

PS 0500: Nuclear Weapons

William Spaniel

<https://williamspaniel.com/classes/IR22>

Outline

- The Nuclear Club
- Mutually Assured Destruction
- Obsolescence Of Major War
- Nuclear Pessimism
- Why Not Proliferate?
- Mixed Strategies
- The Iraq War

Outline

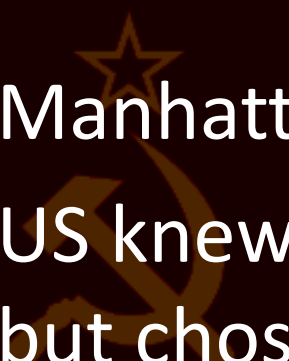
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United States (1945)

- Manhattan Project
- Hiroshima and Nagasaki bombings
- Would have been a lot worse if the Nazi scientists had won the race
 - ...but fortunately the Nazis were Naziing



Soviet Union (1949)

- 
- Manhattan Project spies
 - US knew the Soviets were developing a bomb but chose not to launch preventive war
 - Immediately after WWII
 - No intelligence
 - Cold War starts in earnest

**TABLE 1. PREDICTED IMMEDIATE DEATHS
FROM FIRESTORMS AFTER NUCLEAR DETONATIONS
IN EIGHT U.S. CITIES.**

CITY*	NO. OF WARHEADS	NO. OF DEATHS
Atlanta	8	428,000
Boston	4	609,000
Chicago	4	425,000
New York	8	3,193,000
Pittsburgh	4	375,000
San Francisco Bay area	8	739,000
Seattle	4	341,000
Washington, D.C.	8	728,000
Total	48	6,838,000

*The specific targets are as follows: Atlanta — Peachtree Airport, Dobbins Air Force Base, Fort Gillem, Fort McPherson, Fulton County Airport, Georgia Institute of Technology, Hartsfield Airport, and the state capitol; Boston — Logan Airport, Commonwealth Pier, Massachusetts Institute of Technology, and Harvard University; Chicago — Argonne National Laboratory, City Hall, Midway Airport, and O'Hare Airport; New York — Columbia University, the George Washington Bridge, Kennedy Airport, LaGuardia Airport, the Merchant Marine Academy, Newark Airport, the Queensboro Bridge, and Wall Street; Pittsburgh — Carnegie Mellon University, Fort Duquesne Bridge, Fort Pitt Bridge, Pittsburgh Airport, and the U.S. Steel plant; San

PGH 2019
Population: 300,000

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CAN'T KILL 375,000 PEOPLE

IF 375,000 PEOPLE DON'T LIVE HERE

United Kingdom (1952)

- Tube Alloys
- Agreement with the United States

France (1960)

- France and the United States do not have as intimate a relationship as the U.S. and the U.K.
- France sought strategic independence
 - Therefore, nukes

China (1964)

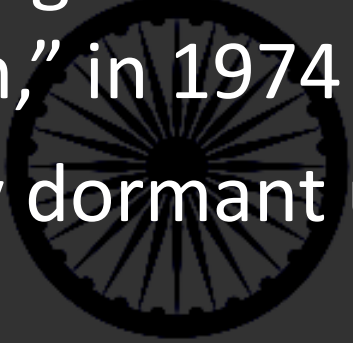
- Sino-Soviet split

Israel (1967)

- Israel does not have nuclear weapons



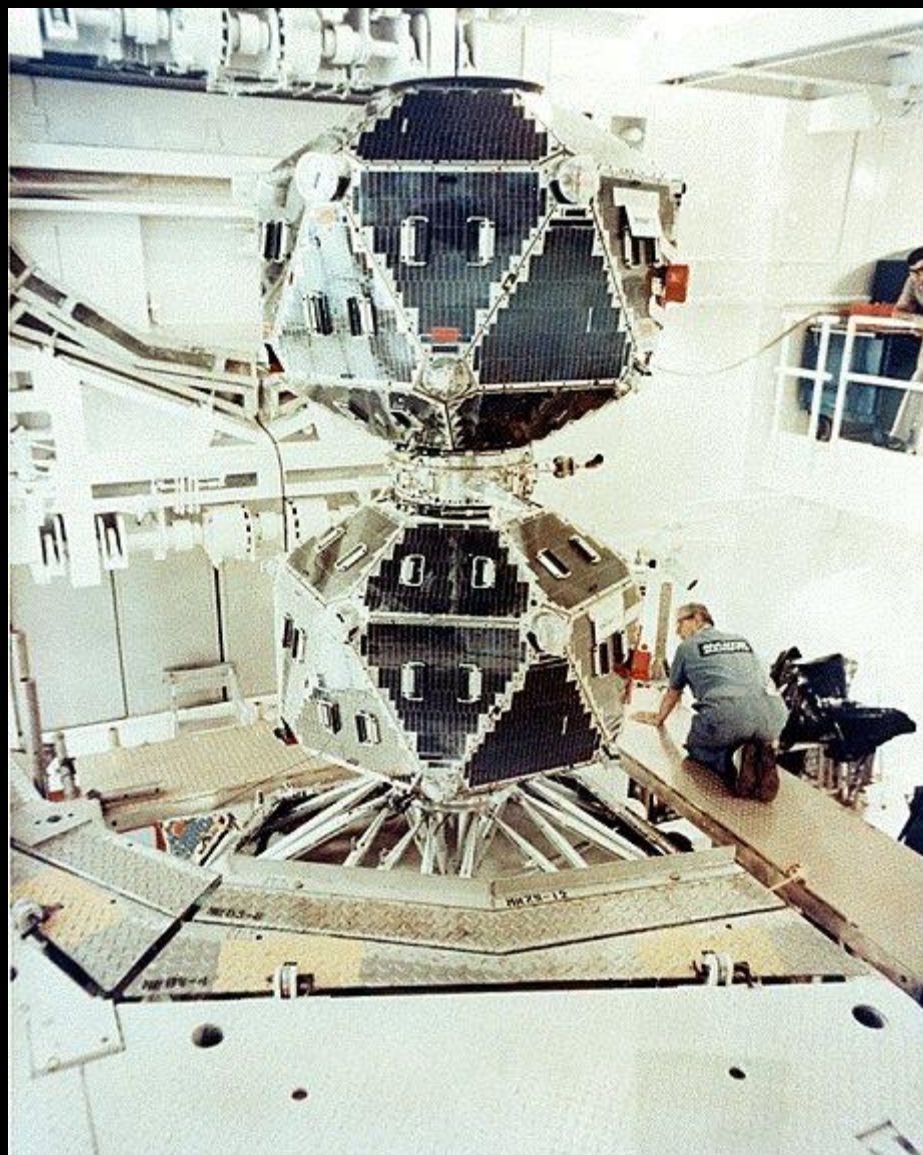
India (1974)

- India does not like Pakistan very much
 - Tested the “Smiling Buddha,” a “peaceful nuclear explosion,” in 1974
 - Remained mostly dormant until 1998. (Hold that thought...)
- 

South Africa (1979)

- The Vela Incident
 - A US satellite (Vela Hotel) detected a flash in the Atlantic Ocean between South Africa and Antarctica





South Africa (1979)

- The Vela Incident
 - A US satellite (Vela Hotel) detected a flash in the Atlantic Ocean between South Africa and Antarctica
- Built due to concerns of civil war spillover from Angola
- Dismantled at the end of Apartheid

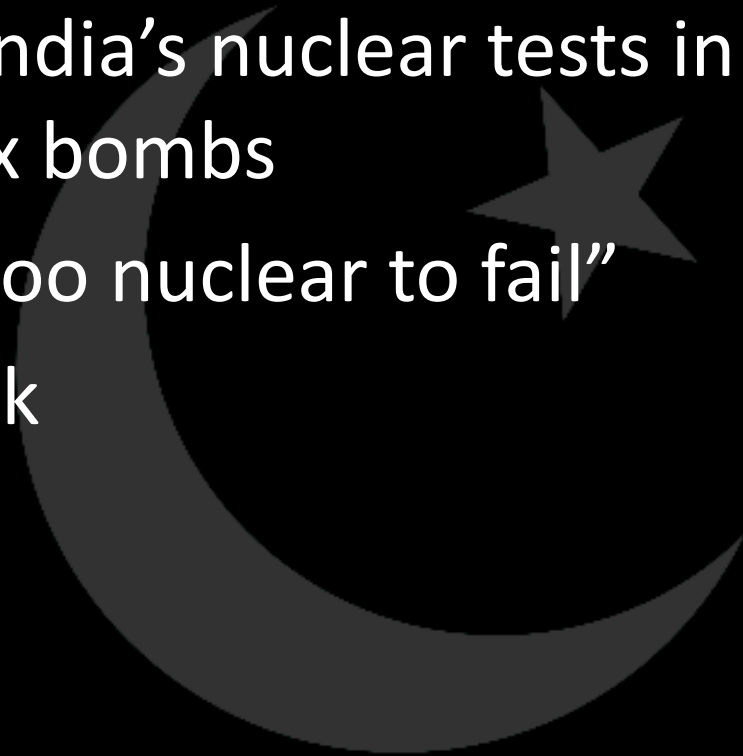


Soviet Successor States

- Ukraine, Kazakhstan, and Belarus had nuclear weapons on their soil during the Soviet Union's breakup
- Moscow still had command control
- Countries accepted cash to dismantle the weapons and forgo native nuclear development

Pakistan (1998)

- Five weeks after India's nuclear tests in 1998, Pakistan tested six bombs
- Pakistan is now "too nuclear to fail"
- A.Q. Khan network



The 1998 Ig Nobel Prize Winners

The 1998 Ig Nobel Prizes were awarded at the 8th First Annual Ig Nobel Prize Ceremony, at Harvard's Sanders Theatre. The ceremony was webcast live.

