Episode Book

EPISODE #5628

What a Nuclear Warhead Actually Looks Like

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SYNOPSIS

Most of us picture nuclear weapons as missiles sitting preloaded in bunkers behind blast doors. The reality is stranger and more mundane: a physics package the size of a wastebasket, warm to the touch, plated in gold, stored in a vault lowered into the concrete floor beneath the very aircraft meant to carry it. This episode walks through what a warhead physically is, how WS3 vaults and earth-covered igloos actually work, and why the real security lives inside the weapon — in Permissive Action Links, twelve-digit codes, environmental sensing devices, and a historical detail about Minuteman launch codes that's hard to forget.

TRANSCRIPT



Corn

What does a nuclear warhead actually look like, and where is one sitting right now?



Corn

That's the question underneath everything Daniel sent in this week, and it's a better question than it sounds, because most of us are carrying around a picture in our heads that turns out to be wrong.



Corn

Here's his setup. We talked recently about Israel taking delivery of a new submarine, and the formal position that Israel has no nuclear capability. We've done non-proliferation episodes before, especially around Iran. But Daniel's point is that the discourse stays abstract. He wants something he can hold as a mental picture.



Corn

So he came across a video on X. Someone opening a door onto a room where a warhead was supposedly stored. Community notes flagged it. It was a mock. Completely inert. But it looked credible in a way he found unnerving, and that got him thinking about what the real thing looks like.



Corn

He describes what the video showed. A series of reinforced blast doors, each one leading down to another floor. And at the bottom, a room with what looks like an ordinary missile head propped up in the center.



Corn

He's careful to say he doesn't assume that's accurate. He's saying it might map onto what a lot of people picture. His own prior image was ballistic missiles sitting preloaded somewhere.



Corn

So, four questions. What do real warheads actually look like, physically? How are they stored by the countries that have them? What's actually known publicly about the storage facilities and the security around them? And how does the real picture compare to that mental image of blast doors and a warhead propped in a room?



Corn

He also asks the bigger one. Why does this discourse feel so abstract, and does knowing the physical reality change how you think about the threat?



Herman

Let's start with the object itself, because the video Daniel saw got the object wrong in a specific and interesting way.



Herman

There's a distinction that does most of the work here. The physics package is the actual nuclear explosive. The fissile pit, the explosive lenses, the tamper and reflector, the neutron generator. That's the part that goes bang.



Herman

The weapon is the physics package plus everything around it. Casing, fuzing, arming and safety electronics, parachute, tail kit. The bomb is a delivery container for the physics package.



Corn

So when people say "warhead," they're usually pointing at the casing.



Herman

Usually, yes. Take the B61, which is the American workhorse gravity bomb and the one you're most likely to see in a photograph. Eleven feet eight inches long. Thirteen inches in diameter. Seven hundred to eight hundred twenty-five pounds depending on the mod.



Corn

That's a torpedo.



Herman

It's a fat pipe. A streamlined cylinder built to be carried externally by supersonic aircraft. If you saw one on a rack you would not think "bomb." You'd think "industrial equipment that belongs to somebody with a forklift license."



Herman

Now shrink it down. The physics package inside a B61 is a silver cylinder roughly the size of a small wastebasket. There are declassified photographs of B61 components laid out on a table, and that's what you see.



Corn

And inside that?



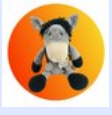
Herman

The pit. A modern plutonium pit holds three and a half to four and a half kilograms of plutonium and produces somewhere in the range of five to ten kilotons. The Fat Man pit was nine point one centimeters across. Three point six inches. The size of a softball.



Corn

The thing that leveled a city was softball-sized.



Herman

The nuclear material is the small part. The bulk of a bomb is the implosion system. Concentric layers of uranium, aluminum, high explosive, all machined to tolerances that would embarrass a Swiss watchmaker.



Herman

Two details that stick with people. Pits are warm to the touch. A five kilogram mass puts out about nine point seven watts of heat, so the weapon needs aluminum parts to wick that away. And pits are plated with an inert metal. Historically gold. Sometimes vanadium now, for fire resistance.



Corn

So the most dangerous object most people will never see is warm, gold-plated, and the size of a piece of fruit.



Herman

And visually boring. That's the point. A real warhead is not dramatic. It looks like precision industrial equipment. The nuclear-ness is invisible.



Corn

Which is exactly why the video worked on Daniel. It substituted a cinematic object for a bureaucratic one.



Herman

The video gave him a missile head propped in a room. The reality is a cylinder that looks like it came out of a machine shop. The fake was more unnerving than the truth because the fake was designed to be.



Corn

So if that's the object, where does it actually sit?



Herman

The single best public answer is a system called WS3. Weapons Storage and Security System.



