

TPWKY - Special Episode - Carl Zimmer

EW: Hi, I'm Erin Welsh and this is, this Podcast Will Kill You. Welcome to our newest episode in the TPWKY Book Club series where I get to chat with authors about their latest books in science and medicine. We have covered some great books so far this season and in past seasons. We've got plenty more excellent books to add to your to read list throughout the rest of this season. If you would like to see the full list of books that we've covered so far, as well as get a sneak peek of the books that will be featured later this season, head over to our website. This podcast will kill you.com, where you'll find a link to our bookshop.org affiliate account. Under the extras tab there, you'll see several TPWKY lists, including a book club list. Check back on that list regularly as I'll be updating it throughout the season. As always, we love getting your feedback. Whether that's a topic request, a suggestion for a book to feature in one of these episodes, or just any other thoughts you have, you can reach out to us via the contact us form on our website. Two last pieces of business before we get into the meat of the episode. Number one. Please rate, review, subscribe. You've heard us say it a million times, but it really does help us out. And number two, did you know that we are now posting full videos of many of our newest episodes on YouTube? Make sure you're subscribed to exactly write Media's YouTube channel so you don't miss an episode.

EW: By now, we are all fairly familiar with the concept of the microbiome, the community of microbes that live in a particular environment such as your gut or your skin, or maybe even inside your belly button. But how many of you have heard of the aero biome? We don't often think of the air as a medium teeming with microbial life, but as Carl Zimmer demonstrates in his latest book, airborne, the Hidden History of the Life We Breathe, that may be a critical oversight. In this book Club episode, award-winning science writer Carl Zimmer, joins me to discuss the long, neglected science of aerial life and the public health implications of this research. Many of you may recall the debate that sprung up seemingly out of nowhere in the first couple of years of the COVID pandemic when scientists couldn't seem to agree on whether the virus was transmitted via respiratory droplets or whether it was airborne. Why this distinction mattered and how the issue grew so contentious is just part of what Zimmer covers in Airborne. By placing this debate in the broader context of the history of aerial biology, he draws a line from the early days of germ theory to the pioneers of this emerging field from the height of bio warfare research, to a Washington State choir in the first weeks of the COVID Pandemic, linking together these disparate stories from the history of science, Zimmer presents a

revelatory picture of a scientific field you didn't know existed. How might the COVID pandemic have been different if we acknowledged the airborne potential of this virus earlier? What lessons can we draw from this oversight to apply to future outbreaks? What even lives in the air and why does it matter? We get into all of these questions and so many more. According to a quick Google search, we breathe about 22,000 breaths a day, breaths that we don't often think about. After this episode, you'll have a newfound respect for those breaths and the invisible airborne life all around us. I am very excited to be bringing this episode to you. So let's just take a quick break and get started.

EW: Carl, thank you so much for joining me today.

CZ: Thanks for having me.

EW: I have long been such a fan of your work and I really especially appreciated your latest book, *airborne*, which tells this really fascinating story of discovery, dismissal, and then ultimately kind of redemption in the end. To start us off, can you give us this big picture view of what the story that you explore in your book and what inspired you to write about it?

CZ: The story is about the air and how. Humanity has slowly come to appreciate the fact that it's alive. In other words, we, we really are walking around on the floor of a giant living ocean, um, that is filled with trillions upon trillions of organisms, thousands of different species. Um, a few of which we can see, you know, we can, you know, see a, see a goose flying overhead. But for the most part, it's totally invisible to us. And I guess I say the, the, the seed of of this book wa came about during the COVID pandemic. I was working at the New York Times and I, along with my colleagues, we were just trying to write as fast as we could about this totally new disease. And, you know, it, it was challenging because scientists themselves are trying to figure out. What exactly this disease is like. Uh, and one of the, the biggest stumbling points, one of the areas with the most debate and uncertainty was how it spreads. You had people telling you on TV to wipe down your groceries? I know I did. Mm-hmm. Um, and just, you know, keep your distance from people and you know you'll be fine. Then there were other, there were scientists, a small number of scientists at first who were saying, we think this might be Airborne World Earth organization, explicitly saying COVID is not airborne. And you know, it took a couple years. And then World Health Organization said, yeah, it's, it's airborne. Um, and I just thought, why was that so hard? Yeah. And, and the scientists themselves said to me like, well, you, you need to understand the history. Mm. One, one scientist said, you know, history set us up.