SAFETY ENGINEERING: Troy Hurtubise, of North Bay, Ontario, for developing, and personally testing a suit of armor that is impervious to grizzly bears. [REFERENCE: "Project Grizzly", produced by the "National Film Board of Canada. ALSO: *Bear Man: The Troy Hurtubise Saga*, by Troy Hurtubise, Raven House Publishing, Westbrook, ME, USA, 2011.]

BIOLOGY: Peter Fong of Gettysburg College, Gettysburg, Pennsylvania, for contributing to the happiness of clams by giving them Prozac.

[REFERENCE: "Induction and Potentiation of Parturition in Fingernail Clams (*Sphaerium striatinum*) by Selective Serotonin Re- Uptake Inhibitors (SSRIs)," Peter F. Fong, Peter T. Huminski, and Lynette M. D'urso, "Journal of Experimental Zoology, vol. 280, 1998, pp. 260-64.]

PEACE: Prime Minister Shri Atal Bihari Vajpayee of India and Prime Minister Nawaz Sharif of Pakistan, for their aggressively peaceful explosions of atomic bombs.

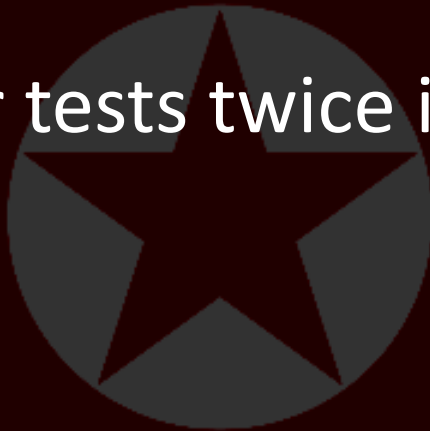
CHEMISTRY: Jacques Benveniste of France, for his homeopathic discovery that not only does water have memory, but that the information can be transmitted over telephone lines and the Internet. [NOTE: Benveniste also won the 1991 Ig Nobel Chemistry Prize.]

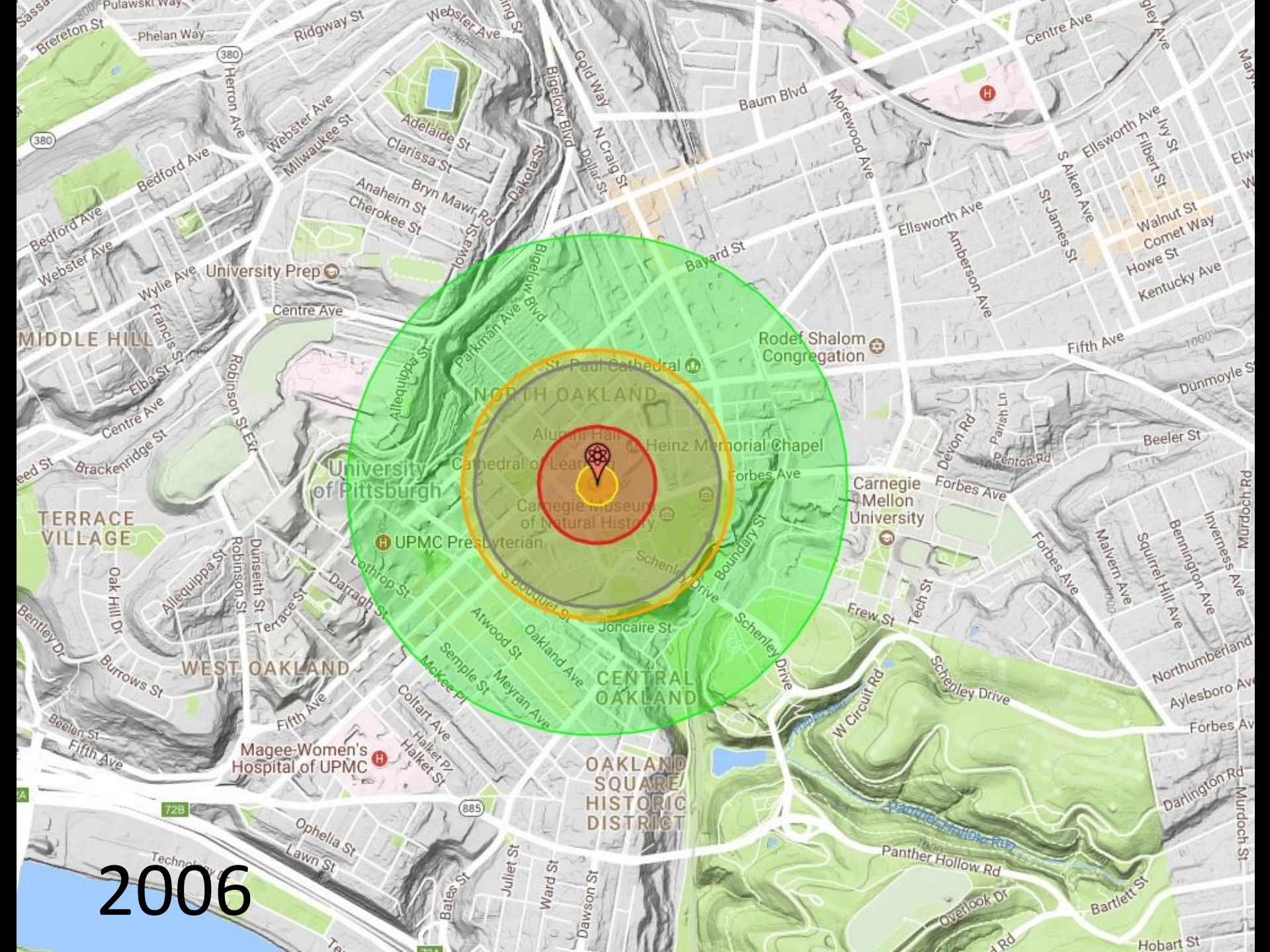
[REFERENCE: "Transatlantic Transfer of Digitized Antigen Signal by Telephone Link," J. Benveniste, P. Jurgens, W. Hsueh and J. Aissa, "Journal of Allergy and Clinical Immunology - Program and abstracts of papers to be presented during scientific sessions AAAAI/AAI.CIS Joint Meeting February 21-26, 1997"]

SCIENCE EDUCATION: Dolores Krieger, Professor Emerita, New York University, for demonstrating the merits of therapeutic touch, a method by which nurses manipulate the energy fields of ailing patients by carefully avoiding physical contact with those patients.

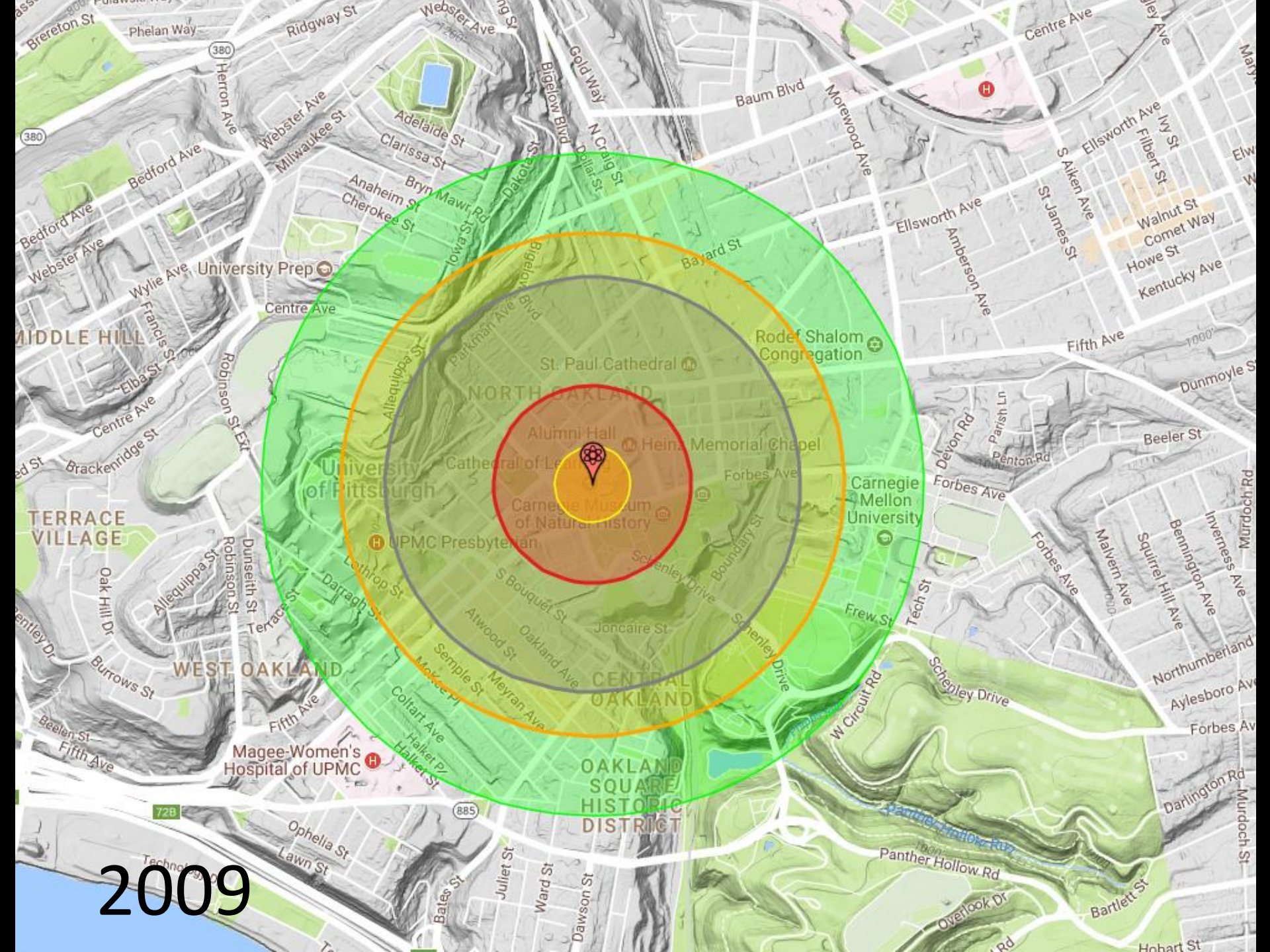
North Korea (2006)

