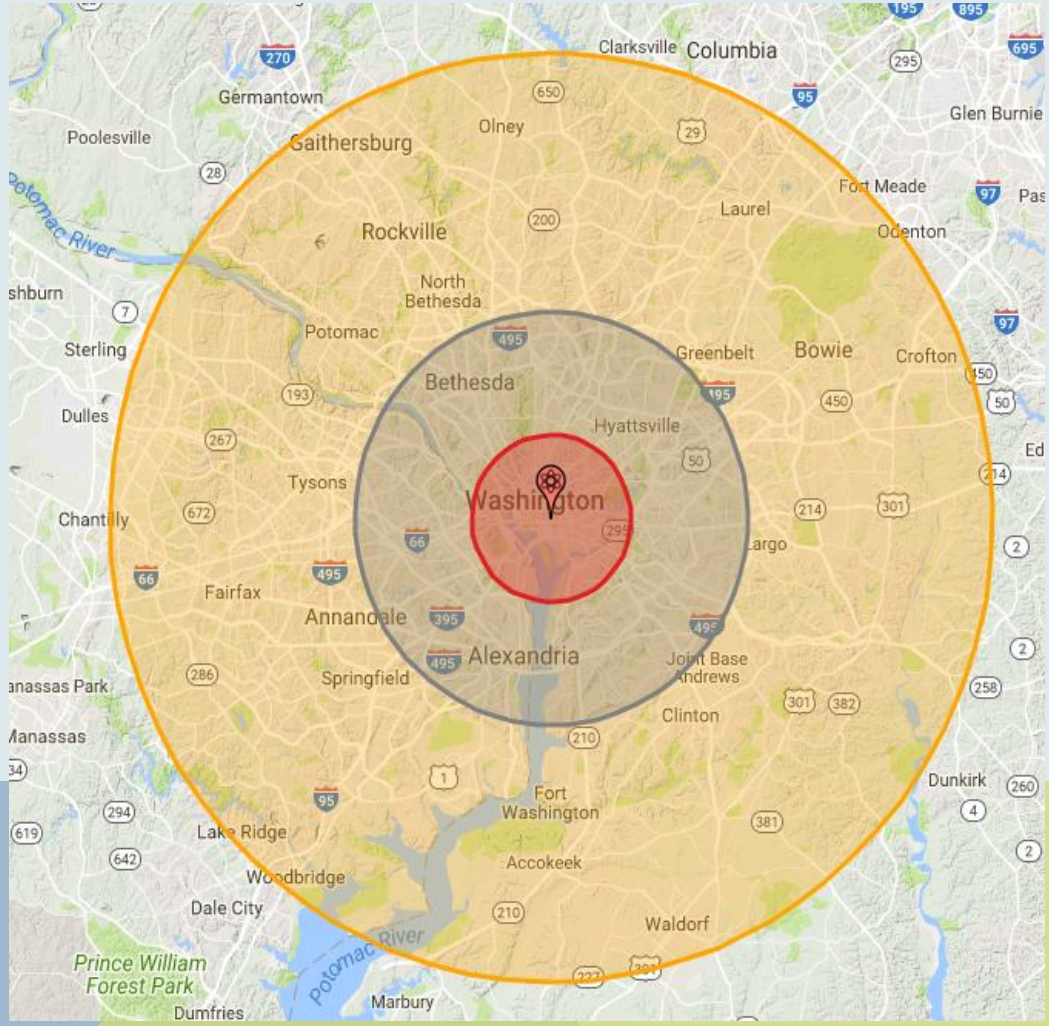
In any given 24-hour period, there are on average 817,953 people in the light (1 psi) blast range of the simulated detonation.

Effect radii for 45.5 kt airburst

- Air blast radius (20 psi): 340 m (0.36 km^2)
- Air blast radius (5 psi): 2.48 km (19.4 km^2)
- Thermal radiation radius (3rd degree burns): 3.261 km (33.5 km^2)

