Theodore Postol: Iran's Missiles & Drones Were Underestimated

MIT Professor and Pentagon advisor Ted Postol explains the extent to which the quantity and quality of Iranian missiles and drones were underestimated, and the consequences of this miscalculation. Follow Prof. Glenn Diesen: Substack: https://glenndiesen.substack.com/ X/Twitter: https://x.com /Glenn_Diesen Patreon: https://www.patreon.com/glenndiesen Support the research by Prof. Glenn Diesen: PayPal: https://www.paypal.com/paypalme/glenndiesen Buy me a Coffee: buymeacoffee.com /gdieseng Go Fund Me: https://gofund.me/09ea012f Books by Prof. Glenn Diesen: https://www. amazon.com/stores/author/B09FPQ4MDL

#Glenn

Welcome back. We are joined today by Theodor Postol, a professor of science, technology, and national security policy at MIT. He's an expert in nuclear weapons delivery systems, missiles, and missile defense, and has worked as an advisor at the Pentagon. So thank you again for coming back on. The audience always really appreciates it, yeah.

#Theodore Postol

Well, I'm very happy to be here. My discussion today might be a little fragmented. I've been putting it together on the fly since yesterday. I actually got up at 5:30 my time this morning to start working on the slides. So, you know, it could be a bit rough around the edges. If I fall asleep during the talk, I'll be ahead of some of your audience. It's probably fair to say that everyone following the situation agrees that Israel and, of course, the United States have made a tremendous strategic blunder—that the war is not going well for either the United States or Israel. And in fact, I think we'll find that the war is going to go worse and worse as time goes on.

And the situation is now entirely in favor of the Iranians. They're, of course, taking tremendous damage from the bombing campaign that began on February 28th with the surprise attack by Israel and the United States on Iran. But as many of us guessed—and I want to underscore, it was a guess at least on my part—the war would rather quickly turn in favor of Iran. The basic reasons for that are multiple. One of them is simply that Iran is a giant country, and while the damage being done is very substantial, it's mostly to its above-ground facilities.

Of course, many innocent people are being killed, which is another moral and ethical issue. But the bigger problem is that Iran's retaliatory capabilities are mostly underground. And it's not simple—people sometimes don't understand that being underground is a very problematic thing, because they focus on the ability. For example, they talk about bunker busters. But for a bunker buster to

work, it has to be extremely precisely targeted. If I build tunnels and have an opening in one of them and launch a missile through that tunnel, through that hole, you don't know where the tunnel might be going.

The tunnel could be going in many different directions, and there could be branches off the main tunnel. Iran has very cleverly, with great thought and strategic intelligence, built its facilities in networks of tunnels. So even if you hit a tunnel entrance, you don't necessarily hit the facility. And this is a real problem that Israel and the United States will continue to face. It's simply not going to be possible to destroy these underground tunnels. Now, if we look at the capabilities Iran has to retaliate, it basically comes down to the total number of missiles and the accuracy of those missiles over time. And we're not just talking about ballistic missiles.

We're talking about drones, right? Drones have tended to be less of a focus until more recently, mostly because they move slowly. They're not exotic. The technology in them doesn't appear to be—although, actually, the technology in drones is very advanced. Let me give you an example of what I mean. Improvised explosive devices, which wreaked havoc during the American invasion of Iraq, for example, are often incorrectly described as low-tech devices. They are, in fact, very high-tech, because you attach a cell phone to the explosive device.

The cell phone is itself an extraordinarily high-tech device. Now, you may not be able to build it, but you can buy it because it's commercially available. And, of course, if you can use it, you have an incredibly sophisticated weapon to use against your adversaries. Now, drones have turned out to be rather similar weapons, but in some ways more revolutionary than, for example, the improvised explosive device. Drones have the advantage of satellite navigation, which allows them to know where they are—typically within a few meters, in three dimensions.

I say three dimensions because they know their altitude, and they know their latitude and longitude. And when I say "to a few meters resolution," I'm talking about drones that are using, for example, China's Beidou system. With the Beidou navigation system, you can typically achieve a few meters' resolution with civilian access. GPS has a lower resolution because the military access is specialized compared to the civilian one. But the Chinese have made their system available for higher precision. And this is available—the Chinese receivers can be put on the drones, and they can, you know, tell the drones where they are.