- Conducted crummy tests in 2006, 2009, and 2013
- Scarier tests twice in 2016 and once in 2017

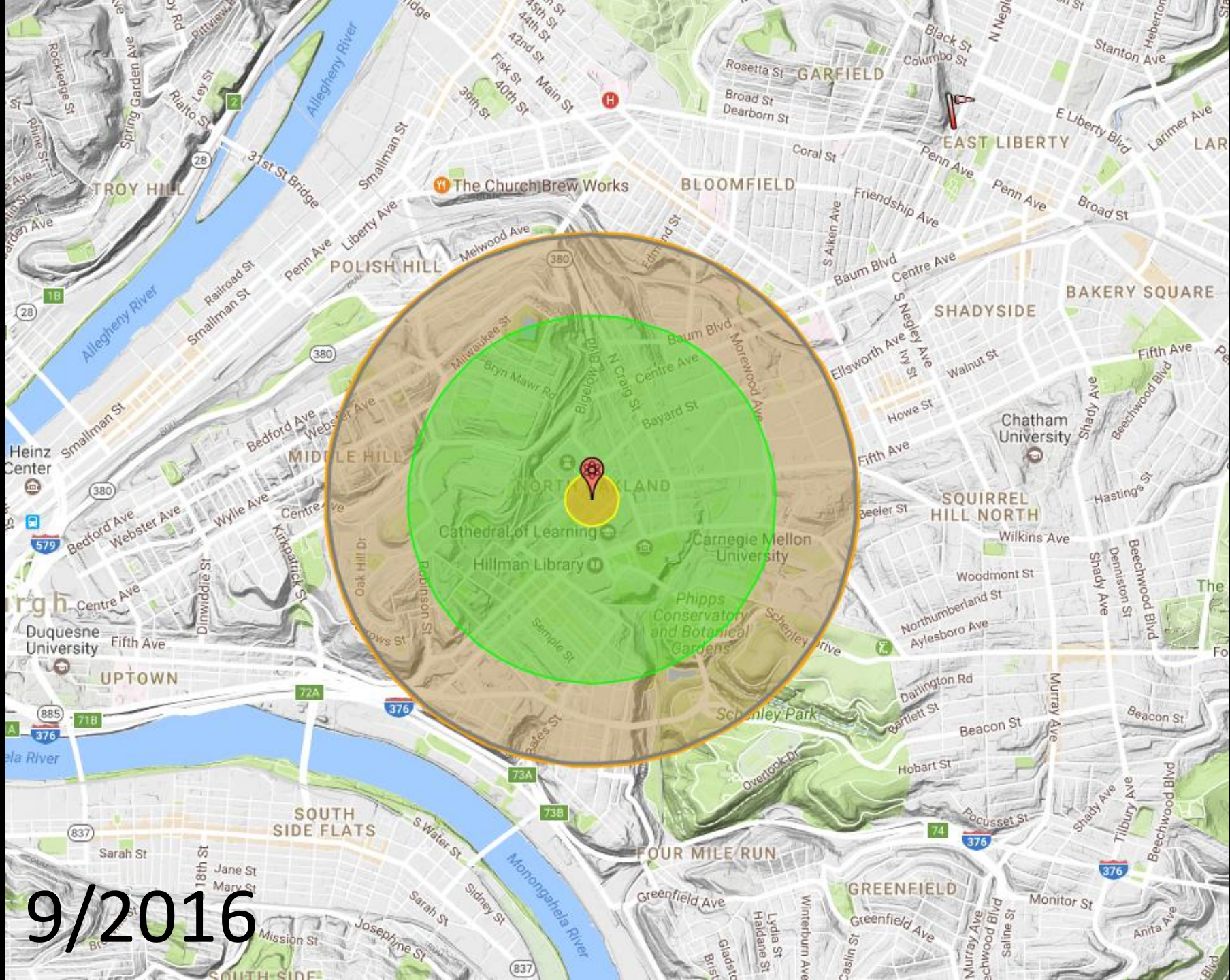




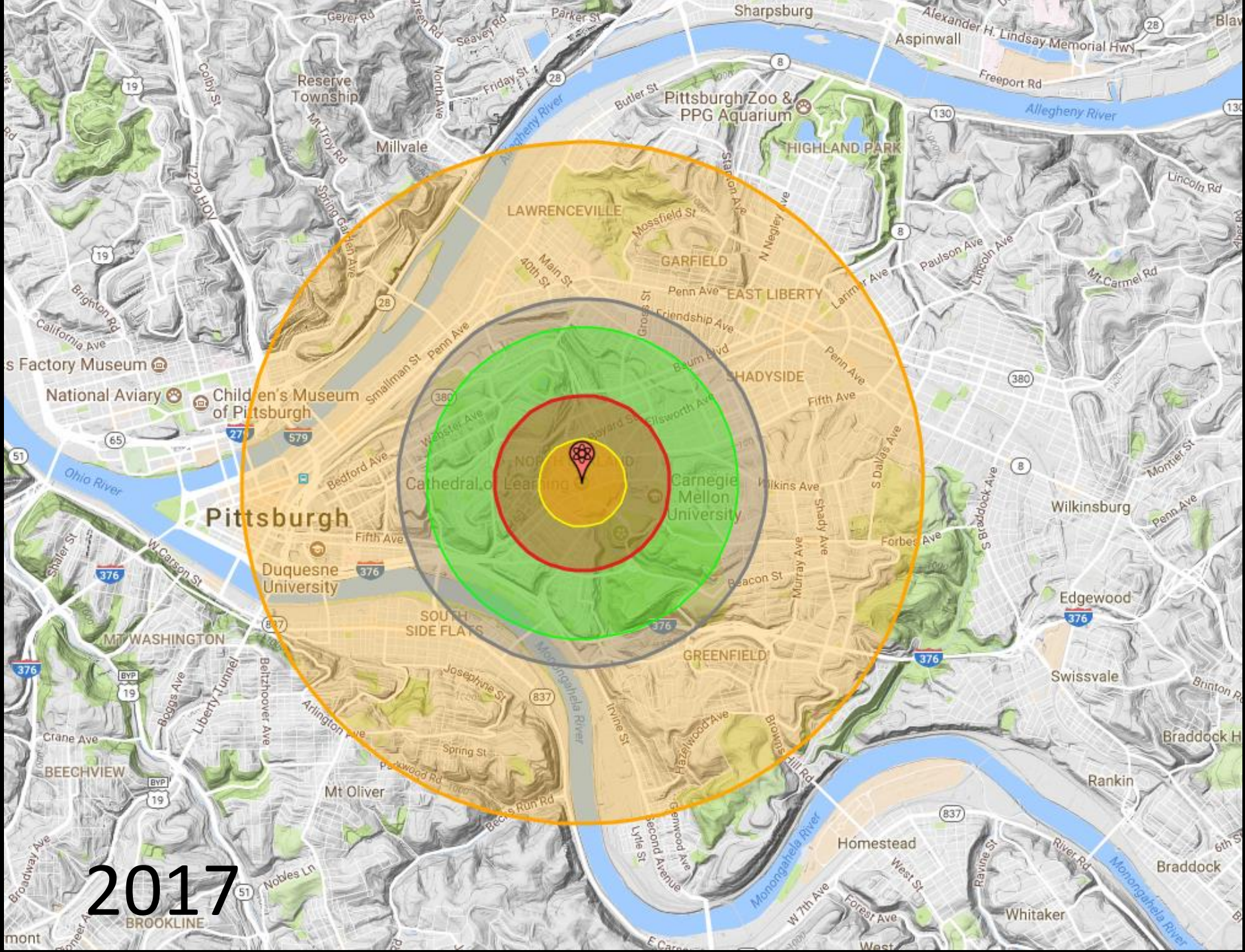
2006



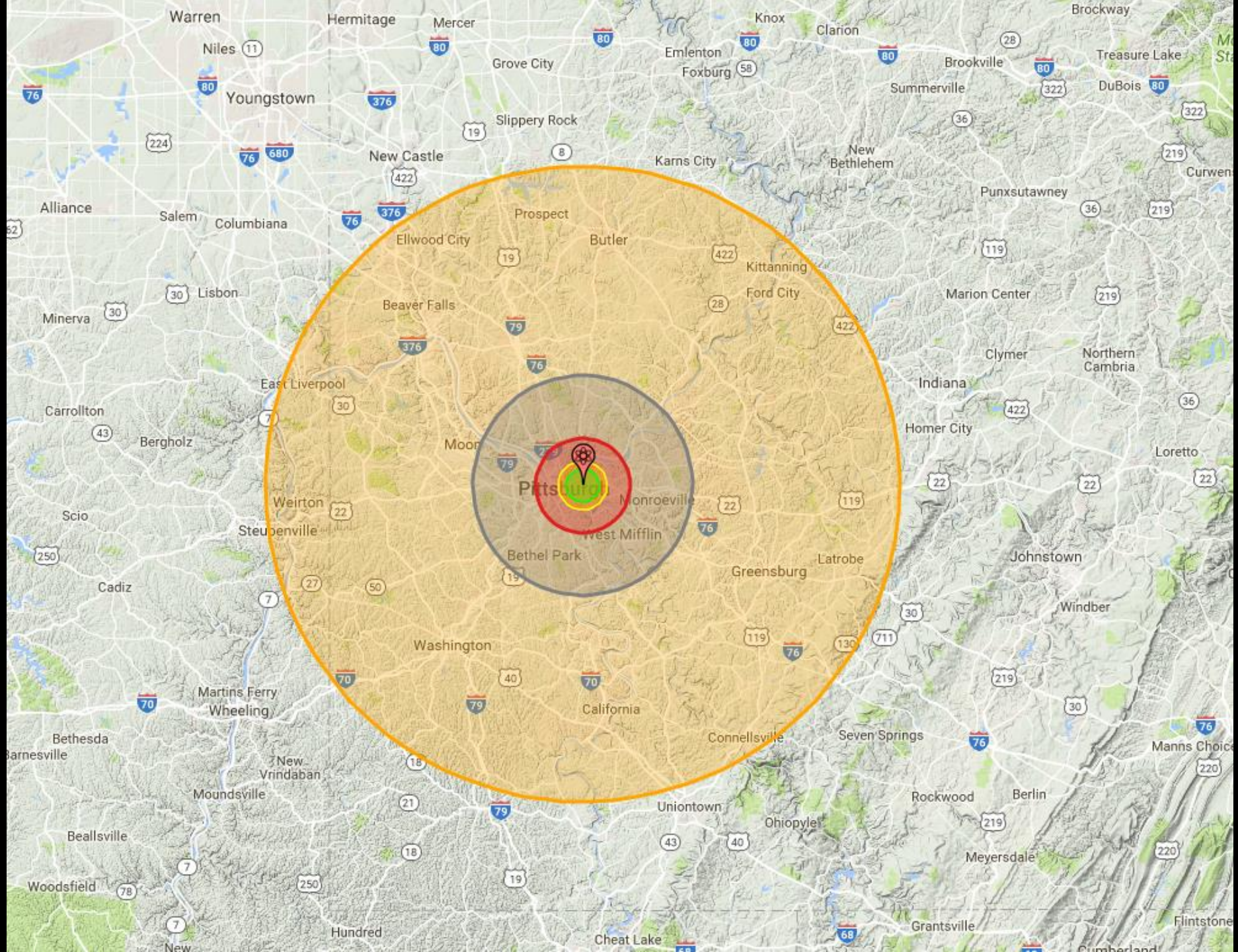
2009



9/2016



2017



North Korea (2006)

- Conducted crummy tests in 2006, 2009, and 2013
- Scarier tests twice in 2016 and once in 2017
- But a crummy bomb on Seoul...
- At one point agreed to trade us their bombs for a billion pounds of food (seriously)

Questions

Macro

- How do nuclear weapons affect the world system?
- Do nuclear weapons promote peace?
- Would the Cold War been a hot war without nuclear weapons?

Micro