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

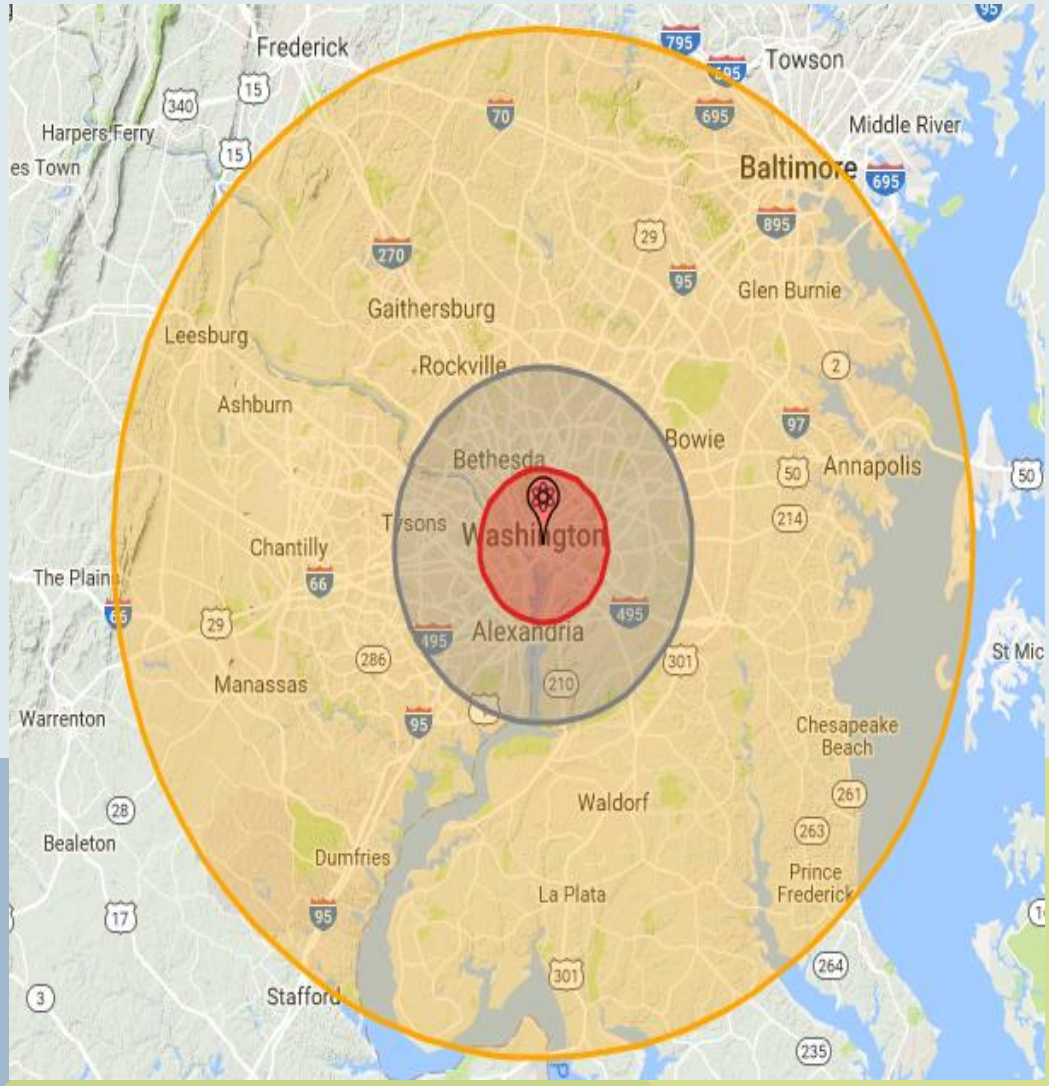
In any given 24-hour period, there are on average 3,298,741 people in the light (1 psi) blast range of the simulated detonation.

Effect radii for 10.4 mt airburst

- Air blast radius (20 psi): 6.16 km (119 km^2)
- Air blast radius (5 psi): 15.2 km (725 km^2)
- Thermal radiation radius (3rd degree burns): 34.1 km (3,660 km^2)

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

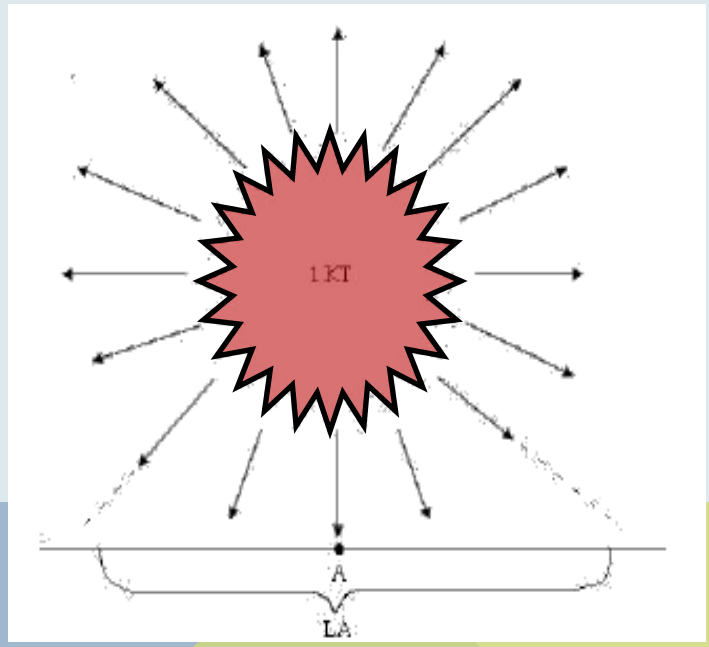
- Air blast radius (20 psi): 8.91 km (249 km^2)
- Air blast radius (5 psi): 20.7 km (1,350 km^2)
- Thermal radiation radius (3rd degree burns): 60 km (11,300 km^2)