Now, when a drone knows where it is to within a few meters of precision, it also knows its direction of motion, because it can measure its movement by a sequence of measurements. If you know your direction of motion and where you are, and you have satellite data—the kind that we now know the Russians and the Chinese are giving Iran—the satellite data tells you the latitude, longitude, and altitude, how much above or at sea level any particular target of interest is. If that target isn't moving, the Iranians can locate it accurately. And because of that, the ability to find a target is very good. This means that if I want to send an image to the drone, I don't need a lot of data.

#Theodore Postol

I just need to send it a rough image.

#Theodore Postol

Because the drone knows where it’s looking, if in the final stages of homing it needs a more detailed update to lock exactly onto a target, it only needs a single picture.

#Glenn

It really doesn’t need a video for the homing.

#Theodore Postol

But, of course, it can have that video, because we also have the system called Starlink. Now, Starlink—I'll show you some Starlink receivers just to give people a sense of them. You can go out and buy a Starlink receiver for about $250. I think you can even find one on Amazon. It’s about one foot on a side, weighs much less than a pound, and only requires about 20 or 30 watts of power, which can easily run off a generator on the drone or a battery. And you can get real-time video through a video link with Starlink. Now, there’s no way to turn off the Starlink system unless you shut it down for a whole region, because people buy Starlink to get the equivalent of cell phone access. So when I buy a Starlink—call it a transceiver or a modem, if you want to call it that—I can put it on the back of a drone or integrate it into the wing of a drone.

And once the drone starts communicating, there's no way for anybody, including the people who operate Starlink, to know what I'm doing with that communication system, because everything's encrypted. So there's no way to say, “Oh, it's Glenn Diesen flying his drone against that poor radar.” They don't know. It's an encrypted communication from one of a million or so of these mobile transceivers or modems that they've already sold—selling more at a fantastic rate. So now you have this ability for drones to get all this data, and that combination is extraordinarily revolutionary in terms of the damage-inflicting capability those drones now have. And that is all in the hands of the Iranians.

Plus, you have the ability to build these drones very easily because everything is commercial, including this Starlink modem, which by itself—if you just talk about the technology needed to implement it—is fantastic. It's the most advanced technology the West can produce. It doesn't matter. What matters is it's commercially available and anybody can use it. That's what matters. And this is now ubiquitous and universally available. Now, just to give you a sense of my understanding—I want to be clear, I want to give your audience a little bit of a chance to understand how my own judgments have evolved over time—this shows you the hit points at the Nevatim Air Base in Israel, which occurred in October of 2024 when the Iranians retaliated.

#Theodore Postol

For one of the many Israeli attacks on them. And basically, from these hit points, you can get an estimate of what the actual accuracy of the ballistic missiles is. Now, of course, that's for these ballistic missiles. If you have more modern ones that are more accurate, you don't have an estimate for them. But these were the estimates—these were the data I had at the time. And at that time, I guessed, well, it was a pretty good estimate, actually, based on the data, that the accuracy of the ballistic missiles Iran was using then was about a kilometer. I don't need to go through all the details; this was discussed. So if this is a kilometer of precision, then this shows you, sort of, if I were aiming at downtown Tel Aviv, a rough pattern of where the warheads would fall.

So a lot of my warheads would fall outside the downtown area, given that the downtown area is my target. Now, if I just improve my accuracy by a factor of two, I get a 500-meter precision. You see, all of a sudden, I'm really getting more and more damage-inflicting capability with greater precision. And what we're now seeing is that the more capable and modern Iranian ballistic missiles are much more accurate than even the 500 meters we're talking about here. And there's some evidence for that. You can even see it if you have a trained eye. I mean, you have to accept that I have some experience with these matters. Here you can see four frames of an incoming modern advanced ballistic missile. Now, if you look here, you can see that's a reflection off the lens of the camera.

You can tell because it tracks exactly with the location of the bright spot, which is the real warhead. Notice there's a trail associated with this warhead, along with a tail, kind of a wake. There are tiny luminous particles in that wake. This trail is due to the rocket motor on the warhead, which is working against aerodynamic drag to keep it moving at high speed and on a stable trajectory. With the earlier Iranian ballistic missiles—the less advanced ones—you could see warheads tumbling, even missiles breaking up at high altitude, if you knew what you were looking for.

#Theodore Postol

You know, I could give a talk on that. It doesn't really matter.

#Theodore Postol

But here you see one that's extremely stable.

