Episode Book

EPISODE #5792

Tsar Bomba: The 50-Megaton Test That Shook the World

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SYNOPSIS

On October 30, 1961, the Soviet Union detonated RDS-220 over the Arctic — a 50-megaton device the West called Tsar Bomba. It was built in just sixteen weeks, carried under a stripped-down bomber, and slowed by a parachute made from nylon hosiery fabric. This episode digs into why Khrushchev ordered a weapon with no military requirement, how Sakharov's last-minute tamper swap cut the fallout by 97%, and what the real numbers actually were — separating documented fact from decades of repetition. Part one of two; next time, the American side: Project Sundial.

TRANSCRIPT



Corn

The largest explosion in human history happened on a single morning in October 1961, and almost nobody who saw it is still alive to describe it.



Herman

And the strangest part is what the weapon was actually for.



Corn

Daniel's question this time is about Tsar Bomba. He wants the full story of the biggest nuclear weapon ever detonated, the Soviet test in 1961, and he's specific about the register he wants. Not a dry technical brief. He wants the scale, the politics, the engineering ambition, the most extraordinary well-documented stories from the day, and he wants us separating what actually happened from what got repeated until everyone believed it. He also flagged this as part one of two. Next time we turn to the American side, Project Sundial.



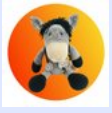
Herman

Ten gigatons.



Corn

Let's get through the fifty megatons first. Why does a country build a bomb this size?



Herman

Because they were losing, Corn. That's the honest answer.



Corn

Say more.



Herman

The US arsenal vastly outnumbered and out-delivered the Soviet one, and Soviet forces couldn't credibly threaten the continental United States. Khrushchev needed to look like he could, especially to a brand-new president he'd already decided was weak. And then there's Berlin, which was coming apart that summer.



Corn

So the bomb is a poster.



Herman

The bomb is a poster. There was no military requirement for it at all. The only carrier they had was the Tu-95, a prop-driven bomber that couldn't reach America with a payload like that.



Corn

Hold on. Prop-driven. In 1961.



Herman

The Tu-95 is a propeller aircraft, yes, and it's still flying today. But for this, it couldn't get near the target that mattered, which is the whole point. The weapon was built to be seen.



Corn

Let's start with the scale, because the numbers here are almost impossible to hold in your head.



Herman

October thirtieth, 1961, eleven thirty-two in the morning Moscow time. The device was called RDS-220. The Soviets nicknamed it Big Ivan. The West called it Tsar Bomba, and that's the name that stuck.



Corn

A bomb that never had an official name.



Herman

Twenty-seven tonnes. Eight metres long, two point one metres in diameter. Dropped from a modified Tu-95 over Novaya Zemlya, the Arctic test range. The yield was about fifty megatons.



Corn

About.



Herman

The Soviets measured fifty. After 1991, when their instrument data finally came out, fifty was the number. The West used fifty-seven to fifty-eight for thirty years, because that's what our bhangmeter estimated. Khrushchev himself claimed fifty-seven in his memoirs, and he may have just liked the bigger number.



Corn

And compared to Hiroshima.



Herman

Fifteen kilotons at Hiroshima, twenty-one at Nagasaki. Fifty megatons is roughly three thousand three hundred times Hiroshima on its own. Counting both cities together, about one thousand five hundred and seventy times.



Corn

Ten times everything we dropped in the Second World War. All of it, all theatres, conventional.



Herman

Roughly a quarter of the Krakatoa eruption in 1883. About ten percent of the combined yield of every nuclear test ever conducted. And the biggest weapon the United States ever fielded was the B41, at twenty-five megatons. Our biggest test was Castle Bravo at fifteen.



Corn

So they weren't just ahead, they were ahead by a category.



Herman

And the central oddity of the whole episode is that a weapon with no military requirement hastened the treaty that banned its own kind. But to see why anyone would build this, you have to go back to the summer of 1961 and a meeting in the Kremlin.



Corn

July tenth.



Herman

July tenth, 1961. Khrushchev summons the scientists from Arzamas-16 to the Kremlin and tells them the moratorium is over. They're going to resume testing to show the imperialists what they can do. And this surprised the room.