- Why do states choose to proliferate?
- What can we do to stop it?
- How do we best handle North Korea and Iran today?

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Mutually Assured Destruction

States live in a world of *mutually assured destruction* if:

1. Both states are self-preserving
2. Both states have large stockpiles of nuclear weapons
3. Each state has a secure second strike; no state achieve a “splendid” first strike

The Strategic Triad

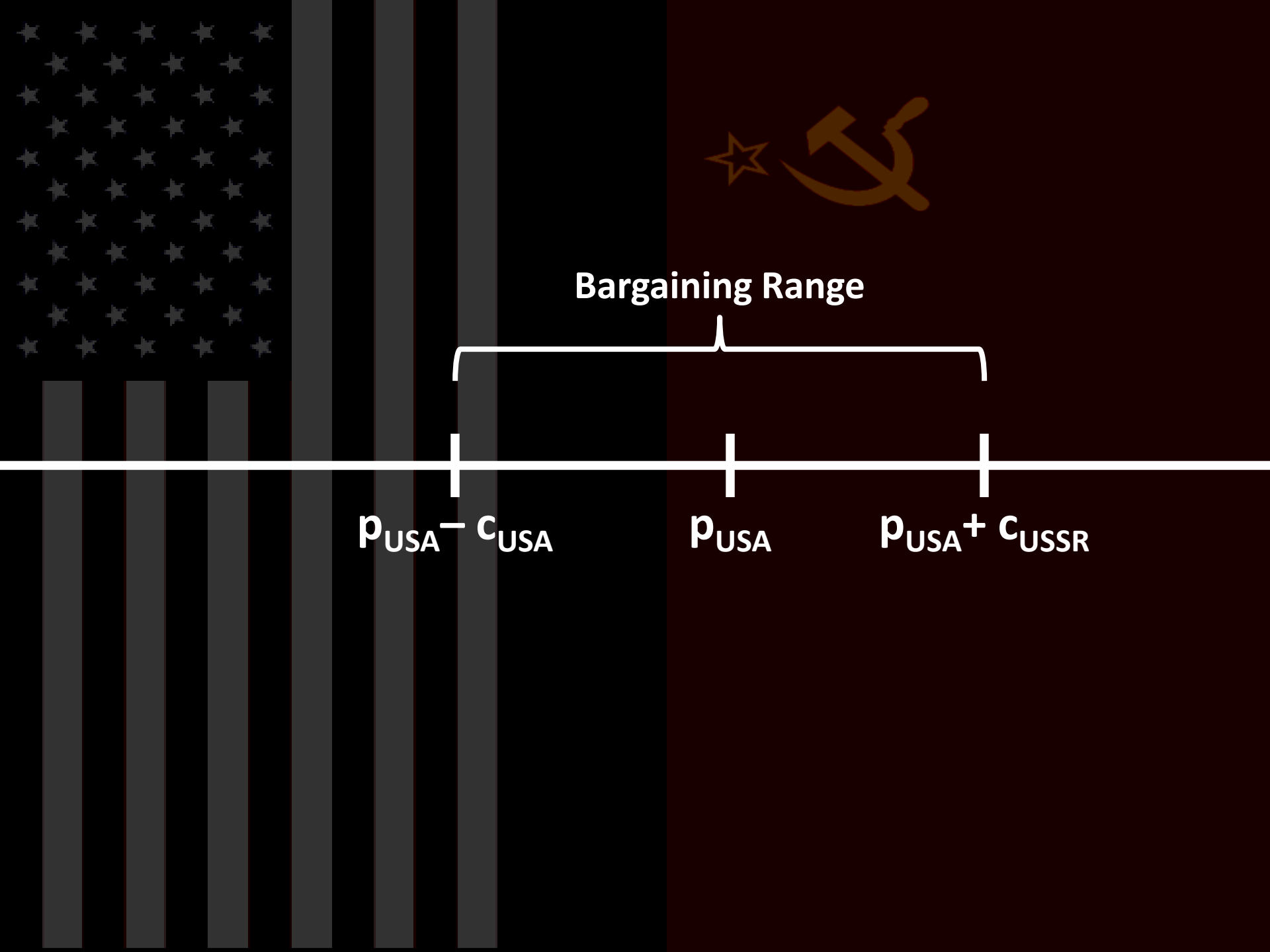
- The United States had three methods of nuclear retaliation
 - Strategic bombers
 - Intercontinental ballistic missiles
 - Submarine-launched ballistic missiles

