

MY WEIRD PROMPTS

Podcast Transcript

EPISODE #295

The 40,000-Foot Ceiling: Why Planes Stop Climbing

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EPISODE SYNOPSIS

Have you ever wondered why commercial flights seem to plateau just above the clouds? In this episode, Herman and Corn dive into the complex world of aviation physics to explain why 40,000 feet is the ultimate "sweet spot" for modern travel. From the terrifying aerodynamics of the "coffin corner" to the structural limits of the Airbus A380, they explore the trade-offs between fuel efficiency, passenger safety, and the harsh reality of thin air. They also look at high-flying outliers like the U-2 spy plane and the future of supersonic travel with startups like Boom Overture. It's a deep dive into the invisible walls of the sky and the engineering compromises that keep us safely in the air.

DANIEL'S PROMPT

Daniel

We've talked about aviation and spy planes that cruise at high altitudes, but in commercial aviation, the cruising altitude tends to be around 30,000 to 40,000 feet. Concorde used to fly higher, but there hasn't been much of a push for that in modern commercial aviation, presumably for fuel economy reasons. Why has the ceiling for commercial aviation capped out at about 40,000 feet? Are there any outliers in regular service today that go higher? What is the actual operational limit of a plane like the Airbus A380, and are there plans to develop planes that will push the envelope higher?

TRANSCRIPT

Corn

Hey everyone, welcome back to My Weird Prompts. I am Corn, and I am sitting here in our living room in Jerusalem with my brother.

Herman

Herman Poppleberry, at your service. It is a beautiful day to talk about things that fly very, very high in the sky.

Corn

It really is. Our housemate Daniel sent us a voice note earlier today that got us both digging through our old aviation manuals. He was asking about cruising altitudes. Specifically, why does it feel like commercial aviation has just... stopped at forty thousand feet?

Herman

It is a great question because it feels like a plateau, right? We had this rapid climb in technology from the Wright brothers to the first jets, and then we hit the nineteen sixties and seventies and just kind of stayed there. Aside from the Concorde, which was always the exception, we have been stuck in that thirty thousand to forty-two thousand foot band for decades.

Corn

Exactly. Daniel was wondering if it is just fuel economy or if there is something more fundamental keeping us down. And he also wanted to know about the outliers. Like, what is the actual limit for something like the massive Airbus A-three-eighty?

Herman

Well, I think to understand the ceiling, we have to understand the sweet spot. Aviation is always a trade-off between physics, economics, and safety. If you go higher, the air is thinner, which means less drag. Less drag means you can go faster with less fuel. That sounds like a win-win, right?

Corn

On paper, yeah. If I am an airline executive, I want to fly as high as possible to save on that massive fuel bill. But clearly, there is a point of diminishing returns.

Herman

There is a very literal point of diminishing returns called the coffin corner. I love that name, even though it sounds terrifying. In aerodynamics, it is technically known as the aerodynamic ceiling. As you go higher, the air gets thinner. To stay in the air, you have to fly faster to generate enough lift. But as you fly faster, you get closer to the speed of sound.

Corn

Right, and most commercial airliners are not designed to go supersonic. Their wings are optimized for subsonic flight.

Herman

Exactly. So you have a minimum speed you must maintain to keep from stalling because the air is so thin. But as you go higher, the speed of sound actually decreases because the air is colder. Eventually, your stall speed and your maximum speed—the speed where you start hitting Mach effects that could tear the plane apart—meet at a single point. That is the coffin corner. If you go any higher, you literally have no margin for error. If you slow down, you stall. If you speed up, you hit structural limits.

Corn

So for a standard Boeing seven-three-seven or Airbus A-three-twenty, that corner starts getting uncomfortably close once you pass forty thousand feet. But what about the engines themselves? I mean, don't they also struggle when the air gets that thin?

Herman

They do. Modern commercial jets use high-bypass turbofans. These engines are incredible pieces of engineering, but they need a lot of air. They work by moving a massive volume of air around the engine core. When you get up to forty-five thousand or fifty thousand feet, there just isn't enough oxygen or enough air density for those big fans to work efficiently. You would need much larger, much heavier engines to get the same thrust, which then ruins your fuel economy.

Corn

So it is a double whammy. You lose lift and you lose engine efficiency. But I remember we talked about the U-two spy plane back in another episode. That thing cruises at over seventy thousand feet. How does it manage that if the physics are so punishing?