Herman

It's a vault built into the concrete floor of a Protective Aircraft Shelter. Not a deep underground bunker. A floor vault.



Corn

Under the aircraft.



Herman

Under the aircraft that would carry it. One vault holds up to four nuclear weapons. The vault sits lowered into the floor, and in the lowered position it gives ballistic protection through a hardened lid and reinforced sidewalls.



Herman

To load, you raise the vault. The weapons come up and go directly into the aircraft parked above. It takes minutes. A few armorers. No vehicles.



Corn

Why build it that way?



Herman

Because the old way was a problem. Under the previous system, weapons sat mounted on alert aircraft or got trucked in from bunkers. That took several hours and a large coordinated team.



Herman

Which meant Soviet satellites could watch the activity and read it as pre-attack mobilization. You're trying to load a bomb and the other side sees a ballet of trucks and thinks you're about to launch.



Corn

So the vault is an operational security device as much as a storage device.



Herman

It solves the visibility problem and the time problem at once. The scale is worth hearing. Two hundred fifteen WS3 vaults built for United States Air Forces in Europe. Thirteen sites, seven countries. Plus thirty-four for the Royal Air Force. Ten at RAF Brüggen, twenty-four at RAF Marham.



Corn

Authorized when?



Herman

Nineteen eighty-eight. Widespread by the mid-nineties.



Corn

And the security on the vault itself?



Herman

Classified sensors, video, motion detectors, CCTV, thermal imaging. Twenty-four seven electronic surveillance. But notice what that is. It's not a portcullis. It's a sensor suite.



Corn

What did the older system look like? Because that's closer to what people picture.



Herman

Weapon Storage Areas. Special Ammunition Storage. Earth-covered igloo bunkers. Arched, grass-topped concrete magazines. Usually inside the perimeter of an army barracks or an air base. Occasionally deep in woods miles from any base.



Corn

Grass on the roof.



Herman

A low grassy mound. That's the closest thing to a real image of nuclear storage most people have ever seen, and it looks like landscaping.



Corn

There's a photograph from Savanna Army Depot that's the canonical version of this. Rows of them. They look like a golf course with doors.



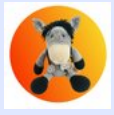
Herman

Largely obsolete now, replaced by WS3. But the takeaway holds either way. Real storage is distributed, mundane, and integrated into ordinary military infrastructure. Weapons sit under aircraft shelters, in floor vaults, in earth-covered igloos.



Corn

There's no Fortress of Doom.



Herman

The security is electronic and procedural. Not architectural spectacle.



Corn

But the physical arrangement is only half the story. The real control lives inside the weapon.



Herman

Right. And this is where it gets clever, because the thing that actually secures a nuclear weapon is not the vault. It's a device inside the physics package called a Permissive Action Link.



Herman

The Department of Energy definition is worth having. A device included in or attached to a nuclear weapon system to preclude arming or launching until the insertion of a prescribed discrete code or combination.



Corn

A lock.



Herman

A lock with a few unusual properties. The elements are located deep within the nuclear device. It's a black box designed to limit information leakage. And it's powered by radioisotope generators. Plutonium-238 decay heat, rather than batteries.



Corn

Why not batteries?



Herman

Because batteries can be attacked. You can cut a power line. You can drain a cell. Decay heat runs for decades and doesn't care what you do to the building.



Corn

How long are the codes?



Herman

They grew over generations. Three to four digits at the earliest. Then four, then six, then twelve digits in the later categories. The twelve-digit version also disables the weapon after failed attempts and controls yield. Dial-a-yield.



Corn

Twelve digits is a lot of entropy.



Herman

And there's a retry limit. After a set number of wrong codes the weapon locks out, and to get it back you have to return it to Pantex for rebuilding.



Corn

So the failure mode of a stolen weapon is that it becomes a very heavy paperweight.



Herman

There's also non-violent disablement. Internal components can be destroyed to render the weapon unusable without any nuclear detonation. You don't have to blow it up to kill it.



Corn

Give me the quote you're clearly holding.



Herman

Peter Zimmerman, nuclear physicist and weapons inspector. "Bypassing a PAL should be, as one weapons designer graphically put it, about as complex as performing a tonsillectomy while entering the patient from the wrong end."



Corn

That's a sentence that stays with you.



Herman

It's meant to. The point is that the difficulty isn't the door. It's the geometry.



Corn

What about the human side? Because a code is only as good as the people entering it.



Herman

The two-man rule. On ballistic missile submarines, the commanding officer and the executive officer both have to agree the launch order is valid and mutually authorize.