QUALIFYING THE NUCLEAR REVOLUTION:

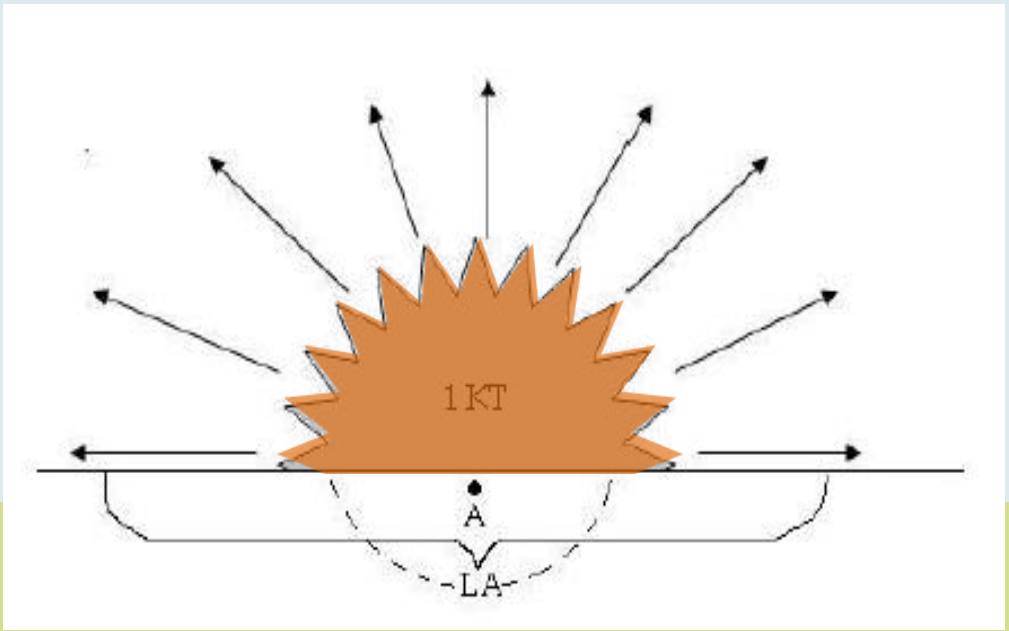
LETHAL AREA AND ITS RELATION TO YIELD

LETHAL AREA: ONLY A FRACTION OF A 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 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 $y^{1/3}$.

- Increasing the yield of a nuclear weapon does not directly increase its lethal radius but instead is subject to the $y^{1/3}$ rule.

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).

Lethal Radius (LR) = Constant x $y^{1/3}$

For a 1kt weapon:

LR= $1^{1/3}$

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

LR = ~1km

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

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

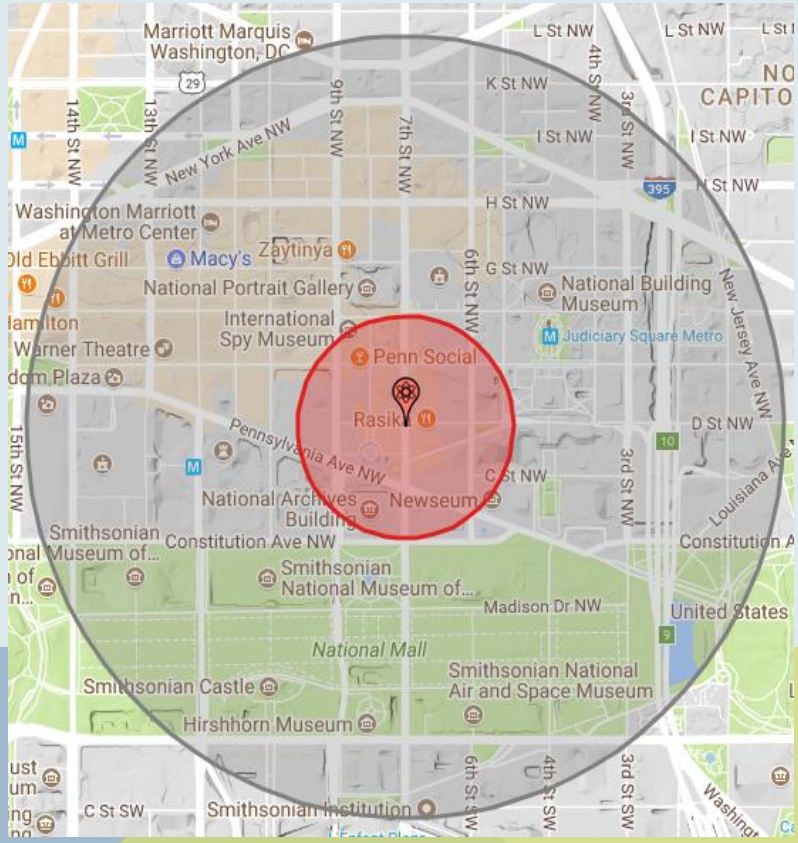
$1{,}000^{1/3} = \sqrt[3]{1{,}000}$

LR = ~10km

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.