#Theodore Postol

Reentry trajectory. So, what does this mean?

#Theodore Postol

This means that if I have a Beidou navigational receiver on this, and it's giving me meter-level precision in telling me my location, then I'm probably going to have tens or maybe a few hundred meters of accuracy when I hit the ground. The reason I have less accuracy than my positional knowledge is that it's very hard to control the incoming missile—it's coming in so fast. Typically, you'll hear the terminology "guidance and control." Guidance refers to knowing where I am; control means making sure my system isn't wobbling around when I'm coming in at, you know, Mach 12 or Mach 13. But what we see here is a very energetic explosion.

#Glenn

Notice that the sky is blue.

#Theodore Postol

If you look at the later frames, it turns red. That indicates a very high energy density in the explosion. That's because you're not only seeing the explosive effect of the warhead itself, but also the kinetic effect of its motion. This thing's coming in so fast that its energy is converted into heat, turning it into a molten mass of material so hot it radiates blue light—which is hotter than the red light you'd see from a cooler explosion. You can really tell how intense these blasts are. The result is tremendous damage. This shows the kind of destruction that happened at Dimona recently. You can see that, although this munition seems to have—well, I can't, unfortunately—people keep putting labels on their video frames.

Even though we know the warhead landed somewhere in the middle here, you can see the shockwave just blew the walls out of all these different buildings. If you were inside and near a window, you could have easily been killed or badly, badly injured. We don't know what the casualties were, and we also don't know what the warning time was, as I'll explain shortly. The warning time has essentially disappeared because the Iranians have been so successful with the use of drones. I want to underscore—drones, not ballistic missiles. The drones have been able to destroy essentially all of the critical radar systems that the Israelis and Americans use for air and missile defenses.

Now, this is a nonlinear consequence. By that I mean, when I have air defenses, I can shoot down a significant percentage of your drones—assuming I have enough interceptors, which, of course, they're running out of. Now, in the case of ballistic missiles, the air defenses have never been able to shoot down a high percentage of them. My guess—and I think history will eventually confirm this—is no more than about a 5% intercept rate, even with their best systems. It's not much more than that. And you can see that. Again, if you want another discussion, I'd be happy to do it. You can see it because we can identify intercepts; we can see them when they occur. And we can also see that they almost never occur.

In other words, we have video after video after video, freeze frame after freeze frame after freeze frame, time-lapse photo after time-lapse photo—almost none of which show any intercepts. So the conclusion is clear: there's a very low percentage of intercepts. It's just that simple. All right, here's another example of the high levels of damage that can be done. One of the problems you're seeing now is that if one of these warheads hits a building—and some percentage of the time they do—it's a purely probabilistic event, but if it hits, it can take the building down.

So if you're in Israel and you have an armored room in your apartment—which, you know, means a specialized room with steel doors and reinforced walls—and you're not foolish, you take shelter, the odds are very high you won't be injured, even with this kind of damage. But if that building comes down, you're going to go down with it. You're going to be buried. So what's happening in Israel now—I know this was reported by some of your earlier interviewees, and I've confirmed it independently—is that people are having to go down out of the building to underground shelters.

Because those are reinforced enough that if the building collapses, you can survive. It'll protect you from the collapsing structure. So that puts tremendous stress on you, because two, three, four, or five times a night you're awakened and have to go down to a shelter. You can't assume your building isn't going to be hit. It's a low-probability event for any individual, but, you know, if you're in that situation—it's easy for me to say. I joke with my military friends, I say, well, you know, it's hard to hit an aircraft carrier. But I always want to be respectful to them, because they're the ones who are out there.

I always say, but of course, I'm not on the carrier. And I understand—you can't take it for granted, and you won't. I know for sure, from my own attitude, I would definitely be down in the shelter. So the fact that there's a low probability it would be hit doesn't mean much. And that's putting tremendous stress on Israeli society. Here's an example—this is from Gaza, actually—and it shows internal damage to an Israeli home that was probably several hundred meters, maybe a fraction of a kilometer, away from the detonation of a ballistic missile warhead.

#Glenn

So this is not minor damage.