EW: Mm-hmm.

CZ: And so that led me down this path to, to discover this whole history of this science, of the air life in the air, which is called abiology.

EW: Yes. And as you discussed, you know, this, we're living underneath this ocean of all of these different organisms, this the aerobiome. What can you tell me about the aerobiome? Like who, who's up there, who's, who's floating around besides the geese that we see?

CZ: Um. Well, all sorts of things. The numbers are kind of crazy. I mean, I actually have to write them down and double check them because I'm like, did I get that right? Because they're just, uh, so I'll just give you one example. So, so insects, okay. So, you know, you've presumably seen, you know, some dragonflies flying by or maybe like a little swarm of mayflies or what have you. I mean, it's not unusual to see an insect in the air, but scientists have long suspected that that maybe large numbers of insects. Uh, flying long distances high in the air, thousands of feet in the air. The problem is you can't see them. And so, uh, scientists have invented technology, so barring radar and tuning it so that you can detect insects that are in large numbers that are way up in the air. Lo and behold, there are a lot of insects up there. And just to give you one example, uh, and there's a study that came out last year from China. Where just in a small region of China, they set up some radar systems to look up and over the course of a year, they recorded 9.4 trillion insects just in that place.

EW: I can't comprehend that. Yeah, yeah.

CZ: Right. No, these numbers are incomprehensible. Um, when you get to fungi, you, you walk around in, in, in a, in a forest trail, you see some mushrooms. You think you know what fungi are. But you really don't because they're everywhere. They're on everything, and they make a living by sending their spores into the air. I mean, they have adapted beautiful, like little cannons and other devices to get their spores up high enough so that the air can carry them away. Uh, and then they can go all the way up to the stratosphere. Fungi alone, they lift up about a trillion trillion. Spores every year.

EW: Again, I can't, I don't know what that means even. Right, right.

CZ: What do you do with that? Right. Uh uh, the, you know, there are back also bacteria, viruses, algae, lichen. And, and again, they, they probably comprise thousands, tens of thousands, maybe millions of species. We, we, you know,

we've barely begun to, to, to sample this habitat, this living habitat in the air called the aero biome.

EW: And I, I love how you describe it as an ecosystem of visitors. You know, this is a. For most of these species, this is a transitory period. If you take one, you know, cubic meter of air or something, wherever it is, how often that changes just within a second, within a, within a minute, within a day, it's completely different.

CZ: Yeah. Uh, it really depends, uh, for the individual organism. On how high they get up initially, you know, and what the air conditions are like when they get lofted into the air, the oceans, for example. Um, every time a wave breaks, there are lots of tiny droplets that. Rise up and, and some of them have bacteria, viruses, other marine organisms in them. Now if there's a enough of a breeze, they may get carried up and maybe they fall right back down after, you know, a few seconds. Um, but it is possible. For them to go up and then keep going up. And then eventually they get so high that they're just riding along long distance waves and they can actually go thousands of miles. Um, they, so they can be floating for, for days, you know, eventually they will land. I mean, it's just a, a matter of time, but because there are so many things coming up all the time, uh, it's always a very lively space. So like the clouds, for example, every cloud you look at is alive. It's, it's. Uh, got, you know, trillions of bacteria, something, something on the order of that. Uh, and you know, the bacteria, there are signs that they might be growing in the clouds. Uh, and, and that means that they are eating the clouds, right? So, you know, it's a different way to look at the sky and think about what's up there.

EW: Let's take a short break and when we get back, there's still so much to discuss.

EW: Welcome back everyone. I've been chatting with Carl Zimmer about his latest book, airborne, the Hidden History of The Life We Breathe. Let's get back into things. Which certain types of pathogens are more likely to be airborne? Do they share certain, you know, evolutionary history or drivers that might make them more likely to be airborne?