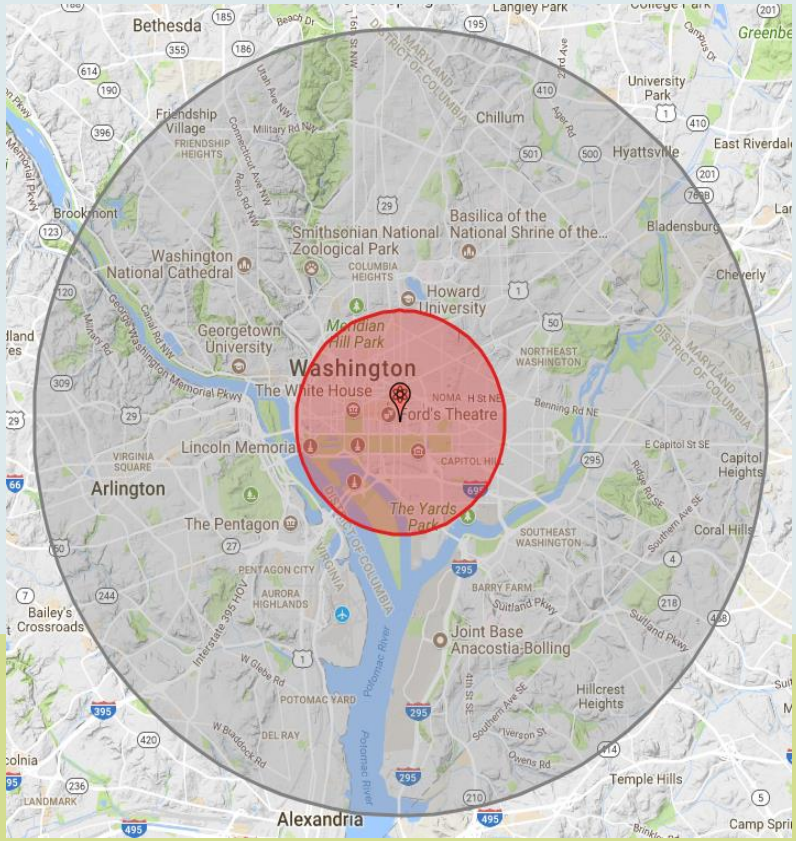
1kt Yield Air Blast



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



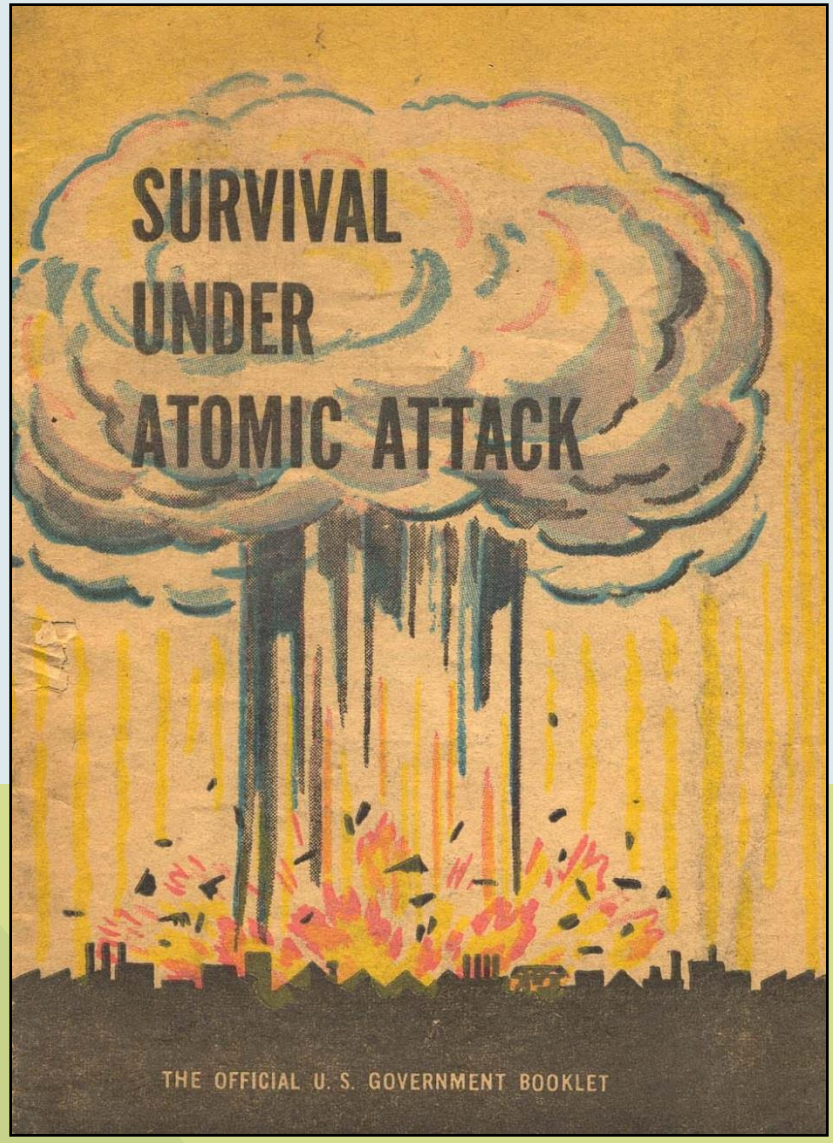
Air blast radius (20 psi): 2.82 km (25 km²)