Corn

Surprised them how?



Herman

They'd been operating under a voluntary pause. Testing had stopped on both sides. And Sakharov argued that more testing wasn't necessary. He thought it was a mistake.



Corn

And Khrushchev's answer.



Herman

He snapped at him. "Sakharov, don't try to tell us what to do or how to behave. We understand politics. I'd be a jellyfish and not Chairman of the Council of Ministers if I listened to people like Sakharov."



Corn

That's a very specific image.



Herman

It's a great line and it's doing real work. It tells you exactly how the decision was being made. This wasn't a weapons programme deciding it needed a bigger bomb. This was a politician deciding he needed a bigger headline.



Corn

And the backdrop was Berlin.



Herman

Berlin, and the arsenal imbalance, and a new American president he'd already written off as soft. There's a line attributed to him, "Let the hundred-megaton bomb hang over the capitalists like a sword of Damocles."



Corn

He got asked about it publicly, didn't he?



Herman

At the twenty-second Party Congress two weeks before the test. He said, we'll round out the tests with a hydrogen bomb equivalent to fifty million tons. We have a bomb as powerful as a hundred million tons, and we have it. But we're not going to explode it, because even in the remotest of places, we're likely to break our own windows.



Corn

That's a man counting his own glassware on a Party Congress floor.



Herman

And it's also a threat wrapped in a joke. Both things at once. That's the whole man.



Corn

Let me put the strongest version of the skeptical case, because I want to know whether there was any real target set. Was there a military requirement, on paper, anywhere?



Herman

The Nuclear Weapon Archive states it flatly. There was no previously existing military requirement for a hundred-megaton weapon. Such weapons are virtually useless for military purposes.



Corn

Useless. That's a strong word from engineers.



Herman

Because of the delivery problem. The only aircraft that could carry it was the slow Tu-95, which couldn't reach the continental United States with that payload. So you've built a weapon that can only be dropped on people you can already reach with everything else.



Corn

It's a bomb you'd only use on a neighbour.



Herman

Which is theatre.



Corn

Fine. So how do you actually engineer one of these in the time they had?



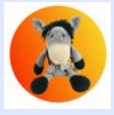
Herman

From that July tenth order to the detonation was exactly sixteen weeks. A hundred and twelve days. Normal American practice was up to two years on the drawing board before you got anywhere near a test.



Corn

Sixteen weeks for a fifty-megaton device.



Herman

And this is the part Daniel is really asking about, I think. The ambition isn't the yield. The yield is just arithmetic. The ambition is the tempo.



Corn

Who's on the team.



Herman

Sakharov overall. Viktor Adamsky, Yuri Babaev, Yuri Smirnov, Yuri Trutnev. Yuli Khariton ran the laboratory, and he'd run it since the forties. These are people who'd built bombs before. That's why sixteen weeks was even conceivable.



Corn

Take me through the design, because the number I keep tripping over is a tenth of a microsecond.



Herman

The device was three-stage, radiation implosion. The clever bit is what they called the bifilar scheme. There's a main thermonuclear unit in the middle, and it's imploded by two primaries firing in from opposite ends.



Corn

Two triggers.



Herman

Two triggers, and they have to fire within a tenth of a microsecond of each other. A hundred nanoseconds.



Corn

What happens if they don't?



Herman

The implosion doesn't stay symmetrical and you get a fizzle. Not a smaller bang. A much smaller bang, or nothing.



Corn

So the engineering miracle is a timing circuit.



Herman

The engineering miracle is a timing circuit and the entire compression geometry that depends on it. That's what's hard here. Making it simultaneous.



Corn

And the full design was a hundred megatons.



Herman

Two hundred megatons on the drawing board, in the version they talked about publicly, but the device as designed was a hundred. And then Sakharov changed the tamper.



Corn

The tamper being the outer layer wrapped around the fusion fuel.



Herman

Uranium-238 tamper in the original design. Fast neutrons from the fusion reaction would fission the uranium, which adds enormous yield — and enormous fallout, because fission products are what make fallout.