Herman

The U-two is basically a jet-powered glider. It has massive, long wings to catch every bit of lift possible in that thin air. But it is notoriously difficult to fly at that altitude. The pilots used to talk about having only a five-knot window between stalling and overspeeding. That is fine for a military pilot in a specialized suit, but you cannot run a commercial airline with three hundred passengers on board with a five-knot margin of error. One little gust of wind or a slight pilot error and you are in a high-altitude stall.

Corn

That makes total sense. We have to prioritize safety and stability over the marginal fuel gains of going ten thousand feet higher. But Daniel also asked about the outliers. Are there any commercial planes today that actually push past that forty-thousand-foot ceiling regularly?

Herman

There are, but they aren't the big ones you usually fly on. Business jets are the real high-flyers of the commercial world. If you look at something like a Gulfstream G-six-fifty or the new Bombardier Global eight thousand, which just entered full service recently, those planes have a service ceiling of fifty-one thousand feet.

Corn

Fifty-one thousand? That is significantly higher than a standard flight from London to New York. Why do the small jets get to go that high?

Herman

It is partly because they have a much higher power-to-weight ratio. They are small, light, and have very powerful engines for their size. But the real reason is traffic. The thirty thousand to forty thousand foot range is crowded. It is like the highway at rush hour. If you can fly at fifty thousand feet, you have the whole sky to yourself. You can take more direct routes, you don't have to deal with the wake turbulence of other planes, and you are far above almost all weather.

Corn

I imagine the passengers paying for a Gulfstream also appreciate the smoother ride. But let's talk about the big boy Daniel mentioned. The Airbus A-three-eighty. It is the largest passenger plane ever built. What is its actual limit?

Herman

The official service ceiling for the Airbus A-three-eighty is forty-three thousand one hundred feet. Most of the time, they cruise between thirty-five thousand and forty-one thousand feet.

Corn

Why forty-three thousand one hundred? That seems like such a specific number.

Herman

It usually comes down to the pressurization limits of the fuselage and emergency safety protocols. This is a huge factor that people often forget. The higher you go, the greater the pressure difference between the inside of the cabin and the outside air. To keep passengers comfortable at forty-three thousand feet, the plane's structure has to be incredibly strong to keep from literally popping like a balloon. Also, if the cabin decompresses at that height, the emergency oxygen systems for passengers—those little masks that drop down—actually struggle to provide enough oxygen because they rely on mixing a bit of outside air in. Above forty-three thousand feet, the air is just too thin for those systems to work safely for three hundred people.

Corn

And that strength adds weight.

Herman

Exactly. If you wanted to certify the A-three-eighty to fly at fifty thousand feet, you would have to reinforce the entire fuselage. That would make the plane so heavy that it wouldn't be able to carry enough fuel or passengers to be profitable. It is all a circle of engineering compromises.

Corn

It is interesting because we discussed the Israeli logistics paradox in episode two eighty-nine, about how weight and efficiency dictate everything in shipping. It is the same here, just in three dimensions. Every pound of aluminum you add to strengthen the cabin against high-altitude pressure is a pound of cargo you can't carry.

Herman

Precisely. And there is another safety factor called the time of useful consciousness. If you are at forty thousand feet and the cabin suddenly loses pressure, you have about fifteen to thirty seconds to get your oxygen mask on before you pass out. If you are at fifty thousand feet, that time drops to maybe nine or ten seconds. It is almost instantaneous. For a commercial airliner with hundreds of people, the Federal Aviation Administration and other regulators are very wary of pushing those limits.

Corn

Wow. Ten seconds. That really puts the safety demonstrations into perspective. But let's look at the history for a second. Daniel mentioned the Concorde. That was the big outlier. It used to fly at sixty thousand feet, right?

Herman

It did. Sixty thousand feet is breathtaking. At that height, you can actually see the curvature of the Earth and the sky above you starts to turn a very dark, deep navy blue, almost black. The Concorde could do that because it was supersonic. It didn't rely on high-bypass fans; it used turbojets with afterburners. It was basically a fighter jet with a luxury cabin.

Corn

But it was also a fuel hog. I mean, that is ultimately why it failed, right? The economics just didn't work.