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 $4^1/_2$, not 100 times as far."



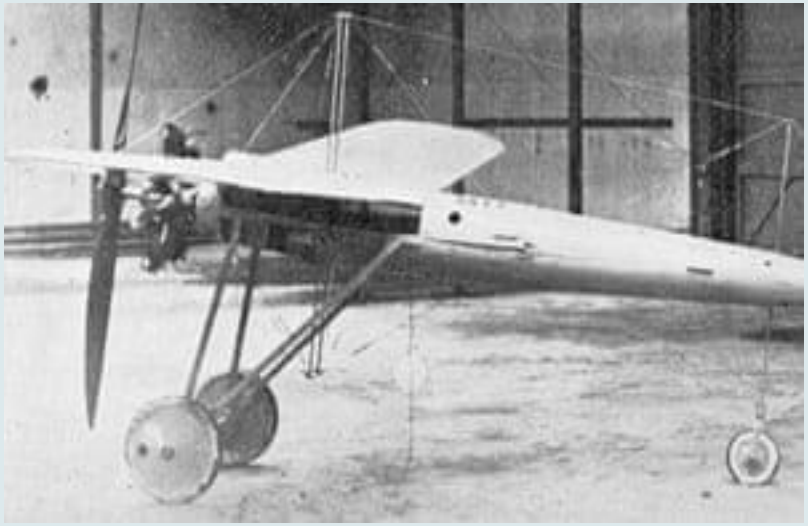
"Beyond 2 miles, the explosion will cause practically no deaths at all."

"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?

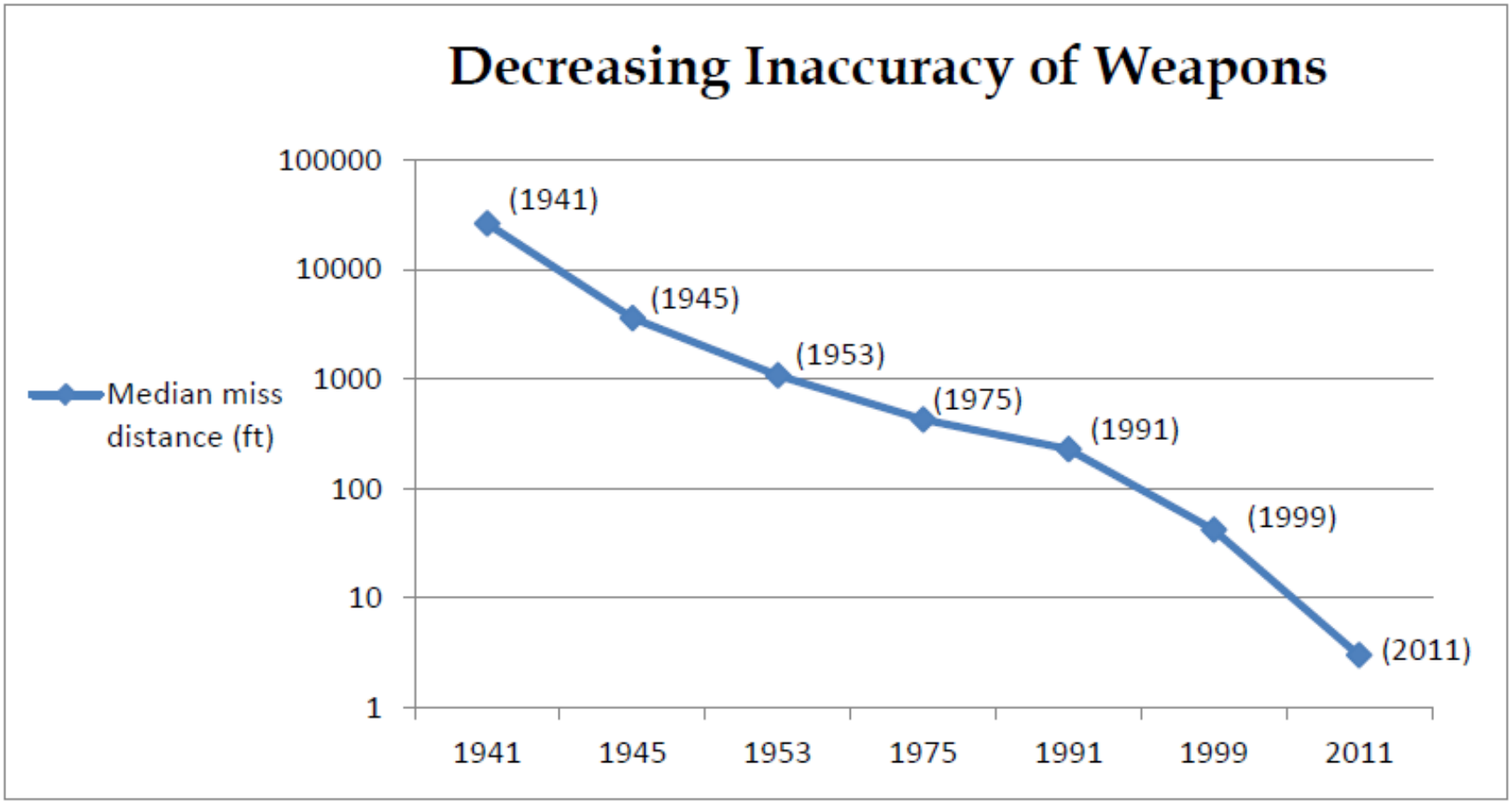
PRECISION GUIDANCE, WHICH DATES BACK TO WWI AND WWII, SLOWLY OFFERED MILITARY ALTERNATIVES