CZ: Um, that's a really good question, and I, I honestly, I don't think anybody has a good answer for you yet. Part of the, the challenge is it's hard to, to really carefully study airborne disease if you're talking particularly about pathogens.

EW: Mm-hmm.

CZ: Um, now certainly there are some very familiar pathogens that are clearly we, we know are airborne. That's my, by no means an exhaustive list. There probably are lots of other things that we are not appreciating fully yet. But just to give a couple examples, the biggest infectious disease killer by far is tuberculosis. Mm-hmm. It's caused by bacteria and it, those bacteria are totally airborne. In other words, um, they really can. Infect people in any other way other than people releasing little droplets that float out, not just, you know, maybe when they cough or sneeze, but. Even when they're just breathing

EW: mm-hmm.

CZ: They are gonna release, uh, droplets, some of which have tuberculosis bacteria in them. These are so good at being airborne that they actually manipulate us. They actually have adaptations to sort of essentially tickle our airway, to get us to cough more because that gets them out mm-hmm. And gets them out and gets them into the air. Propels them and then they can float off and infect someone else. And they make the droplets make their way into the very finest, uh, tips of our airway endings in the, in the lungs, the alveoli, and that's where the bacteria can grow. So tuberculosis kills over a million people a year. But you know, it's also a huge threat to, in terms of pathogens, it's also a huge threat to, um, our crops. So there are lots of diseases, particularly fungi that. Spread through the air, um, in part or entirely. I write a lot about, um, a kind of fungus called, uh, rust. Mm-hmm. Which can just, you know, it can endanger the food supply of whole countries, uh, if it really, uh, breaks out seriously. So, um, I'm just giving you two, two examples. Um, but there's a long list and, you know, is there something about air airborne pathogens that, you know, they all have in common? Uh, I would say they're rugged. In the sense that they can survive being floating around in the air. It's not easy to be a pathogen floating around out in the air. It's a, it's hard. Um, and there's some viruses that, um, don't last very long when they're exposed to air. Other viruses can last a really long time, and it might be that they sort of, they have adaptations that let them kind of use the chemicals inside of the, those droplets that come out of our lungs to sort of shield themselves from the, from the elements.

EW: This respiratory droplet versus airborne debate, you know, as, as you say, really took center stage during COVID, as we all remember, and kind of like you, it seemed baffling. Like why is this so controversial? Why is this something that we're so resistant to the idea of this being airborne? Especially when it seemed like, you know, this research had been going on for quite some time. And before we get into how that controversy started in the germ theory, miasma debate, what. Role did people think the air played in diseases before germ theory?

CZ: So if you go all the way back to, uh, say Hippocrates in the sort of the world of Western thought in particular, there was this idea that, well, obviously, you know, air is essential to us. Um, the Greeks considered it, you know, one of the main elements. We, obviously we need to breathe, but people couldn't really say why, and yet there was sort of a, a sinister, dark side to the atmosphere.

EW: Mm-hmm.

CZ: And you know, like, I mean, we've all, I suppose we've all had that experience walking around. It's, you know, today here. In Connecticut, it's a beautiful, sunny day. The air feels very lovely, but you know, there are also days where you're like, it smells really wrong. Or there's a, there's a weird light in the sky because there are wildfires someplace and you know, like the, the, the air is unpredictable. And so Greeks had this idea that Gods could visit curses on them, and, and they would call these miasmas and Hippocrates said. Sort of took that name and applied it to, what do you call it? Like corruptions of the air, so that if you breathe in that air, you would become sick. Mm-hmm. And there were different miasmas for different diseases and even different species could get different diseases 'cause they had their own miasmas, but they were all. Transformations of the air itself. It had a certain explanatory power. I mean, how was it that, you know, a bunch of people in the same town all would get the same disease around the same time? You can imagine. Well, uh, you know, a breeze just came through and people all inhaled it, and then they all. Keeled over, but that explained plague and, and, uh, you know, influenza and, you know, malaria, literally like bad air. Like that's what the, what the disease name means. And so it held on for a long, long time until people who had been discovering and studying microbes said, no, wait. We think these are responsible for these diseases. And it was a very. You know, it was a very long slog. I mean, to us, in hindsight, it seems obvious, but, you know, this was a, a battle that started around 1700 and lasted up until about 1900. So about 200 years of a long, drawn out fight.