Herman

On Minuteman, both operators compare the order's code against something called a sealed authenticator, stored in a safe with two separate locks. Both operators turn four launch keys simultaneously. And a second launch control center has to do the same thing.



Corn

Two crews, two safes, eight keys.



Herman

And then there's the part I find most elegant. Environmental Sensing Devices.



Corn

Explain.



Herman

The weapon senses whether it's in its combat environment. On an intercontinental ballistic missile, that means strong acceleration, then free fall, then re-entry acceleration. And it only arms when those are sensed in the correct order.



Corn

So a warhead sitting in a vault doesn't arm.



Herman

A warhead sitting in a vault, or dropped, or in a fire, will not arm. It has to go through the sequence. The weapon knows where it is.



Corn

There's a design philosophy underneath that, isn't there? Stronglinks and weaklinks.



Herman

Yes. In an accident, weaklinks are designed to fail before stronglinks, so the weapon fails safe rather than failing armed. The default state of the object is inert. You have to actively walk it toward being dangerous.



Corn

Which brings us to the historical bombshell.



Herman

Bruce Blair, the nuclear safety expert, reported that Strategic Air Command worried launch codes wouldn't be available in a crisis. So they set the Minuteman codes to eight zeroes. In all launch control centers. And checklists confirmed it until nineteen seventy-seven.



Corn

The most consequential weapons in human history had a combination of eight zeroes.



Herman

For years. And here's the detail that makes it worse and better at the same time. The Air Force told Congress in twenty fourteen that a code consisting of eight zeroes has never been used to enable a Minuteman ICBM.



Corn

Which doesn't contradict Blair.



Herman

It doesn't. Blair said it was the code for doing so. Not that it was used. Those are different claims, and the Air Force answered the narrower one.



Corn

The lock was a zero. The door was never opened.



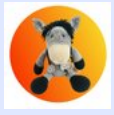
Herman

That's the honest reading.



Corn

Bring this to Israel, because that's where Daniel started.



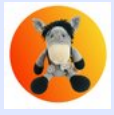
Herman

Israel is widely believed to possess nuclear weapons. Estimates run from ninety to four hundred warheads, and it's believed to have a full triad. Air, land, sea.



Corn

The policy is deliberate ambiguity. Amimut.



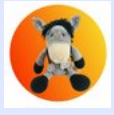
Herman

Neither confirm nor deny. The only line they repeat is that Israel will not be the first country to introduce nuclear weapons to the Middle East. And they interpret "introduce" to mean they won't test and won't formally acknowledge.



Corn

The submarines.



Herman

Five Dolphin-class boats. Twenty launch tubes total for the Popeye Turbo submarine-launched cruise missile. That's the sea leg, and the presumed second-strike capability.



Corn

Launch authorization?



Herman

Believed to require joint agreement of the Prime Minister and the Minister of Defense. And Israel is believed to use PALs on its warheads.



Corn

The Vanunu case is the closest the public has come to seeing Israeli warhead components.



Herman

Nineteen eighty-six. Mordechai Vanunu was a technician at Dimona. He leaked about sixty photographs of the complex, including a glove box containing nuclear materials in a model bomb assembly. He was kidnapped by Mossad from Italy and imprisoned for eighteen years.



Corn

And Ted Taylor looked at those photographs.



Herman

Ted Taylor, the physicist, reviewed the leaked photos of disassembled components and concluded Israel possessed boosted weapons. He also judged that advancing to full two-stage megaton weapons without testing would require era-appropriate supercomputers.



Corn

So the public picture of Israeli warheads rests on sixty photographs taken by one man forty years ago.



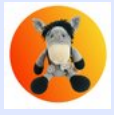
Herman

That's about the shape of it.



Corn

Which brings us to Daniel's real question. Why does all this feel so abstract?



Herman

Four reasons, and they compound. Classification is the first. The details that would make it concrete are the most tightly held secrets in any nuclear state. What's public is a shell of dimensions and acronyms.



Corn

Second.



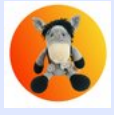
Herman

The weapons are designed to be invisible. A PAL is a black box inside a black box. An ESD is a sensor. The nuclear-ness is deliberately unobservable.



Corn

Third.



Herman

Deterrence is a psychological phenomenon, not a physical one. The threat lives in the belief that the weapon works and would be used. So the discourse naturally drifts toward signaling and credibility and doctrine, because that's where the action actually is.



Corn

Fourth.



Herman

Cinema fills the vacuum. Because the real thing is boring-looking and hidden, popular culture supplies the blast doors and the propped-up warhead. And that imagery is more unnerving than the truth, precisely because it was designed to be.



Corn

Which is what happened to Daniel. He got the designed-to-be-unnerving version, and it left him with a picture that's wrong in a way he couldn't have known.