AT, 1916

ASM-N-2 Bat, 1944

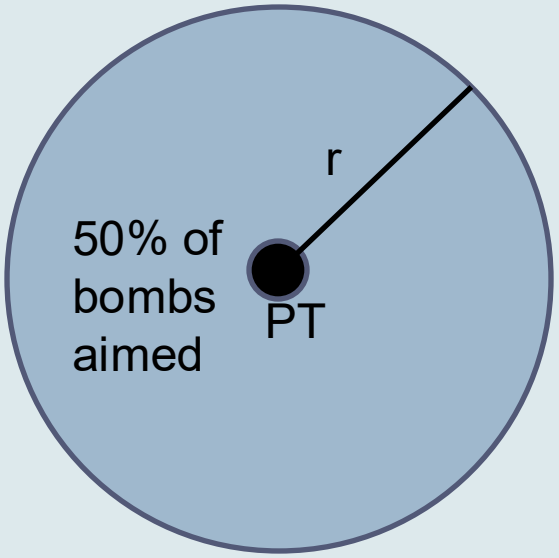
AIMING INACCURACIES, 1941-2011: A THOUSAND FOLD REDUCTION



26,400 ft in 1941 vs roughly 2-3 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

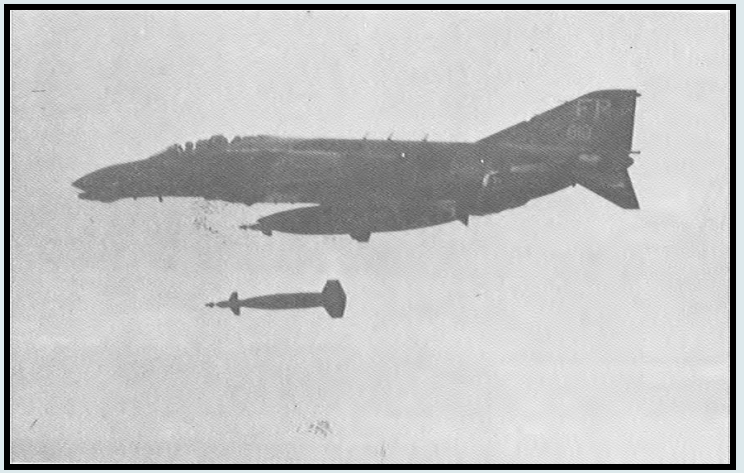
INCREASING AIMING ACCURACY DRAMATICALLY REDUCES THE NUMBER OF NUCLEAR WEAPONS NEEDED TO DESTROY A POINT TARGET

- 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

GPS AND PRECISION STRIKE

FEWER SORTIES FOR A GREATER EFFECT

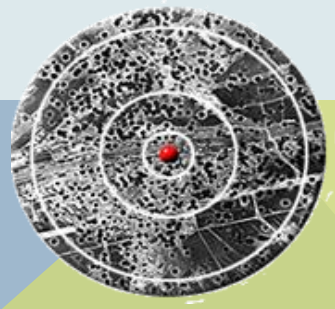
Position, Navigation and Timing - GPS → **Precision Engagement**