#Theodore Postol

I mean, you're not dead. Your apartment—well, you could be dead if you were near the window, if you weren't wise enough to go into your shelter. But, you know, this isn't the kind of damage you can routinely accept unless you have a shelter. And you don't want to ignore the possibility that this thing could have hit your building, and that apartment would just be rubble at the bottom. So again, these levels of damage are very large and very much a problem. So now, let's get to the problem of drones. The drones are different—they're somewhat low-tech vehicles. This is an example of an

Iranian one; it’s called a Shahed drone. It’s very close to the Russian Gen-2 drone, which is based on the same design. Right now, the Russians, Ukrainians—obviously the Iranians, who invented the first design—Turks, and Americans all have drone models that look very much like this vehicle.

#Theodore Postol

And the reason is simple.

#Theodore Postol

It's very easy to implement, extremely inexpensive, and very hard to shoot down. Again, let me say, it's easy to shoot down if I have a surface-to-air missile. But the surface-to-air missile—for example, the Iron Dome interceptor—is essentially useless against ballistic missiles. Iron Dome is a total failure against ballistic missiles, but it's very capable against drones. If you're going to use it against drones or cruise missiles, it’s going to have a very high intercept rate, probably close to one. So I wouldn’t even shoot two of these things at a drone; I’d shoot one. But the thing probably costs half a million dollars. Israelis claim it’s $100,000, but that’s nonsense.

Nobody knows how to build one of these things for $100,000. Maybe $200,000 or $300,000 if you're very clever at building them, but even that I doubt. So you're talking about a half-million-dollar intercept. If you're talking about a Patriot, you're talking about a $1 million to $4 million interceptor, depending on whether it's a Patriot PAC-2, Patriot Advanced Capability II interceptor, or a Patriot Advanced Capability III interceptor. That's a $4 million interceptor—against a $30,000 drone. And probably these drones are cheaper than that, because when you're building them in large numbers, they’re going to be a lot cheaper. So here's an example of one of these underground tunnels.

#Glenn

Now, this is an Iranian underground tunnel.

#Theodore Postol

And you can see photos of these underground tunnels all over the place now. Just to give you an example of how difficult these tunnels can be to work with—or to work against if you're trying to strike them—you could cut a hole in the tunnel somewhere. You wouldn’t have the drones there, but you could have a ballistic missile that you’re launching through that hole. On top of the hole, you could put a very thin layer of plastic or fiberglass, something like that, and then cover it with sand.

So when you look down from an airplane, or even from the ground walking around, you don’t even know there’s a tunnel entrance there. I was in Vietnam as a visitor, fortunately, and I was standing literally a foot away from a hole leading into an underground tunnel that the Vietnamese had used against the Americans during the war. And this fortunately friendly—because I was visiting—

Vietnamese guide popped out of the ground. I had no idea the hole was so close to me. When he went back down, I couldn't find the hole, even though I'd been standing right next to it. I mean, it's very hard to identify these holes.

And you put the missile there, and you just fly through to cover. Now, let's say I know the hole is there. So I come with one of my bunker buster bombs—because I'm into bunker buster bombs—and I just drop it through that hole and do a lot of damage locally. But I don't know that there aren't tunnels running all around this thing. I mean, I could have tunnels branching off with holes, and I can seal those tunnels after the blast, then reuse them later. And this is what we're dealing with with ballistic missiles, too—a lot of these ballistic missiles are being launched from underground.

#Glenn

So the ballistic missiles are less accurate, but they have much larger warheads.

#Theodore Postol

And they're doing tremendous general damage. So it's a very bad situation from the point of view of both the Israelis and the Americans. Here's another example of these things stacked. Now, you see these drones are stacked in these canisters here. But look at this back here—God knows how many canisters there are. And look at this tunnel going on. You don't know what other tunnels are going elsewhere. So this is the kind of complex you're never going to be able to destroy. Even if you had nuclear weapons and went after them, you still wouldn't be able to destroy them.

You'd be able to destroy larger areas of them, but you definitely wouldn't be able to destroy them completely. And here again, you know, these things mean... So the situation is extremely bad from the point of view of the Americans and the Israelis. So now we're in a situation where the drone can be—well, you can put a navigation system on the drone. There are several systems available. The obvious one to use right now, I think, is Starlink, because you just go to Amazon and buy yourself a Starlink receiver.

#Theodore Postol

So let me show you what one of these things looks like.