Herman

That and the noise. But the Concorde also faced a unique problem at sixty thousand feet: cosmic radiation and ozone. The higher you go, the less atmosphere there is to protect you from solar radiation. Concorde actually had a radiation meter on the flight deck. If a solar flare happened, they would sometimes have to descend to lower altitudes to protect the passengers.

Corn

I never thought about that. So there is a literal health limit to how high we should be flying regularly.

Herman

There is. Even at thirty-five thousand feet, frequent flyers and flight crews receive more radiation than the general population. If we started cruising at sixty thousand feet regularly, we would have to rethink the shielding on planes, which, again, adds more weight.

Corn

So, we have the coffin corner, engine efficiency, structural weight, safety margins for depressurization, and radiation. It sounds like forty thousand feet isn't just a random number. It is a very hard physical and economic wall.

Herman

It really is. It is the sweet spot where the air is thin enough to be efficient, but thick enough to support the wings and feed the engines, while the pressure isn't so high that the plane needs to be built like a tank.

Corn

But Daniel also asked about the future. Are there plans to push this envelope? I have been reading about these new supersonic startups like Boom Overture. Are they going to go higher?

Herman

They have to. If you are going to fly supersonic, you want to be in the thinnest air possible to minimize the sonic boom and the heat from friction. Boom Overture is aiming for a cruising altitude of about sixty thousand feet, very similar to the Concorde. They have been making great progress with their XB-one demonstrator flights over the last couple of years, proving that modern materials can handle those stresses better than the tech from the seventies.

Corn

How are they planning to solve the fuel efficiency problem that killed the Concorde?

Herman

Better materials and much better engines. We have made huge leaps in carbon fiber composites since the nineteen seventies. A lighter plane needs less lift, which means it can fly higher more easily. And modern computer modeling allows them to shape the wings and the fuselage to handle those high-altitude Mach effects much more efficiently.

Corn

It is funny, we touched on aviation security and the future of flight in episode two seventy-three. It seems like we keep coming back to this idea that the next big leap isn't just about speed, but about where in the sky we are allowed to be.

Herman

Right. And there is also the hypersonic dream. There are companies and military projects looking at flying at Mach five or higher. To do that, you are looking at altitudes of nearly one hundred thousand feet. At that point, you aren't even really an airplane anymore. You are a sub-orbital vehicle. You are skipping along the top of the atmosphere.

Corn

That feels like a completely different category. You would probably need rocket engines or scramjets for that, right?

Herman

Exactly. A scramjet, or supersonic combustion ramjet, only works at extremely high speeds and very high altitudes. But that is years, maybe decades away from being a commercial reality. For the average traveler, for the next twenty years, forty thousand feet is likely where we are going to stay.

Corn

It is a bit disappointing in a way, isn't it? We have all this technology, but we are limited by the density of the air and the strength of aluminum.

Herman

I don't know if I find it disappointing. I think it is actually kind of beautiful. It is a perfect example of humanity finding the exact balance point with nature. We found the one slice of the atmosphere where we can move hundreds of people at eight hundred kilometers per hour safely and affordably.

Corn

That is a very Herman Poppleberry way of looking at it. Turning a technical limitation into a poetic balance.

Herman

I try! But think about it. If we flew lower, we would be in the weather all the time. The turbulence would be constant, and the fuel cost would be double. If we flew higher, the risks of depressurization and radiation would make tickets ten times more expensive. We are living in the golden age of the troposphere.

Corn

Speaking of weather, I wanted to ask about the outliers in the other direction. Are there any commercial reasons to fly lower? I know some short-haul flights stay around twenty thousand feet.

Herman

Yeah, that is usually just because the flight is too short to make the climb worth it. It takes a huge amount of energy to push a hundred-ton plane up to forty thousand feet. If you are just flying from Jerusalem to Eilat, or from New York to Washington D.C., you would spend the entire flight climbing and then immediately have to descend. It is more efficient to just stay in the thicker air for thirty minutes.

Corn

That makes sense. It is like a car. You don't shift into fifth gear if you are just driving two blocks to the grocery store.

Herman

Exactly. But you know, there is one more outlier we should mention. There is a phenomenon called step climbing. Have you ever been on a long-haul flight, maybe ten hours in, and you feel the engines rev up and the plane climb for a few minutes?

Corn

Yeah, I always assumed we were just avoiding some turbulence.