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

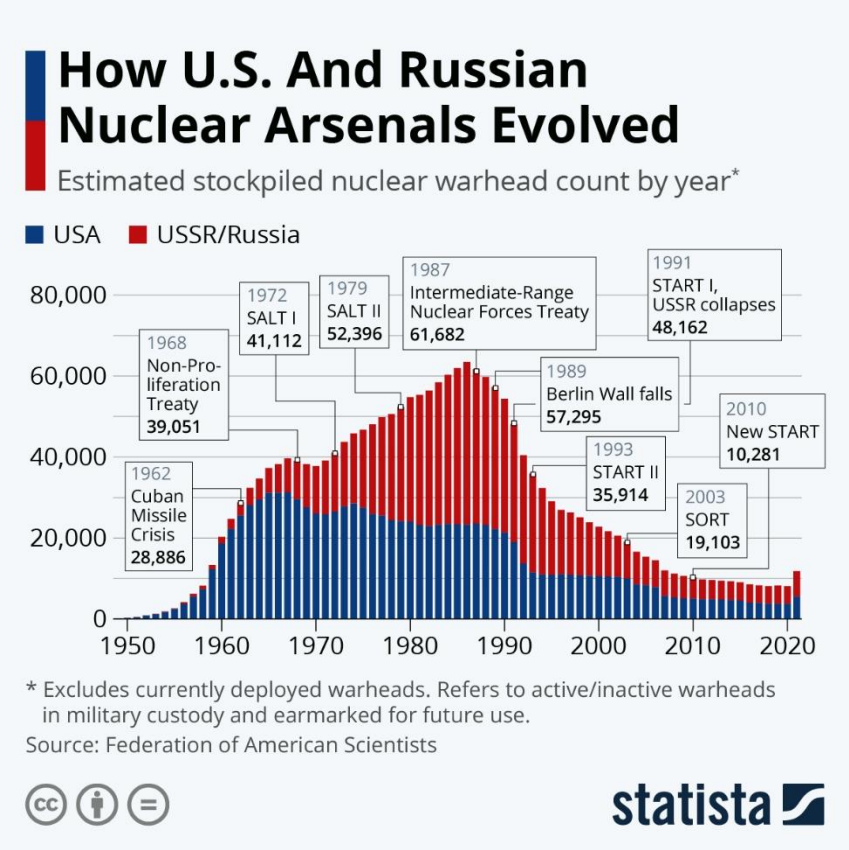


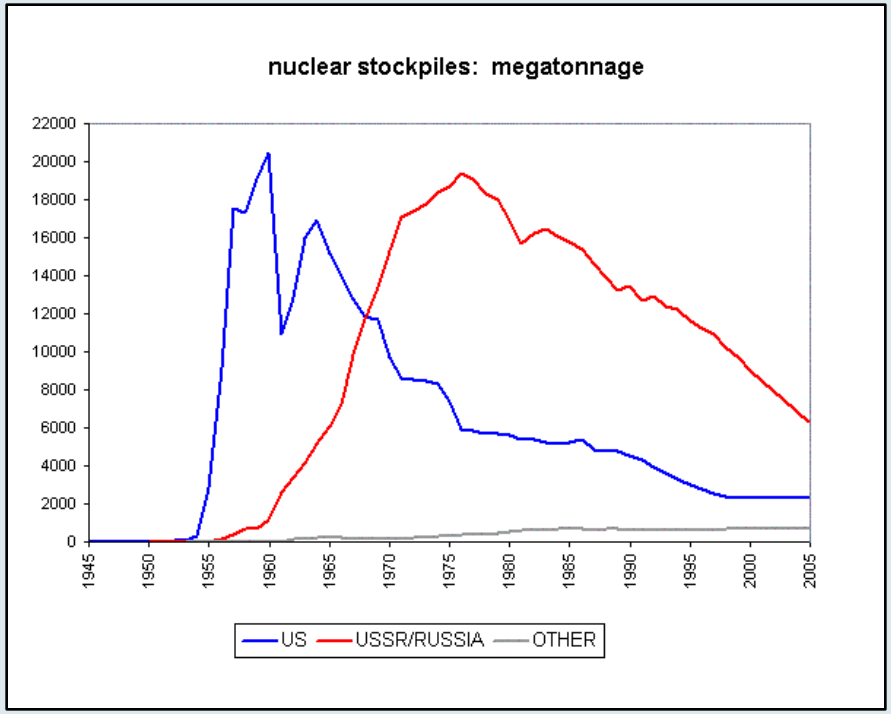
PRECISION GUIDANCE MADE RELIANCE ON LOWER YIELD WARHEADS POSSIBLE

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





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

https://www.statista.com/chart/16305/stockpiled-nuclear-warhead-count/

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)

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

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)

AMERICANS STILL WILLING TO BOMB CITIES: 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

AMERICANS STILL WILLING TO BOMB CITIES: N. KOREA

- 33% of Americans "preferred" a preventative nuclear first-strike.
  - There is no significant change in the percentage that prefer if North Korean fatalities increase from 15,000 to 1.1 million, including *1 million civilians*.