EW: It seems like a blink of an eye, like Louis Pasteur came in and solved everything. But it's not, that's not what actually happened. But I, I think it's, it's so interesting to think about my asthma. An airborne transmission because they seem like almost the same thing. Right? Like how was that distinction made between microbes in the air causing disease and miasma causing disease?

CZ: There were a lot of confusing, seemingly contradictory pieces of evidence flying around. So Louis Pasteur, uh, who you mentioned, who was an architect of the germ theory disease, um, he actually was the first person to really clearly demonstrate that there were germs floating in the air. I mean, PE and people

said at the time when he was trying to persuade them of this, um, that this was crazy. One journalist said, this is. You, you wanna lead us into a world that's too fantastic to believe. I just love that line. Yeah. But he, he would go outside with flasks and he would catch bacteria. They would fall down the long neck of the flask and fall into sterile broth and start multiplying. And he did it in Paris streets. He did it in farmland around France, and he even climbed a glacier, which it was my favorite episode of this. And, and he actually initially said that he thought that lots of diseases were caused by these floating germs, by airborne germs.

EW: Mm.

CZ: But it didn't really go that way. Um, and the what happened instead was that a, as, as scientists definitively showed that the diseases were caused by germs. So for example, cholera not caused by miasma as the authorities claimed. Instead, it was caused by *Vibrio cholerae*, like one particular. Bacteria and that particular bacteria spread in water. So, so you have this, you have a waterborne disease, and then you have other bacteria that get into, uh, food and contaminate food. So you have foodborne diseases, you have, you know, bacteria that spread through sex, so sexually transmitted diseases and on and on and on. So it was like the germ theory disease was taking one disease after another out of the air.

EW: Ah, yeah.

CZ: And by the early 19 hundreds you had very prominent public health figure saying. We don't need to worry about the air anymore. Like this should be a relief. The air, you know, has been this specter of infections since Hippocrates. They literally said this and now you don't need to worry that. I think that really did keep people from really thinking very much about. Life in the air, and they also didn't have very good technology for really measuring and capturing life in the air. So that combination really did lead to a real, very strong consensus starting in the early 19 hundreds that has endured for over a century.

EW: Let's take a quick break here. We'll be back before you know it.

EW: Welcome back everyone. I'm here chatting with Carl Zimmer about his book *Airborne, the Hidden History of the Life We Breathe*. Let's get into some more questions. There were still some people that did remain intrigued by the concept of, you know, living things. That, that the *aero biome*. And, um, I, I wanna ask you about one of these, which is Fred Meyer. How did he end up turning, what was first a hobby into this bra, this whole branch of science?

CZ: Yeah, Fred, Fred Meyers, a really remarkable figure and is, is kind of typical for early abiology figures. Completely forgotten. So I, you know, I had to dig into archives to really figure out what I could about his life. So I had mentioned before about, you know, how. There are these pathogens of plants, particularly of crops. Uh, so Fred Meyer was a plant pathologist. He worked at the US Department of Agriculture ever since he was like 20 years old. Um, he was just his lifelong uh, uh, employer and he was part of this tradition of studying diseases that affected crop, like watermelon and wheat and so on. And they were very comfortable with the idea of airborne disease because there were these spectacular, uh, crop failures like, you know, the, the great Irish famine that was caused by potato blight. That in part was airborne that that organism, so by the early 19 hundreds plant pathologists, they knew that things moved through the air. They just didn't know how far they could go or high they could go. And so eventually, um, Fred Meyers says, like, I am gonna try to figure out how. High and far, I can go to catch them. Um, and this was something that his bosses did not want him to do, so he just did it on the side, on his off hours and it's kind of spectacular. He would, he would jump into planes, these open cockpit, cockpit, biplanes, and uh. You know, he'd have these Petri dishes stuck on the handle, wooden handles, and he would just basically be waving his arms around out of the, out of a flying plane in the clouds, and the pilots would just be totally baffled by him. But he'd bring these. Preach judicious back to his lab and he would grow stuff. He was catching things. So then he started looking for opportunities to send, uh, more sophisticated devices higher and farther. So for example, Charles and Ann Lindbergh, they flew in 1934 across, uh, the, the North Atlantic, over Greenland. And he talked them into trying to catch life. As well, and they did. And then there were these explorers who got into sort of metal spheres that were attached to giant balloons, and they went up to the stratosphere. And so they took along with them probes at Meyer, had to see if life could survive up in the stratosphere. And then on a second voyage, they actually were able to catch stuff up there in the stratosphere. So what's really kind of unbelievable to me is that by 1937. Meyer had done, assembled so much dazzling work that he was able to talk to government into creating a whole new service, uh, in than the government. A kind of a, a centralized lab. For life in the air, and he was gonna head it. He coined the, the, the word for the science that they were gonna do abiology. He came up with that word in 1937 with this plan and everything was looking great. And then he went on his, you know, sort of maiden voyage across the Pacific in search of, uh, in search of life and was never heard from again. So, uh, it feels sometimes writing about these people, there's this, there's a certain curse that hangs over abiology.