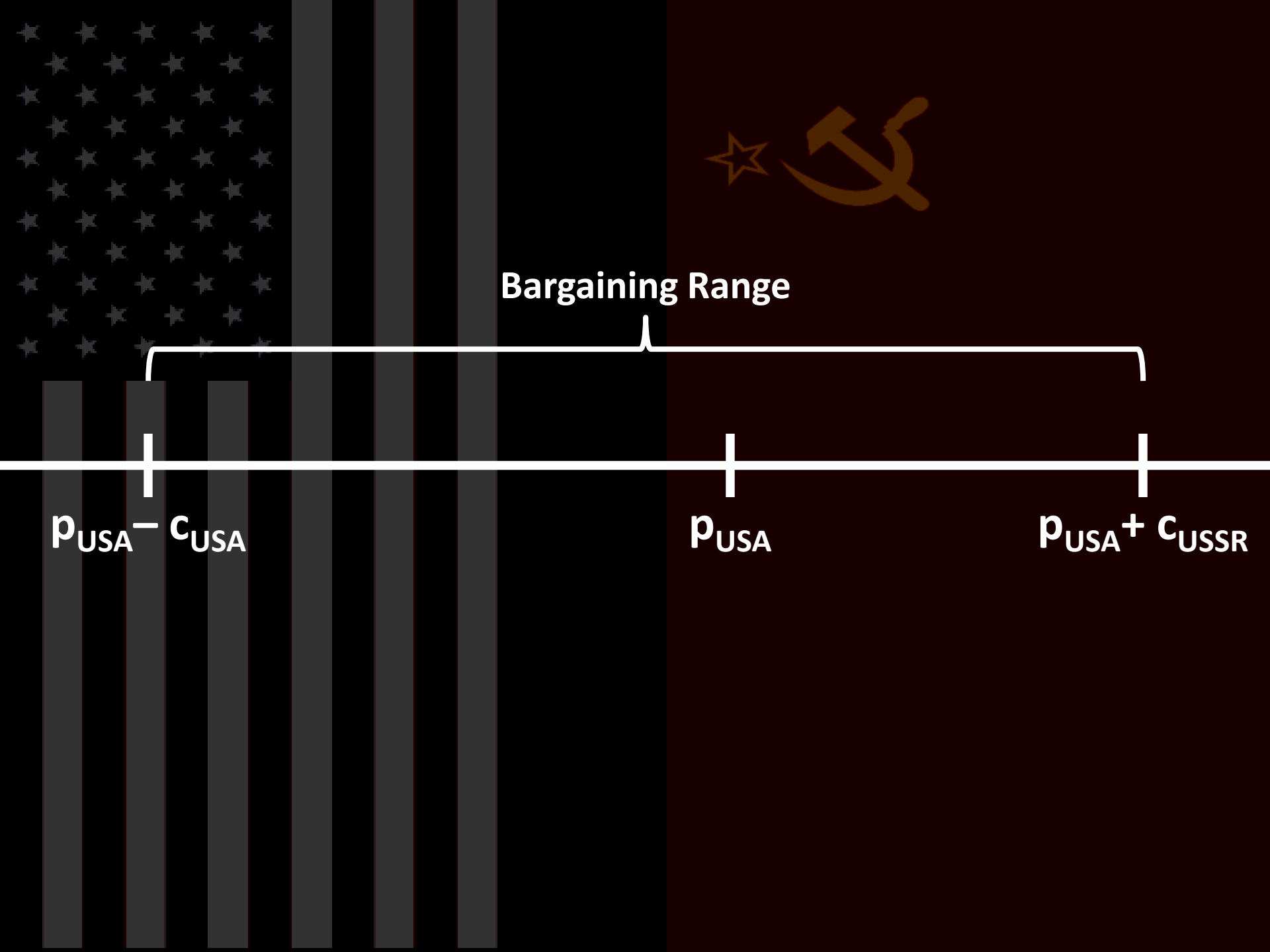
Mutually Assured Destruction

- Under these conditions, no side would want to start a large-scale war
 - If I start a war, I face enormous nuclear retaliation
 - Worse than a disadvantageous peace
 - If my opponent starts a war, he faces enormous nuclear retaliation
 - Worse than a disadvantageous peace

Bargaining Model of War

- Larger costs: more mutually preferable settlements





Policy Implication

- Promoting nonproliferation may be a waste of time
 - If we really just want to stabilize the world and minimize the number of wars, spreading nuclear weapons might be the way to do it

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Alternate Hypothesis

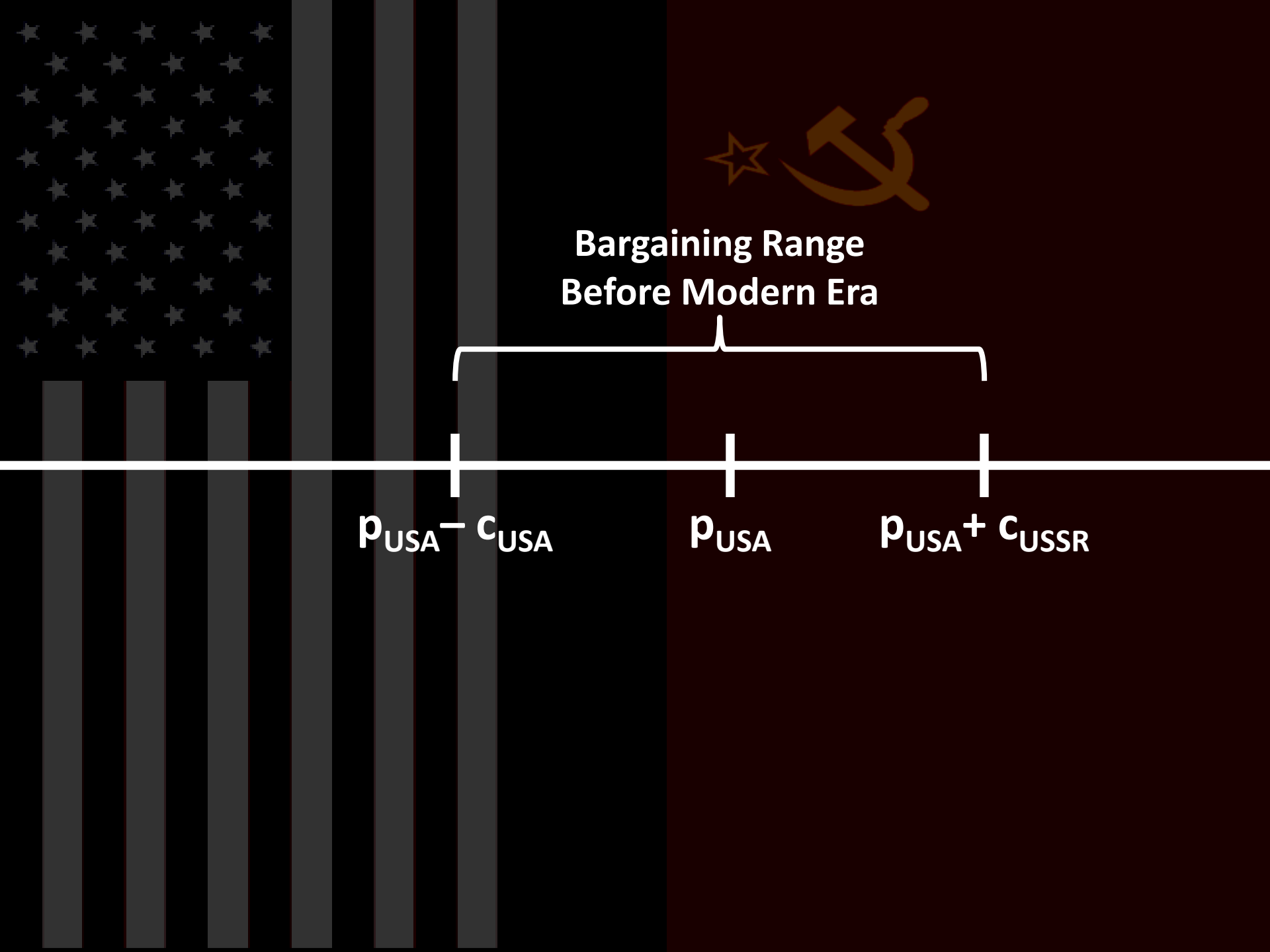
- War between **major powers** is obsolete
 - Two major powers cannot fight wars with one another because the costs will outweigh whatever possible benefit there is