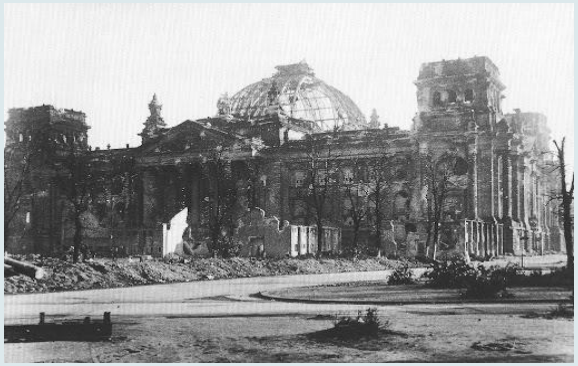
- While only 33% "preferred" preventative nuclear first-strikes, 50% of respondents ***approved***
  - This assumes the success of a preventive strike remains at 90%. At 50%, support halves.

Study by Alida Haworth, Scott Sagan, and Benjamin Valentino, What do Americans really think about conflict with nuclear North Korea? June 2019

SUMMARY OF TWO REQUIRED READINGS

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

Government political control systems, killing possibly no one?



Hitler's Bunker

Government Leadership killing possibly one?

OR

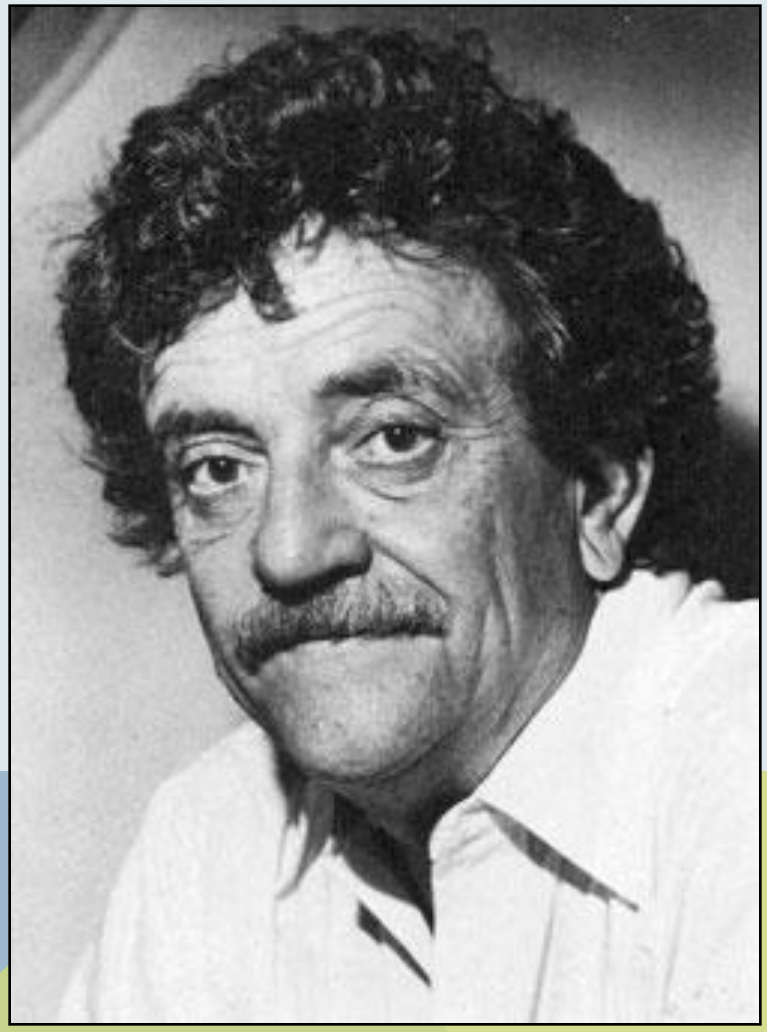
Cities, killing millions?

"Sympathetic" targets, killing thousands?

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

ADDITIONAL SLIDES

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).

Lethal Radius (LR) = Constant x $y^{1/3}$

For a 1kt weapon:

LR= $1^{1/3}$

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

LR = ~1km

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

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

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

LR = ~10km

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 ~16%
- If CEP is 1km = P_K 50%
- If CEP is .5km = P_K ~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.