EW: I mean, I was shocked when that was like the, the twist in the story, but then also it did feel like fitting in a way. Like, of course this, like, there's more things, like you said, befall these people that c you know, can't quite get their

ideas and their evidence to take hold in the public. I, I think in the public facing side of science, but as you talk about the military side of things, this really did gain hold. There was more interest in abiology and the potential of air as a, you know, way to transmit disease and how to protect ourselves from that. And I think it's interesting to think about these two sort of lenses through which people viewed abiology. You have, you know, Fred Meyer on the one hand who's just interested in the rich tapestry of life in the air. Then you have more of the US government interest at the time, um, in part shaped by global politics where it's like, but what about bio weapons? What about biodefense? Um, and how did that, how did that branch kind of grow more or gain more interest, uh, than Meyer's side?

CZ: Yeah. Uh, when World War ii. Begins and then the United States is starting to prepare to enter. There was, uh, a serious concern that, you know, that Nazi Germany might be developing biological weapons that it might use in battle. I mean, it never have never been done before, but there was this great fear for decades. There have been a fear that someone might somehow deploy these, these deadly germs against soldiers or, or even civilians. So the US government actually started to reach out to these aero biologists. They would say, well, what do you think? What do you think are the, what do you think are the risks that we face? And um, so there was one. Aero biologists, uh, named Ellen Stackman, who wrote a very long memo, based a lot on the work that he and Fred Meyer and others had been doing, saying, yes, we could be attacked and here's what could happen. So I mentioned stem rust. So he said, you could imagine someone dropping a stem rusts bomb over our farms and wiping out our food supply. And you know, they, someone like Stackman who had, you know, been involved in World War, I could see like what happens when an army loses a food supply. 'cause Germany actually had its own potato blight and you know, this airborne disease that was devastating. To its food supply and that may have really tipped the balance of the war. So he said, we need to be aware of that. We need to have like plant pathologists looking out for attack and so on. But then it's quite amazing, like in writing is like we have to explore developing our own weapons. It would be remiss of us not to, it would be irresponsible for us not to start building our own arsenal. You know, it's kind of like the nuclear sort of logic. Like, well, if they're gonna be building him, well, we should too, as defense. And he had this, he said, here, here's how you could like go after Japan. You know, they. Have these rubber plantations, uh, for their tires, for their vehicles. Well, here's a microbe you could drop on their, their rubber plantations and wipe those out. He, he really thought a lot about this. And there were other aero biologists, William and Mildred Wells, a husband and wife team in the, who in the 1930s had been showing how people can spread diseases to each other. Through the air, and William Wells in particular had developed all sorts of really elegant devices to demonstrate how germs can

float in the air and, and also then to sort of measure how much you would need an animal to inhale to, to die to. The military, you know, at Camp Dietrich, they started building very similar devices. They took secretly without his, his awareness, they secretly started building these devices. And so that to figure out, well, how, instead of saying like, well, how do we understand these airborne diseases to protect people? How do we build better weapons? Like what, what's the minimum dose we need of anthrax? In the air to kill these mice. Right? And they did all this research in a giant building, literally called the Abiology Building. And, you know, the United States, the Soviet Union, um, and other countries, you know, would go on for decades to build huge stocks of biological weapons all firmly based on this new science of abiology.