Herman

Sometimes that is it, but often it is because the plane has burned off so much fuel that it is now significantly lighter than it was at takeoff. Because it is lighter, its optimal altitude has shifted. The wings can now support the plane in thinner air. So the pilots ask Air Traffic Control for permission to climb from thirty-four thousand to thirty-eight thousand feet. It is a way of chasing that sweet spot as the weight of the plane changes.

Corn

That is fascinating. So the ceiling isn't even a fixed number for a single flight. It is a moving target based on how much fuel is left in the tanks.

Herman

Precisely. For an Airbus A-three-eighty, which can carry over two hundred fifty thousand liters of fuel, the difference in weight between takeoff and landing is massive. It is like the weight of a whole other airplane has disappeared. So they might start the flight at thirty thousand feet because they are too heavy to go higher, and end the flight at forty-one thousand feet.

Corn

So Daniel's question about the limit of the A-three-eighty is actually two different answers. There is the structural limit, which is that forty-three thousand feet we talked about, but there is also a performance limit that changes every hour of the flight.

Herman

Right. If you tried to take a fully loaded A-three-eighty to forty thousand feet right after takeoff, you might actually stall it. It just doesn't have the lift yet.

Corn

This really highlights why pilots have to be so well-trained. It isn't just about steering; it is about managing this incredibly complex equation of weight, air density, and engine power in real-time.

Herman

And doing it while keeping three hundred people asleep in the back. It is a miracle of modern coordination.

Corn

It really is. You know, we have covered a lot of ground here. From the coffin corner to the radiation at sixty thousand feet. I think the big takeaway for me is that forty thousand feet isn't a failure of imagination. It is a victory of optimization.

Herman

I love that. A victory of optimization. We have carved out our little niche in the sky.

Corn

Before we wrap up this part of the discussion, I want to talk about the environmental side of this. We talked about fuel economy, but does altitude affect the actual impact of the emissions? I have heard that contrails and nitrogen oxides behave differently depending on how high you are.

Herman

Oh, that is a huge topic right now. Yes, it does. Contrails, those white lines you see behind planes, are essentially artificial clouds. At certain altitudes and humidity levels, they can trap heat in the atmosphere, contributing to global warming. There is actually research being done right now—Google and American Airlines have been testing this—to see if we can reduce the climate impact of aviation by slightly changing altitudes to avoid the layers of the atmosphere where contrails form.

Corn

So we might actually start flying lower or higher not for fuel, but for the planet?

Herman

Exactly. Sometimes flying two thousand feet lower might use one percent more fuel, but it could reduce the warming effect of the flight by fifty percent because it prevents a persistent contrail from forming. It is a whole new layer of the altitude equation that we are just beginning to understand in twenty-six.

Corn

That is a great point. It adds a whole new dimension to the discussion. It isn't just about the plane; it is about the atmosphere itself.

Herman

It always is. The atmosphere isn't just empty space. It is a fluid, a shield, and a very delicate chemical system.

Corn

Well, I think we have given Daniel a lot to chew on. From the physics of the coffin corner to the future of supersonic travel and the environmental impact of contrails.

Herman

It was a great prompt. I always love an excuse to talk about the A-three-eighty. It is a tragedy that they stopped making them, but I am glad some of them are still in the air, pushing right up against that forty-three thousand one hundred foot ceiling.

Corn

Yeah, it is a magnificent machine. And hey, for everyone listening, if you have been enjoying our deep dives into these weird prompts, please take a second to leave us a review on your podcast app or on Spotify. It really helps other curious people find the show.

Herman

It genuinely does. We see every one of them and we really appreciate it.

Corn

You can also find us at our website, myweirdprompts.com. We have the full archive there, including the episodes we mentioned today like the one on the Israeli logistics paradox and aviation security. There is also a contact form if you want to be like Daniel and send us a question that has been rattling around in your head.

Herman

Please do. No topic is too obscure for us. We live for the rabbit holes.

Corn

Definitely. Well, I think that is it for today. Thanks for joining us in our living room in Jerusalem.

Herman

This has been My Weird Prompts.

Corn

Until next time, keep asking the weird questions.

Herman

And keep looking up! Though maybe not past forty thousand feet unless you are in a Gulfstream.

Corn

Fair point. Goodbye, everyone!

Herman

Bye!