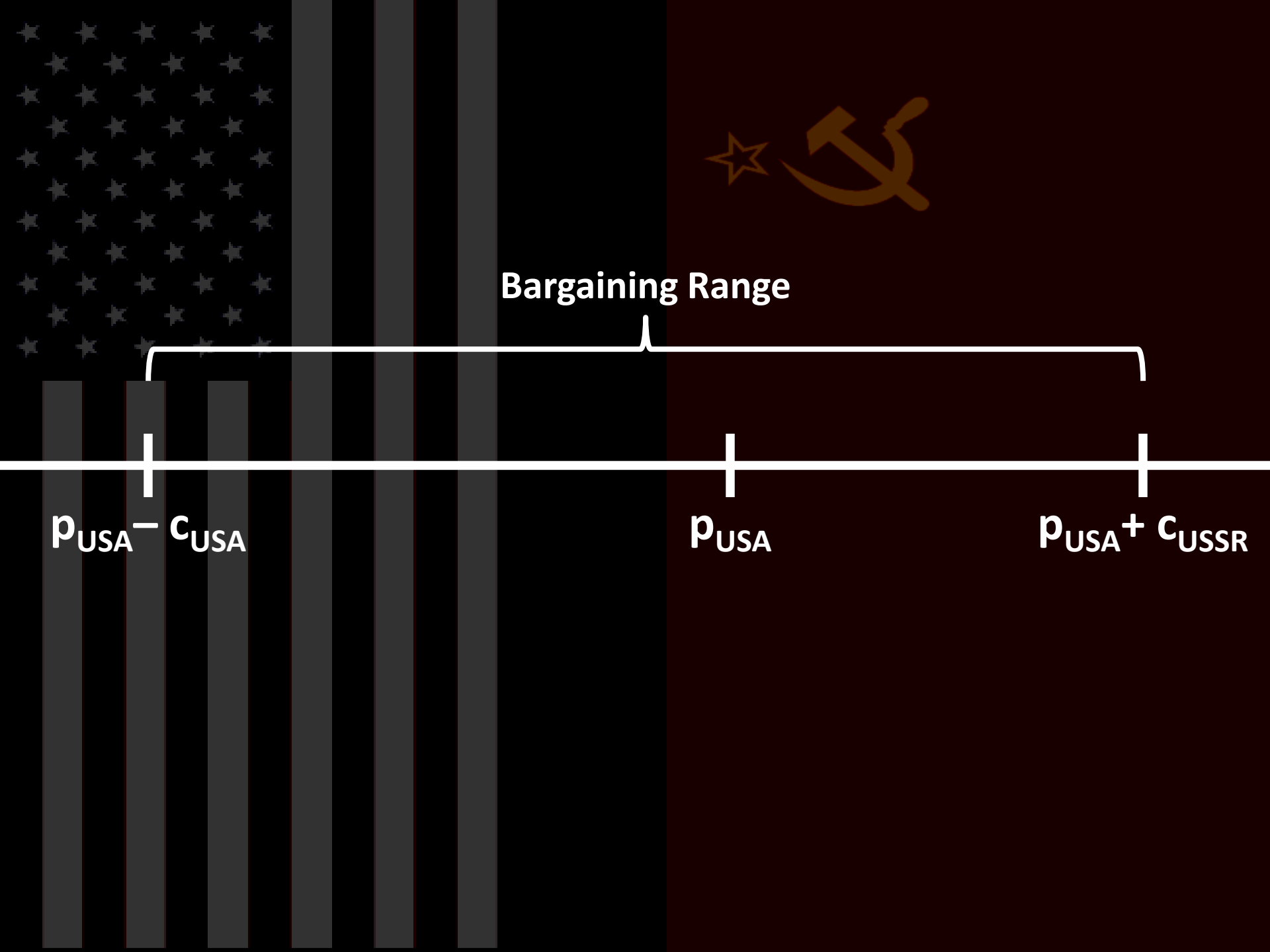
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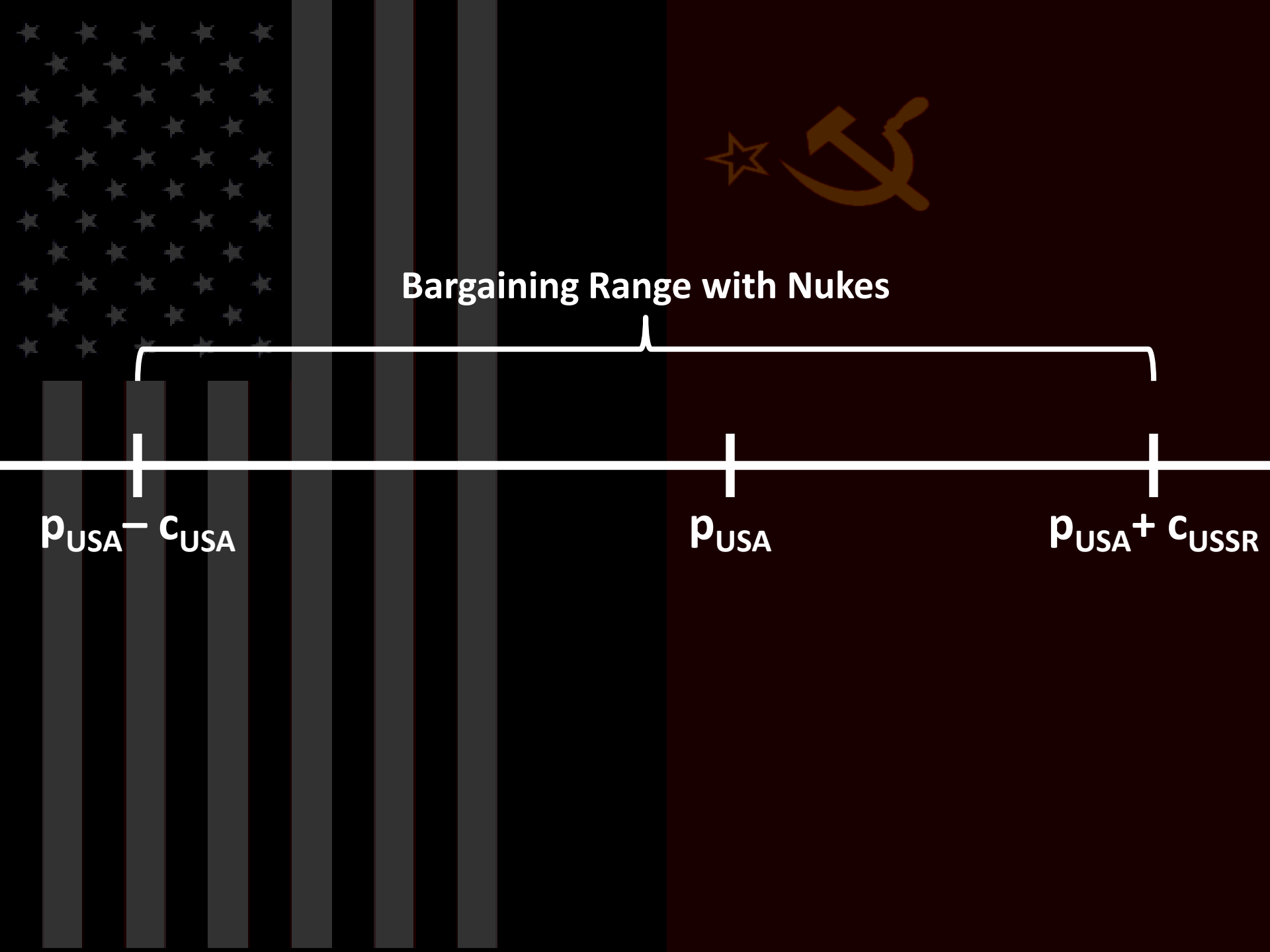
- Nuclear weapons do not change this
 - Mueller: “A jump from a fiftieth-floor window is probably quite a bit more horrible to think about than a jump from a fifth-floor one, but anyone who finds life even minimally satisfying is extremely unlikely to do either.”

Most Deadly Wars

1. World War II: 16.6 million dead
2. World War I: 8.5 million dead
3. Iran-Iraq: 1.3 million dead
4. Vietnam: 1 million dead







Policy Prescription

- Suppose mutually assured destruction is not necessary to maintain peace
- Should we have nukes?
 - Accidents?
 - Costs?

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If nuclear weapons aren't very
useful, should we have them?

Nuclear Downsides

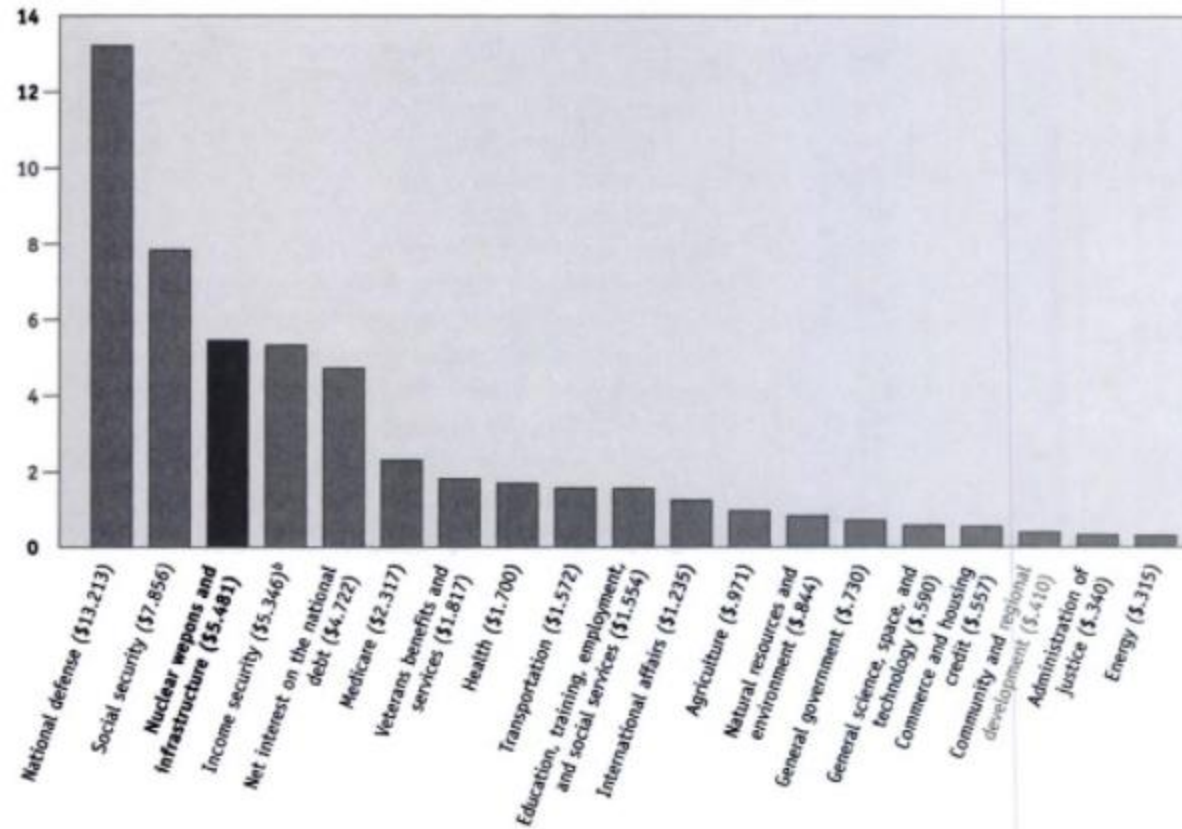
1. Costs of nuclear weapons
2. Accidental nuclear warfare
3. Rogue nuclear weapons

Costs of a Nuclear Program

- Nukes are not cheap
 - Costs of development
 - Costs of delivery
 - Costs of maintenance
- Total cost of US program (1945-1998): \$7 trillion (2012 dollars)
 - Still spend around \$16 billion per year

FIGURE 2. U.S. Government Historical Obligations by Function, 1940-96^a

Trillions of 1996 dollars



Risky Business

- Unlike conventional weapons, it is easy to accidentally destroy the world with nuclear weapons
 - Dr. Strangelove and fluoride
 - Stanislav Petrov and the 1983 Soviet false alarm



Missing Weapons?

- During the height of the Cold War, 68,000 nuclear weapons were active in the world
- Now down to 4,100
 - Less concern about having massive retaliation capability
 - More concern about losing a weapon

Nuclear Realities

- No one in Washington is seriously interested in dismantling all American warheads
- The talk about doing so is just that—talk

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- **Why Not Proliferate?**
- Mixed Strategies
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Why Not Proliferate?