#Theodore Postol

Here's a Starlink receiver in the wing of a drone. Now, you can see that this is the receiver here again. Notice this section, which has been broken off—it's filled with styrofoam, and it's got a very thin, non-metallic surface. This thing has very, very low radar reflectivity. The styrofoam that fills the cavity gives it good physical rigidity, so I don't need to have a thick cover. You have a thin cover that hardly reflects radar, and I get rigidity from very cheap materials that are light, common, and

adequate for making the drone strong enough to be aerodynamically functional. The radar cross-section of this vehicle is probably around one hundredth of a square meter. It could be a few hundredths of a square meter, maybe a little less.

You know, radar cross-sections are sensitive to orientation, but it's very low. And just to give you a sense of what a hundredth of a square meter radar cross-section is—that's equivalent to the radar cross-section of a bird. So when the radar looks out, it sees birds. If it's a very good radar, it sees birds—and it also sees drones. How do you tell the drone from a bird? Well, you can tell the drone from a bird because it's traveling faster. But a bird is often flying fast enough that it looks enough like a drone that separating the two can be quite a trick. Signal processing theoretically allows you to separate them, but it really requires the radar to have certain properties that are extremely difficult to build in. I won't get into radar theory, but it's not easy to separate the two.

#Theodore Postol

To moving targets.

#Theodore Postol

Uh, here's that radar receiver next to a pretty cute dog.

#Theodore Postol

You see, it's very small.

#Theodore Postol

Um, you get it in a pizza box. So if someone's ordering pizza boxes around you, you'd better watch out—they may not be getting pizzas but, uh, Starlink transceivers. If you want to see what this thing looks like, from the top that's what it looks like, and from the bottom you can see there are attachments. You just pull the attachment off—that's the link for the power, which is maybe about 25 or 30 watts. A battery can easily provide that, or you can draw it from an engine in a drone. And, you know, it basically allows you to have a TV camera on the drone. So here's an example of a drone that has a TV camera on it.

Now, the TV camera is no use unless you can transmit the signal up into space to a Starlink satellite. The Starlink satellite sends the data through a laser link to other satellites. That laser link eventually delivers the signal to someone on the ground who can see what's happening. And as the drone homes in on the target, they can send commands to the drone to give it, you know, perfect precision. So now, let's not even bother with this. So, if you want to see what one of these drones can do in terms of damage, it's not nearly as powerful as a ballistic missile warhead—it's maybe 50 to 100 kilograms. But that's still a lot of damage if you can point it directly at objects.

And so here are examples of damage done by drones. It's not something you can just ignore. If you were in a supposedly safe apartment on the second floor, you'd probably be killed when it collapses. I think this footage is actually from Ukraine, but the point is it could just as well be Israel. A safe room is not adequate—even against drones, safe rooms aren't necessarily enough. You really want to go to a basement shelter, where the walls, ceilings, and structure aren't going to collapse on you. So if you're sheltering in place—and "in place" means a basement or some strong, fortified shelter—that's going to disrupt your life in a very major way.

#Glenn

Here's an apartment building that was hit by a drone.

#Theodore Postol

All right. So how have these drones been used more effectively? And by "more effectively," I mean they've been destroying radars. Those radars are really important—the radars are the eyes and ears of a defense system. If you don't have eyes and ears, you can't intercept anything. When I...

#Theodore Postol

I'm attacking your country.

#Theodore Postol

The first thing I want to do is destroy the radars. I don't even care about the interceptors—although it turns out we're running out of interceptors too. But I don't care about them, because if you don't have a radar to find and track the adversary, you can't do anything. So, what happens next is this: here's an example of what happened in Bahrain. You can see there were two radars. These are almost certainly air defense radars, not missile defense radars—they're too small or too specialized. They're in radomes, and you can see both of them were destroyed.

I don't know whether this happened on February 28th or March 2nd or 3rd, but it happened very shortly after the war began. So here's an example. Again, I want your audience to understand what I understood and when I understood it, because I don't claim to have any kind of visionary grasp of the situation. When I saw this, I said, "These guys have got the problem under control." It's not obvious that they would have the ability to home in—although there was evidence they could do that earlier—but I wasn't sure they had it. And it's not obvious that they could have the precision that they have.

But this demonstrated it. Once they show that they have this precision, the problem is only getting the data—where are these radars? Well, I know where those radars are because I have a satellite from China or Russia giving me detailed location information. So when that drone comes in, it knows

exactly where it is, and it knows when its direction is looking this way. It's going to see this radar dome as soon as it starts scanning. So it's not a big problem—it's not searching everywhere. It's got the target in view, so all it has to do is make very minor adjustments to hit it. And we can see it was totally successful.