Corn

And he swapped it for lead.



Herman

Lead doesn't fission. He removed the entire fission contribution from the outer layer. That halved the yield, down to fifty megatons, and cut the fallout by about ninety-seven percent. Fifty-one and a half megatons of fission products down to about one and a half.



Corn

So the actual test was one of the cleanest weapons ever detonated. Roughly ninety-seven percent fusion.



Herman

Which is counterintuitive, because the biggest bomb in history is also one of the least dirty ones ever set off.



Corn

Why did he do that? And I don't want the flattering version.



Herman

The honest version is fallout conscience. He'd done the arithmetic himself. He calculated around six thousand six hundred premature deaths per megaton of even clean weapons, spread over eight thousand years. And a full hundred-megaton test would have added roughly a quarter to all the fission fallout released since 1945.



Corn

So he's doing the moral accounting before the test, not after.



Herman

Before. And von Hippel's read on it is that this was the beginning of his journey from being a bomb designer to becoming a dissident. You can watch it happen in the record.



Corn

Sixteen weeks, and then days before the test, someone decides it won't work.



Herman

Evsei Rabinovich. He became convinced the design was wrong, and this is days out, not weeks. So Sakharov and colleagues spent the time developing counter-arguments, and then making last-minute design changes. The designers worked through the night on revised blueprints.



Corn

The night before shipping a fifty-megaton device.



Herman

The night before. And Sakharov's line about it, which I think tells you where his head was, is: "If we don't make this thing, we'll be sent to railroad construction."



Corn

So the pressure isn't only professional.



Herman

The pressure is your colleagues' careers and possibly your colleagues' freedom. These are people who'd lived through what happened to scientists who disappointed the state.



Corn

So the bomb is designed, the yield is halved, the scientists have worked through the night on revised blueprints. Now they have to actually deliver it.



Herman

And that's where it starts to get absurd.



Corn

The aircraft.



Herman

Tu-95V, tail number 5800302. They stripped the bomb-bay doors off entirely. They removed the fuselage fuel tanks to save weight. The bomb was carried semi-recessed, hanging under the aircraft, over half of it protruding into the airstream.



Corn

So it's not in the plane. It's under the plane.



Herman

It's bolted to the underside. And both the drop aircraft and the Tu-16 observer were painted anti-flash white, top and bottom, because they expected to be lit up like a photographic plate.



Corn

The parachute.



Herman

A special parachute, about eight hundred kilograms, sixteen hundred square metres of canopy. Because you don't want to drop the crew with the bomb, so the bomb descends slowly, for a hundred and eighty-eight seconds.



Corn

Three minutes and eight seconds of falling.



Herman

Three minutes and eight seconds. And the fabric for it came out of the Soviet nylon hosiery industry, which means somewhere in the supply chain, someone's stocking production got disrupted for this.



Corn

I want to sit on that for a second. The largest weapon in human history was delayed by underwear manufacture.



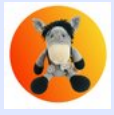
Herman

It's not quite delayed, but the allocation is real. Reed and Kramish documented the hosiery disruption. You've got a state that can build a fifty-megaton bomb in sixteen weeks and can't get nylon for stockings without someone feeling it.



Corn

Where did it detonate, and how did the bomb itself travel?



Herman

Assembled on a camouflaged railway flatcar and shipped by train to the airfield. The Tu-95V took off from Olenya, on the Kola Peninsula. Dropped from ten thousand five hundred metres. The parachute did its work, the bomb fell for a hundred and eighty-eight seconds, and detonated at four thousand metres over the target.



Corn

And the aircraft positions.



Herman

The Tu-95V was about thirty-nine kilometres from ground zero at the moment of detonation. The shock wave caught it at a hundred and fifteen kilometres. The Tu-16 caught it at two hundred and five.



Corn

Walk me through those three minutes, because the crew had to think they were going to die.



Herman

They had to think they might. And then the blast wave hit the Tu-95V. Its speed jumped from eight hundred and eighty kilometres an hour to nine hundred and eighty. The aircraft dropped eight hundred to a thousand metres before the pilot got control back.