1. Threat of preventive war
2. Costs of proliferation
3. Bribes

Preventive War

- Previously: *exogenous* power shifts cause preventive war if the shift is too large relative to the costs of conflict
- If shift is *endogenous* and visible, proliferator internalizes the credible preventive war threat and does not build
- No concessions necessary

Preventive War

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Too Hot

How big is the power shift?

Costs

- Nuclear weapons are not free
- Proliferation is an investment in the future
- If additional coercive power is not worth cost, proliferator does not build
- No concessions necessary

Too Cold

Too Hot

How big is the power shift?

Bribes

- Previously: more power => more concessions
- Why not just offer concessions as if proliferator already had nuclear weapons?
 - Proliferator has no incentive to build
 - Opponent doesn't have to deal with another nuclear country

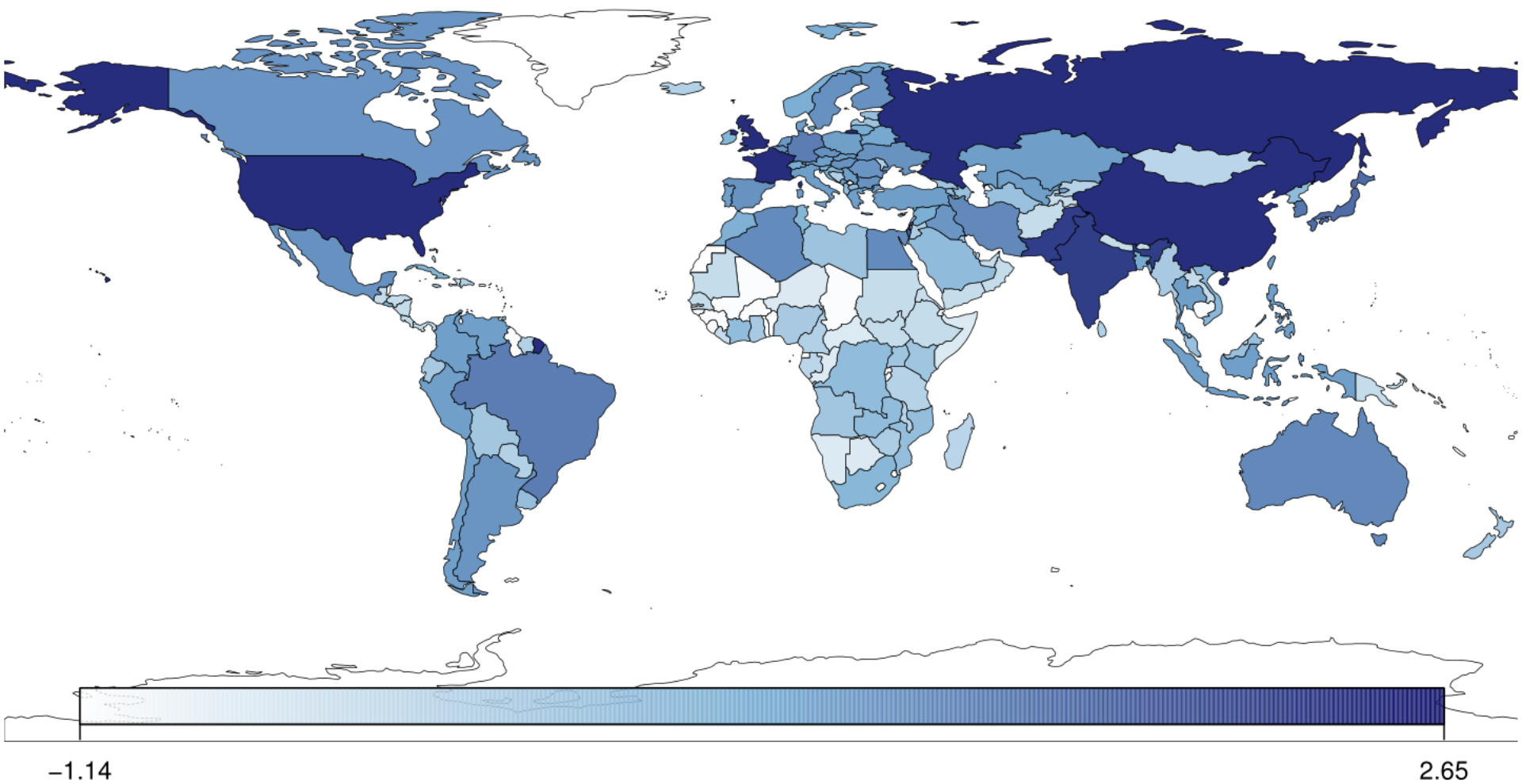
Too Cold

Just Right?

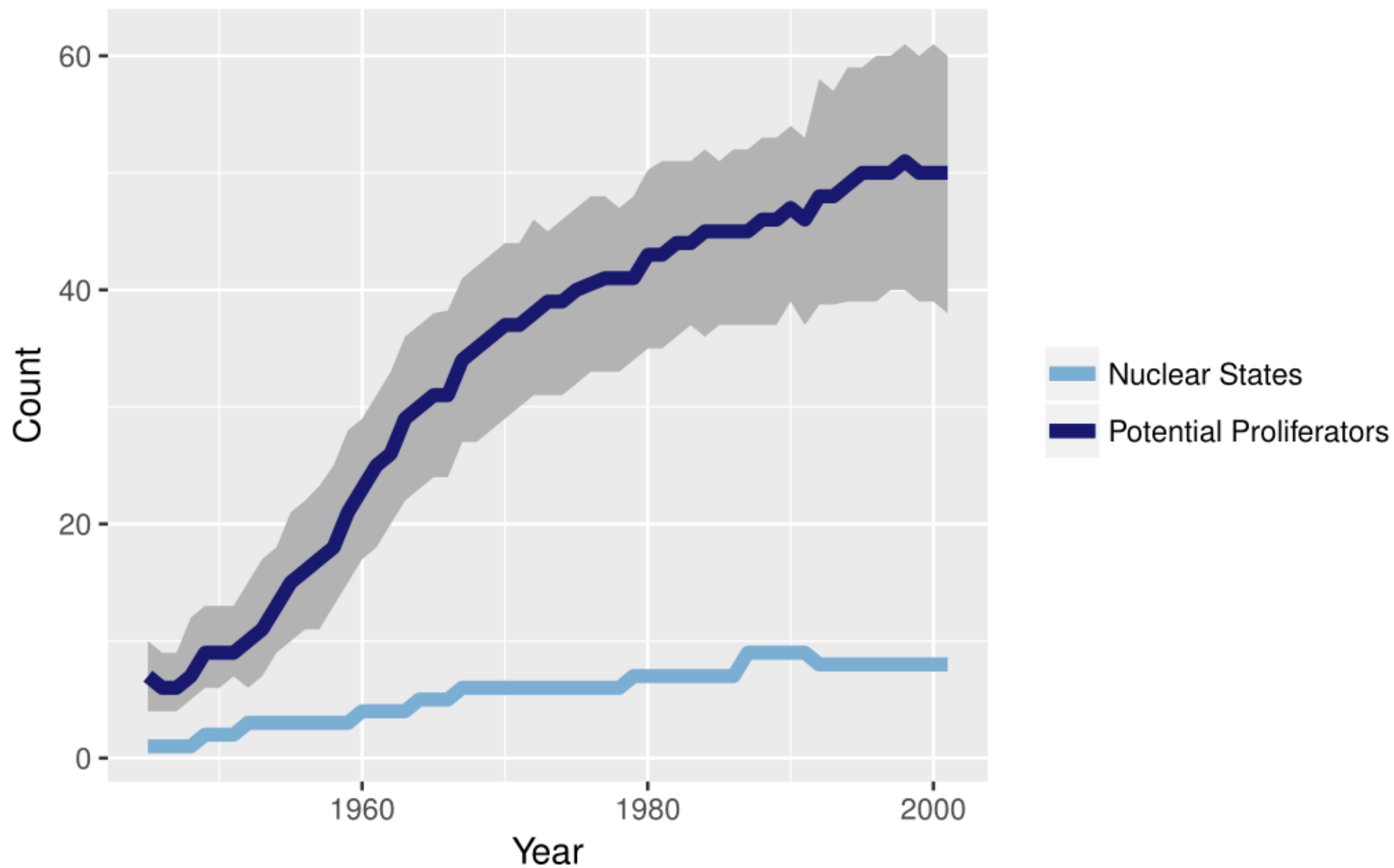
Too Hot

How big is the power shift?

Estimated Nuclear Proficiency, 2001



Capability and Proliferation Over Time



Preventive War

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Covert Proliferation

Rising State

Declining State

Prevent

Peace

Build

Don't Build

Prevent	Build	Don't Build
Peace		

Scaling the Cliffs of Insanity.
Hurling Hordes of Unwieldy Size.
Facing torture in the Worst Degree.
True love has never been a ruse.

AND HERE COMES

THE PRINCESS BRIDE

It's as real as the feelings you feel.