Here's an example of larger warheads, or maybe multiple drones, hitting a facility. My guess is that it's multiple drones hitting these buildings. But, you know, the death of a thousand cuts is still a death. And remember the drones—let's say there were three or four used there—you're talking about a hundred thousand dollars' worth of drones. A ballistic missile is going to cost you a couple of million dollars. You got these things? If there's no air defense, then there's no way to shoot down the drone. That's the big deal. Once the air defenses are destroyed, you're in very big trouble. Here's an example of a THAAD radar that was destroyed.

I looked all over and finally found the photograph. This radar is a masterpiece of modern radar technology. You can buy it for the bargain price of $500 million. Right. A man standing next to it would look so tall—so it's actually a very small radar. It can detect the launch of a ballistic missile from Iran at a range of 1,000 kilometers. So this is an incredibly capable system. The power it can generate, the low-noise capability of its amplifier system—it's extraordinary. They took it out with a $30,000 drone. And if we look at what probably happened, it's hard to tell exactly what's what here, but it looks like the attack took out some ancillary equipment. For example, behind this, you can see another structure.

That's probably the generator system for the radar. It's got megawatts of power to run this thing. So here is a billion-dollar radar. This is what's called an ultra-high-frequency radar. It's in Qatar. I won't have time to go into all the details, but this radar was critical because it cues the THAAD radars. This radar is bigger, has a much longer range capability, and can search much larger areas of sky very quickly. So what it does is scan a large area of sky, and when it detects something, it tells the THAAD: you can only search a small area of sky—look here, and here, and here.

So when I lose that radar, all of a sudden these THAAD radars have to search large areas of the sky. They become much less capable. They don't necessarily disappear, but they can only search at shorter range. If they can only search at shorter range because they have to drop their range to search, then I have less warning. And what we're now getting reports of in Israel is that attacks occur and people sometimes don't even receive a warning. People were reporting that they were getting only one or two minutes of warning. I can tell you where that's coming from—that's coming from the Green Pine radars that are associated with the Israeli Arrow missile defense system.

Those radars should be able to see incoming ballistic missiles at about 200 kilometers range, which gives roughly two minutes of warning. Now, if those radars are taken out—and I've heard some reports that a Green Pine radar, or maybe several of them, have been damaged—you have no warning. A typical air defense radar is not going to be able to see these things coming in. Even a Patriot radar might have a range of maybe 100 kilometers, so it could spot incoming objects only 20

or 30 seconds before they arrive, because the range just isn't adequate. And the Patriot radars, of course, are also under attack.

#Glenn

So life is—this is just a...

#Theodore Postol

You can see that this face has been destroyed. There are two other faces—they didn't even bother with those.

#Glenn

Why bother attacking them? They're looking in the wrong direction. Here's an actual drone attack.

#Theodore Postol

This is on the second of the two radars you saw in the other picture. Here's the drone—it's a delta-wing drone, and it's coming in. If you watch the whole video, you can see it was at a fairly high altitude at a distance, then it came in, getting larger and larger, and started diving. My guess is it was flying at very low altitude. None of these radars could see at low altitude. There were probably birds, ships, even small waves creating what's called clutter. And this drone wasn't seen until it began to climb to higher altitude. Once it climbed, you had maybe a minute. You can't launch an interceptor in a minute—you just don't have time. You have to track this thing.

#Theodore Postol

So here's the drone coming in.

#Theodore Postol

And, of course—bang. You can actually see a bit of light here because this is the last frame as the drone struck the center. And here's the explosion. Very, very severe damage was done in this case. It doesn't matter how severe—the radar is no longer functioning. Here's an example of a defense system that was mounted near, or maybe on, the American embassy in Baghdad. It's a small system, basically a gun-like setup for shooting at easy targets like a drone. And the drone just came in and hit it. So now the system is—well, unless you have others of these systems—you're not defended. I'm not going to talk too much about how these systems work because it's... well, the key technology we're left with is satellites in space. Those technologies are still available.