Herman

So what changes when you know the physical reality?



Corn

The threat stops being a place.



Herman

It stops being a vault or a silo and becomes a system. A chain of codes, sensors, procedures, and human agreements. The vault lid is concrete. The real lock is a twelve-digit code and a two-man rule.



Corn

And the distribution is the sobering part. Under aircraft shelters. In floor vaults. In grassy igloos. Woven into ordinary military life.



Herman

Which is more unsettling than a fortress, in a way. A fortress is somewhere else. A floor vault is under the building where somebody parks a fighter jet.



Corn

And the most dangerous moments in history were human and organizational, not physical. The eight-zero codes. The near-misses.



Herman

The hardware is engineered to fail safe. The risk is in the people and the procedures.



Hilbert

How many of them do you think are actually loaded?



Corn

What?



Hilbert

The vaults. You said two hundred fifteen for the Air Force in Europe, thirty-four for the British. I'm asking how many of them had something in them on a given Tuesday.



Herman

That I don't know. The public numbers are about the vaults, not the fill.



Hilbert

I spent about nine months on a site where we were responsible for counting things that came in crates and went out on aircraft. Test equipment, mostly, and some of it was sensitive enough that we had a two-man rule of our own. Two signatures to open, two signatures to close.



Hilbert

And the thing I learned is that the count is never the problem. The count is easy. The problem is that after a few months, a crate stops being a crate. It becomes the thing you sign for on the way to lunch.



Corn

The object becomes furniture.



Hilbert

It becomes furniture. We had a mock-up on a stand in the corner of the shop, a training piece, and it looked like a piece of plumbing. A cylinder with fittings. If you set it on a bench next to a pump you couldn't tell which one was which. I walked past it for months.



Herman

That matches what the declassified photographs show. The physics package looks like a wastebasket.



Hilbert

The one that looked least like a weapon was the one everybody was most careful around, because the paperwork on it was the worst. You couldn't move it without three people knowing. And the stuff that looked scary, the stuff with the fins and the stencils, people handled that like it was luggage.



Corn

So the visual signal was inverted.



Hilbert

Completely inverted. And I think that's the thing you two skipped past. You said the enemy's satellites are looking for the dramatic. That's true. But the people inside the fence are looking at the same thing. A weapon that doesn't look like a weapon is easy to stop seeing.



Herman

That's the complacency problem, and it's real. The Air Force has had incidents where crews lost track of what they were handling precisely because the handling was routine.



Hilbert

I had a supervisor who used to make us say the item out loud before we touched it. The item. What it was. He said the day you stop saying it is the day you stop knowing it.



Corn

Did it work?



Hilbert

It worked on me. I still remember what was in those crates and I haven't seen one in thirty years.



Herman

That's the human layer of the security story, and it doesn't show up in any of the diagrams.



Hilbert

The diagrams are the easy part. The hard part is a man on a Tuesday afternoon who has signed for the same thing four hundred times and is thinking about his lunch.



Corn

So the most secure nuclear weapon is the one that looks least like a weapon.



Hilbert

And that's on purpose. It's not an accident. Somebody decided that.



Herman

Which puts the risk somewhere the architecture can't reach.



Hilbert

The lock is fine. The lock has always been fine. The lock is not the thing that worries me.



Corn

If the real threat is procedural and human rather than architectural, what does that do to how we talk about non-proliferation? Because the entire public conversation is built on counting things. Warhead counts, missile counts, enrichment percentages.



Herman

And counting is the part that's knowable. It's why the discourse gravitates there. You can put a number on a stockpile. You can't put a number on whether the crew on the Tuesday shift still says the item out loud before they touch it.



Corn

Which means the thing that actually keeps these weapons from being used is the thing least visible to anybody outside.



Herman

The hardware is engineered to fail safe. The people are not engineered at all. They're trained, and training decays, and the decay is invisible until it isn't.



Corn

As arsenals modernize, does any of that change? Do the mundane storage and the invisible security systems get replaced with something more legible?



Herman

I don't think legibility is the goal. The vault is designed to be unremarkable on a satellite photograph. The lock is designed to be unremarkable to anybody holding the weapon. The whole system optimizes for not being noticed.



Corn

The most unnerving thing about nuclear weapons isn't the blast doors or the warhead propped in a room. It's how ordinary they look. And how much of their danger lives in the people and procedures around them, which is the part nobody can photograph.



Herman

That's the piece Daniel was reaching for. The mental picture matters, and the accurate one is quieter than the fake.



Corn

If you found this useful, a review helps other listeners find the show.



Corn

Thanks to our producer, Hilbert Flumingtop.



Herman

This has been My Weird Prompts.



Corn

We'll be back soon.