WITH COMING-ATTRACTIONS PRESENTS
A ROBERT SWEENEY PRODUCTION WILLIAM GOLDFRANK THE PRINCESS BRIDE
CAROL ELLEN - MARY PETERSON - CHRISTOPHER GUEST - WALLACE SHOWN
ANDRE THE GIANT Directed by BOB WEINSTEIN Special Appearance by PETER FALK and JULIA CRISTAL
Edited by ROBERT L. ELLIS Production Designer: WILLIAM GOLDFRANK Executive Producer: RICHARD STONE
Music by JAMES NEWTON HOWARD Screenplay by WILLIAM GOLDFRANK
Produced by ROBERT SWEENEY and BOB WEINSTEIN Directed by ROBERT SWEENEY





Movie is so old Bears were actually good back then



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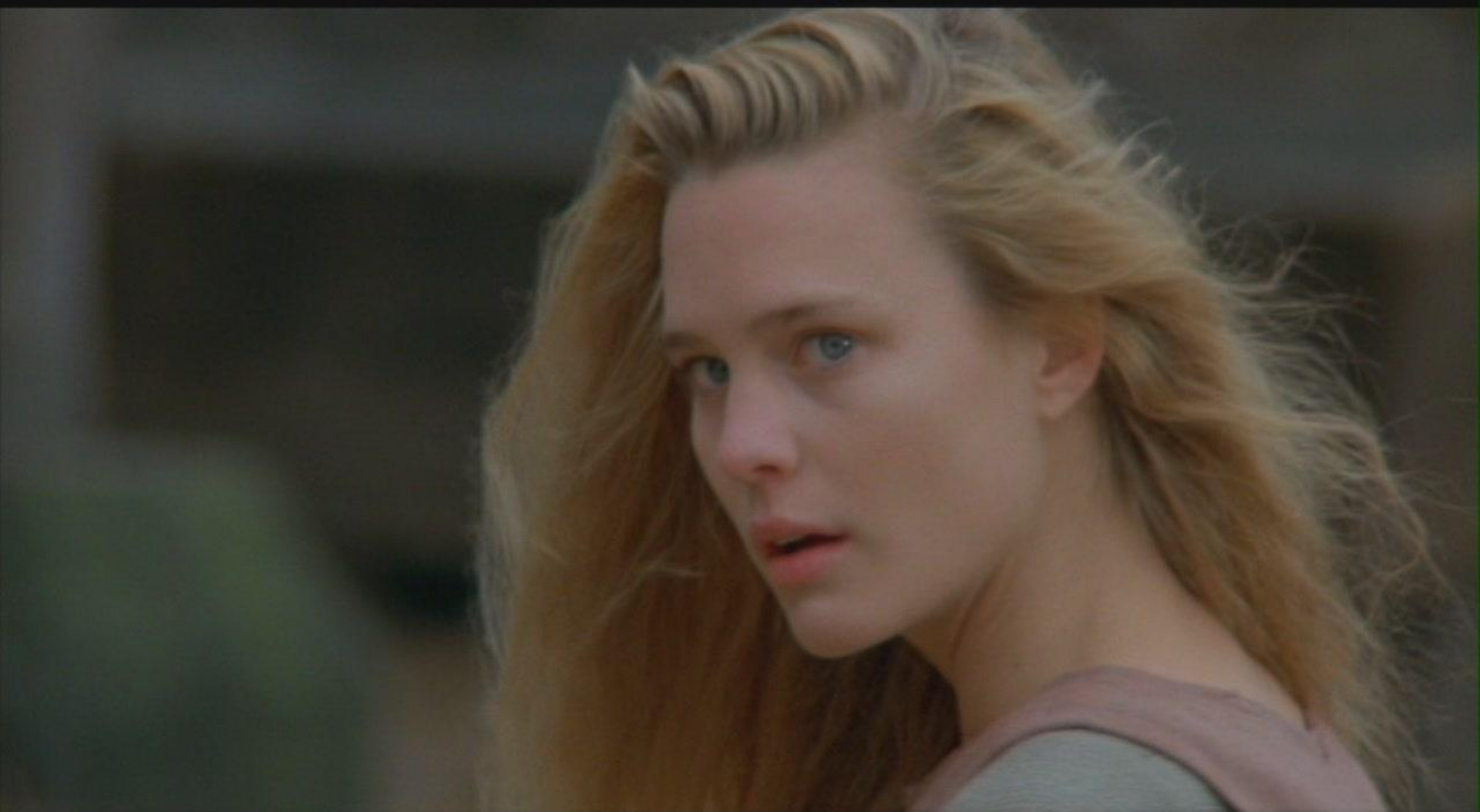


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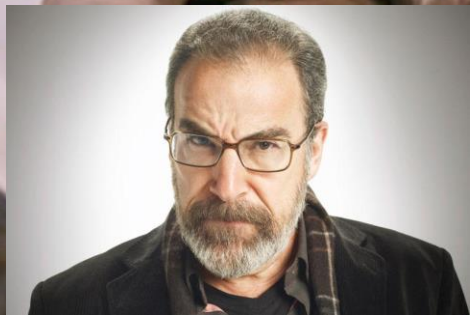
















[clip]

Simple Soccer Penalty Kicks

- The striker aims left or aims right
- The goalie dives left or dives right
- Assume the striker and goalie are superhuman. How should they play?

Penalty Kicks

Goalie

Striker

		Dive Left	Dive Right
Kick	Left	0, 0	1, -1
	Right	1, -1	0, 0

Penalty Kicks

Goalie

Striker

		Dive Left	Dive Right
Kick	Left	0, 0	1, -1
	Right	1, -1	0, 0

Penalty Kicks

Goalie

Striker

Kick Left

Kick Right

Dive Left

Dive Right

0, 0

1, -1

1, -1

0, 0



		Dive Left	Dive Right
Striker	Kick Left	0, 0	1, -1
	Kick Right	1, -1	0, 0

Penalty Kicks

Goalie

Striker

Kick Left

Kick Right

Dive Left

Dive Right

0, 0

1, -1

1, -1

0, 0



Penalty Kicks

Goalie

Striker

Kick Left

Kick Right

Dive Left

Dive Right

0, 0

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Penalty Kicks

Goalie

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Dive Left

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Penalty Kicks

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Penalty Kicks

Goalie

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Penalty Kicks

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Striker

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0, 0

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1, -1

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Penalty Kicks

Goalie

Striker

Kick Left

Kick Right

Dive Left

Dive Right

0, 0

1, -1

1, -1

0, 0



Penalty Kicks

Goalie

Striker

Kick Left

Kick Right

Dive Left

Dive Right

0, 0

.5, -.5

1, -1

0, 0



Guessing Games!

- Penalty kicks are a guessing game
 - Makes players act randomly (but intelligently)
- Is preventive war also?

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Rising State

Declining State

Prevent

Peace

Build

Don't Build

Prevent	Build	Don't Build
Peace		

Covert Proliferation

Rising State

Build

Don't Build

Declining State

Prevent

Peace

Status Quo

Covert Proliferation

Rising State

Build

Don't Build

Declining State

Prevent

Peace

War
Payoffs

Status
Quo

		Build	Don't Build
Declining State	Prevent		War Payoffs
	Peace		Status Quo

Covert Proliferation

Rising State

Declining State

		Build	Don't Build
Prevent	Peace	War Payoffs & Wasted Costs	War Payoffs
	Peace		Status Quo

Covert Proliferation

Rising State

Declining State

		Build	Don't Build
Prevent	Peace	War Payoffs & Wasted Costs	War Payoffs
	Peace	Successful Power Shift	Status Quo

Some Payoffs...

Rising State

Build

Don't Build

Declining State

Prevent

.6, .1

.6, .2

Peace

.3, .6

.8, .2

	Build	Don't Build
Prevent	.6, .1	.6, .2
Peace	.3, .6	.8, .2

Covert Proliferation

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Declining State

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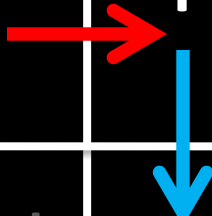
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Prevent	War Payoffs & Wasted Costs	 War Payoffs	
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Covert Proliferation

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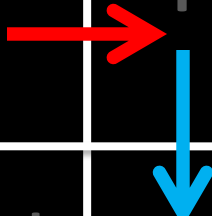


Covert Proliferation

Rising State

Declining State

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Rising State

Declining State

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Declining State	Prevent	War Payoffs & Wasted Costs	War Payoffs
	Peace	Successful Power Shift	Status Quo

The diagram illustrates a strategic game between a Declining State and a Rising State. The Declining State chooses between 'Prevent' and 'Peace'. The Rising State chooses between 'Build' and 'Don't Build'. The outcomes are as follows:

- If the Declining State chooses 'Prevent' and the Rising State chooses 'Build', the outcome is 'War Payoffs & Wasted Costs'.
- If the Declining State chooses 'Prevent' and the Rising State chooses 'Don't Build', the outcome is 'War Payoffs'.
- If the Declining State chooses 'Peace' and the Rising State chooses 'Build', the outcome is 'Successful Power Shift'.
- If the Declining State chooses 'Peace' and the Rising State chooses 'Don't Build', the outcome is 'Status Quo'.

Arrows indicate a sequence of events: a red arrow points from 'War Payoffs & Wasted Costs' to 'War Payoffs', and a blue arrow points from 'War Payoffs' to 'Status Quo'. A red arrow also points from 'Status Quo' to 'Successful Power Shift'.

Covert Proliferation

Rising State

Declining State

		Build	Don't Build
Declining State	Prevent	War Payoffs & Wasted Costs	War Payoffs
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Declining State	Prevent	War Payoffs & Wasted Costs	War Payoffs
	Peace	Successful Power Shift	Status Quo

Covert Proliferation

Rising State

Don't Build

Declining State

Prevent

	War Payoffs

Covert Proliferation

Rising State

Don't Build

Declining State

Prevent

	Mistaken Preventive War

What Are You Buying?

- Do you accept that the U.S. should have invaded Iraq if Iraq had a WMD program?
- Do you accept that the U.S. could not adequately monitor Iraqi activity?

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