Basically, the way they work is they detect the rocket plume. Once the rocket motor shuts off, you can't see the missile anymore—you're only seeing the plume against the bright background of the

Earth. These systems are remarkably capable; they can see through clouds because they operate at wavelengths that penetrate them. You can't actually see through the clouds yourself—they refract and scatter the signal, like looking through frosted glass. But in the infrared, you can see the missile as it rises above, so even with cloud cover you can tell a launch has occurred. It's a very good warning system, but it doesn't provide tracking data. So I might know there's a launch from Iran, but I can't tell where it's going.

I can roughly tell it's going toward Israel. I have enough precision data—it's very imprecise, but I can tell if it's going south, west, or east. Not much better than that, but enough. If it's going south, it's going toward Israel. I don't know where in Israel. I don't know if it's going to hit Haifa, Beersheba, or Dimona—you know, Tel Aviv. So what do I do? I have no choice but to issue a warning to the whole country. Well, if I issue a warning to the whole country, everybody's getting out of bed and going to shelters. This has a tremendous psychological impact over time. You know, spend a few nights getting up three or four times a night and see how you feel about it. So I won't go into the satellite details. The effectiveness of these drones is certainly going to increase over time.

The Royal United Services Institute just came out a few days ago with a very interesting study. They projected how soon, based on their estimates of interceptor consumption, the different defensive and offensive systems would be affected. It's a bigger study than this. What I did was take one of their tables—which was much longer—and extract only the Israeli defensive systems, because we're talking about the defense of Israel at the moment, and the pressure that's going to be on the Israeli government from these attacks. What they're saying—it's their estimate, so we can't say for sure—is that, at the rate Arrow interceptors are being depleted, Israel is going to run out of interceptors by the 27th of March. Who knows if they're already out or not.

#Glenn

And in early April, David's Sling.

#Theodore Postol

Of course, in my view, neither of these systems matters much, because they're not intercepting much anyway against ballistic missiles. The THAAD system isn't even operating—the THAAD radars have already been destroyed. So I don't know why they give THAAD 18 days before depletion, because it's not functioning.

#Glenn

THAAD no longer exists.

#Theodore Postol

Iron Dome still works to some extent against drones, but it's useless against ballistic missiles. So the ballistic missiles are coming in essentially unhindered. Against drones, the Iron Domes may or may not be effective. In fact, I had a conversation with a very dear friend of mine—an Israeli—and I asked him, "Why the hell didn't the Israeli military put the Iron Dome interceptors on the air defense systems? They have to know they can't shoot down ballistic missiles. Defend your air defense assets—the ones that are going to be attacked by drones." And he said to me, "They just didn't think." I mean, this guy is one of the smartest people I know—brilliant, very decent, incidentally. He' s against the government.

But, you know, he's clued into the system because he's an active soldier. And he says, you know, they didn't think. They just weren't thinking. Then they have air-to-air missiles—well, you know, air-to-air missiles are almost useless. An airplane can only stay airborne for a certain amount of time, while drones can come at any time. You still have to find the drone, so you need a radar system to cue the airplane. So you really don't have much in the way of capability. I'm not going to talk about the Baidu system for the moment, if you don't mind. But what these air defense systems do need are surveillance and tracking capabilities. And that's what the Ukrainians are supposedly bringing to the game. You know, they've been talking.

I think it's unlikely that the Ukrainian defenses are going to have any utility at all. And the reason is, you don't have air defense radars. Now, what you can use are things like acoustic detection. The drones are noisy. So here's an example: this is a street detector. You don't have the benefit of American society, where we have gunshots on our streets routinely—you're just too civilized over there. But here are three microphones, and by using time delay, or time difference of arrival, I can use an array like this hanging from a pole to tell the direction from which a gunshot is coming. Because the gunshot is very distinct, I can measure the time at which the impulse occurred, the time difference, and then triangulate its location.

So if I have several of these on street poles in your favorite neighborhoods, I can tell where gunshots occur, and I can direct the police to areas where things are happening. This is not a new idea. Just to give you a sense, here's what was done during World War I. These are air defense acoustic sensors, and they were used to look for airplanes, which, of course, made a fair amount of noise. These are the kinds of systems you can now build. There are variants of these systems already in existence, but that's about the best you'll be able to do against these drones. And the way sound propagates through the air makes it extremely difficult to track them, even if you can occasionally pick them up. So basically, here's a good example of one of these systems.

#Glenn

This is...

#Theodore Postol

And you can build an electronic version of this with soldiers on the ground. I highly recommend it—this is what you want to give your soldiers, because they're being killed by these drones all over the place.