Corn

The plane got faster and fell a kilometre at the same time.



Herman

The blast wave pushed it forward and down. And both aircraft landed safely. Both. The Tu-95V and the Tu-16.



Corn

Which brings me to the story everyone repeats, and I want to take it apart carefully, because it's the best-known anecdote from this event.



Herman

The fifty percent survival chance.



Corn

You hear that the crew was told they had a fifty-fifty chance of making it back. It's in the BBC's coverage, it's in Wikipedia, it's in the Nuclear Museum, it's in RFE/RL. It's in everything, and it's the most dramatic thing anyone says about this test.



Herman

It traces to a single page, as far as anyone can find. The CTBTO website. That's where the citation chain ends. Not a Soviet document, not a crew memoir, not a technical report.



Corn

And the Russian Wikipedia doesn't include it.



Herman

The Russian Wikipedia omits it. And there's a cited document in the record that says the opposite: even if the parachute system had failed during the test, the bomber's crew would not have been endangered, because the bomb contained a special mechanism which triggered its detonation only after the plane had reached a safe distance.



Corn

So the bomb had a fuze that knew when the plane was far enough away.



Herman

Barometric and timing fuzes. It wouldn't detonate until the conditions were met.



Corn

Then the fifty percent number is a story, not a record.



Herman

It's a widely repeated, unsourced story. It might be true in the sense that nobody in that aircraft could be entirely sure. But it's not established fact, and I'd rather say that clearly than repeat it as though it were.



Corn

Because the vivid version travels and the accurate version doesn't.



Herman

The drama is better. That's why it survives. But the whole point of the plane, the parachute, the fuzing, is that the crew was meant to come home. The design is a story about engineers who didn't want to kill their own pilots.



Corn

Now the part I didn't know, and I think it's the best detail in the whole episode.



Herman

The Americans.



Corn

The Americans were closer to the explosion than the Soviets' own drop plane.



Herman

A US Air Force JKC-135A Stratotanker, tail number 55-3127, call sign Speed Light Bravo. It had been modified under the Big Safari program to observe the test with a bhangmeter — a device for measuring the flash of a nuclear detonation.



Corn

And it flew inside the Soviet aircraft's separation.



Herman

Closer than the forty-five kilometre separation of the Soviet drop plane. Its anti-radiation paint came back scorched.



Corn

Scorched paint on an aircraft the crew landed.



Herman

They flew home with the paint blistered, yes. And that tells you something about the American posture here. We weren't watching from a distance. We wanted the measurement badly enough to take a real risk for it.



Corn

So the Soviets got the propaganda, and the Americans got the data.



Herman

The Americans got the data.



Corn

What did the explosion actually look like, from a thousand kilometres away?



Herman

The flash was visible about a thousand kilometres away. It was observed in Norway, in Greenland, in Alaska. The fireball itself was roughly eight kilometres wide.



Corn

Eight kilometres of fireball.



Herman

The mushroom cloud rose to sixty-four, sixty-seven kilometres. That's into the mesosphere, well above the stratosphere. The cap of the cloud was about ninety-five kilometres across.



Corn

And the shock wave.



Herman

The blast wave circled the globe three times. The first circuit took thirty-six hours and twenty-seven minutes. The seismic waves also circled three times. Atmospheric pressure waves were recorded in New Zealand three separate times.



Corn

Three times. The pressure wave went around the world, came back, and hit New Zealand again. And again.



Herman

You can see the signature on the instruments at each pass.



Corn

So on the far side of the planet, instruments twitched three separate times because of one bomb.



Herman

And there's a wonderful detail about the command post on the Kola Peninsula. Their radio communications went dead for about forty minutes. Atmospheric ionisation from the blast.



Corn

So their confirmation, their first confirmation that the thing had worked, was that they'd lost contact.



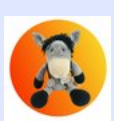
Herman

The silence was the signal. That's how they knew, before any report came in. They'd stopped hearing the far stations, which meant the ionosphere was disturbed, which meant the bomb had gone off.



Corn

And the ground at the point of detonation?



Herman

A witness description from the aftermath: the ground surface of the island had been levelled, swept and licked so that it looked like a skating rink. Everything in this area has been swept clean, scoured, melted and blown away.



Corn

What happened to Severny, the settlement fifty-five kilometres away?



Herman

All buildings destroyed. Wooden houses destroyed hundreds of kilometres away. Windows shattered up to nine hundred kilometres away. Windows broke in Norway and Finland, via atmospheric focusing — the pressure wave bent and concentrated by the atmosphere itself.



Corn

So bombing a frozen archipelago broke windows in Scandinavia.



Herman

Third-degree burns were possible at a hundred kilometres. Complete destruction out to twenty-five kilometres. Severe house damage out to thirty-five. Below the burst point, blast pressure was three hundred PSI, six times the peak at Hiroshima. Seismic magnitude somewhere around five.



Corn

And the fireball never touched the ground, which is why the local fallout was minimal.



Herman

The shock wave reflected off the ground and drove the fireball upward. So the ground underneath came out extraordinarily clean, in the sense that it wasn't vaporised and lifted into the air.



Corn

The bomb that hit nothing.



Herman

Fifty megatons, and it detonated over empty ice.



Corn

Now the two descriptions I want read out carefully, because this is where Daniel's "surreal" comes from. The Soviet cameraman.



Herman

"The ball was powerful and arrogant like Jupiter. Slowly and silently it crept upwards. It seemed to suck the whole Earth into it. The spectacle was fantastic, unreal, supernatural."



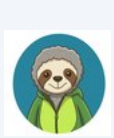
Corn

"Arrogant like Jupiter." That's a cameraman.



Herman

That's a man watching something he knows the size of, and then watching it do something he didn't anticipate. The slowness is what's in both accounts. It's not a bang. It's a thing rising, for what feels like a long time.



Corn

And the distant observer.



Herman

"A powerful white flash over the horizon and after a long period of time he heard a remote, indistinct and heavy blow, as if the earth has been killed."



Corn

As if the earth has been killed. Not the country, not the town. The earth.



Herman

People reporting it also kept saying the ground shook before anything they could hear arrived, because the shock travels through solid rock faster than through air.



Corn

So you feel it before you hear it. You'd feel the earth move, and then a minute later the sound arrives.



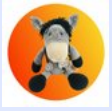
Herman

And that's where the "killed the earth" phrase comes from. The sound is the last thing to arrive and the world is already shaking.



Corn

So what did any of this actually prove?



Herman

Philip Coyle, who ran US nuclear testing, said it plainly: it's hard to find a use for it unless you want to knock down very large cities. It simply would be too big to use.



Corn

Which is the whole thing in one sentence.



Herman

The White House said the same thing the day of the test, and said it more sharply: There's no mystery about producing a fifty-megaton bomb. The United States Government considered this matter carefully several years ago and concluded that such weapons would not provide an essential military capability.



Corn

Which sounds a lot like a man who didn't get one and is pretending he didn't want one.



Herman

That's exactly what it sounds like, because that's what it was. And there's a beautiful detail in the declassified files. Even as the White House was denouncing the test publicly, the Kennedy administration asked Los Alamos and Livermore to scope what a US hundred-megaton weapon would look like.



Corn

Publicly denouncing it, privately commissioning the study.



Herman

Livermore scientists wrote, in the memo, that high-yield weapons, fifty megatons to a thousand megatons, should be reconsidered.



Corn

A thousand megatons, said out loud, in prose, in a memo.



Herman

And there's a Sandia scientist whose note is my favourite line in the whole archive. The Soviet test, he wrote, started some thinking in this country that there must be a good application for these things that has escaped our attention.



Corn

I want to sit with that. There must be a good application.



Herman

That's the whole Cold War in one sentence. Two countries, both convinced the other had found a use for the useless thing.



Corn

Did the test do anything useful beyond embarrassing us?



Herman

It changed the treaty math. Von Hippel's read is that the fallout concern hastened the end of atmospheric testing, in 1963. And Sakharov's own hope was that a record-setting test would be the last one anyone would ever need.



Corn

Which almost makes it the opposite of a bomb.



Herman

Which almost makes it a bomb that argued against itself.



Corn

So the largest explosion in history was arguably the least useful weapon ever built, and it accelerated the treaty that made its own kind impossible. And the Americans took the bait. They went to their labs and asked for the numbers.



Herman

They did. And the numbers they got, they wouldn't shut up about.



Corn

And that's when the shock wave hit the plane.



Hilbert

I agree with you.



Corn

Good.



Hilbert

About the fifty percent. That's a piece of folklore, they made it up. But you've got a bit wrong, and I want it corrected.



Herman

Right.



Hilbert

The stocking story. It's backwards.



Corn

Backwards how?



Hilbert

The factory I know made stockings on the same looms, same nylon line, for parachute cloth. They didn't take fabric out of stockings to make parachutes. The parachute order went in first and the stockings were the thing that got squeezed.



Herman

So the priority was inverted.



Hilbert

The plant was in Podolsk. Before that, that floor made tights. Then the allocation came down. Foreman on that shift was called Sosnov. He kept the count in a book.



Corn

So you know about this how.



Hilbert

They diverted nine thousand eight hundred pairs. That number was in his book.



Herman

That's an oddly precise figure.



Hilbert

It was. He wrote in pencil.



Corn

Okay. So the parachute, in your telling, was first and the stockings paid for it.



Hilbert

Parachutes first. And I've got a piece of it.



Corn

Of the parachute.



Hilbert

A yard of it. It's in a drawer, next to the batteries.



Herman

You kept a piece of the parachute.



Hilbert

It was in the hall cupboard, then I moved it to the drawer, because the cupboard started to smell like varnish. I remember it like it was yesterday.



Corn

You weren't there.



Hilbert

I remember it like it was yesterday. I moved it last Tuesday, same as I said.



Herman

You were not born in 1961.



Hilbert

The drawer's fine. It's the batteries that are the problem.



Corn

Why are the batteries a problem.



Hilbert

They're leaking. They've been leaking since I put the parachute in. I don't think it's the parachute's fault.



Corn

You don't think it's the parachute's fault.



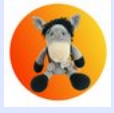
Hilbert

The cloth is only in one corner. It doesn't touch the positive end.



Corn

And that's where he stops.



Herman

The positive end.



Corn

Let's carry on.



Herman

So what did any of it actually prove?



Corn

The weapon had no military use, and everybody eventually admitted it. Khrushchev joked about his own windows. Coyle said you'd only use it on very large cities. The White House said such weapons don't provide an essential military capability, which was true, and then went looking for one anyway.



Herman

And the part that interests me is that the bomb most designed to intimidate ended up constraining the guys who built it. Sakharov swapped the tamper because of fallout, argued against the hundred-megaton test, and later helped push the Partial Test Ban into existence. Von Hippel's point is direct: the fallout concern from that test hastened the end of atmospheric testing in 1963.



Corn

So the bomb's own architect became its most consequential critic.



Herman

Which is the strangest thing in the whole story, and it happened within eighteen months. The weapon that was supposed to demonstrate Soviet strength spent its political credit buying the treaty that ended open-air testing for everyone.



Corn

The one thing I'd take from this is that enormous weapons are a measurement of political fear, not of military capability. The fifty megatons tell you how scared Khrushchev was of looking weak, not how he intended to fight. And that's why the American response to Tsar



Corn (continued)

Bomba was to study, not to match. They wanted the number, not the bomb.



Herman

What they discovered about that number was that the practical ceiling on yield sits with the delivery aircraft, not with the physics. Once you're past the aircraft, the bomb is just a demonstration.



Corn

Which is a nice setup, because next episode we're going the other direction. Daniel's asked for the American side, and specifically for Project Sundial.



Herman

Ten gigatons. Or more, depending on which version of the proposal you read.



Corn

We'll get there. On that, let me do the housekeeping. Hilbert, thank you, as always, for producing. This has been My Weird Prompts, the human-AI collaboration podcast. If you've got your own question, send us your own prompt on Telegram at t dot me slash MWP listener bot. We'll be back soon.



Herman

See you tomorrow.