EW: I mean, that is such a, an interesting aspect of this story where you have this. Acceptance of this idea of of how much the air can contribute to the spread of disease and, and the potential there. So we have that happening in the military side of things. What was happening in the more public facing side of science and abiology with the Wellises,

CZ: the wells is kind come into the world of abiology, kind of in a very. Peculiar sort of sideways manner. You know William Wells, he gets a bachelor's degree at MIT and Sanitation and he goes off to study typhoid and water and he gets into studying how it is it oysters actually can be really dangerous to eat because they filter all the bacteria that cause typhoid and you eat them raw and you die. And so I was trying to figure out how do I purify oysters and so on. And then he gets. Pulled into World War I, his job is to clean the water for the, for the soldiers. And so he's protecting, you know, American soldiers, uh, by providing clean water, but meanwhile they're dying of influenza. Mm-hmm. Uh, the, the not a waterborne disease. And it's not really clear how it's spreading, but I think that the seeds were planted there that he thought maybe this is airborne, despite that prevailing, you know, view that diseases are not airborne. So he comes back from the war. He, he's married Mildred Wells. She had gotten a medical degree, but she didn't practice medicine. She was raising their son who probably had some sort of psychiatric disorders. Just judging for medical files I was able to come across later. They have a good run in the twenties. He continues studying oysters. He gets famous for being the oyster godfather because he is figuring out how to breed oysters. And then the Great Depression comes and he's out of a job. Mildred. Somehow gets a job studying the epidemiology of polio, and she actually contributes to a book about it and she develops this idea that maybe polio is being spread through the air. She doesn't really develop it a lot in her writings, but it definitely influenced William Wells. He gets a job at Harvard teaching. He's terrible at it. Like just, I mean, I'm not making it up like you, like the, the dean of the School of Public Health says this is, this is something that Wells does

very badly like it's in writing. Um, and he in particular had a very difficult time with communication and just, he would get into arguments with people or long, long monologues. Um, Mildred was really fierce herself. They didn't make friends, put it this way. They're brilliant, but they alienated everybody. But at Harvard, they start to do some experiments that, that actually establish some of the basic ideas about airborne infection. In other words that, you know, when you breathe, you, uh, are releasing droplets, and some of them have, can have. Viruses or bacteria in them, they can float around for hours, maybe days in the right conditions, primarily in indoor spaces. And, um, and they even show that you can use ultraviolet light to kill them in the air. First. They do this with, uh, you know, with experiments on animals. But then when they moved to Philadelphia, they put ultraviolet lamps in a school. And in 1940 there's an outbreak of a disease we've been hearing a lot about recently, measles. At the time, there was no vaccine, so people were just very resigned to this terrible disease sweeping through. The Philadelphia school was substantially protected from this measles outbreak by these ultraviolet lamps. And you know, this was not stuff they did in secret. This was all heavily reported. People were very excited. They, they were like, wow. Like we, we, maybe we don't have to worry about. A new 1918 flu pandemic again, because we know that influenza's airborne and we have a way to protect ourselves from it. And yet nobody knows who the wells are these days. They just, they crashed into obscurity later on. So, you know, they might not have died in a plane crash like Fred Meyer, but they had their own crash. Uh, nevertheless.

EW: That's another kind of mysterious disappearance of its own. Like why this work that could have such profound implications for public health just kind of went away. And I'm curious to hear your thoughts on why that might be, you know, was was part of it. Any sort of taint that, like the, the military's interest in bio weapons, like was that part of it? You mentioned like antibiotics and vaccines and sort of the decline is like we're winning the war against infectious disease. What were some of the factors at play there?

CZ: Yeah, I think there are many of these factors that you mentioned that were all at play. I think that first of all. Epidemiology and trying to establish how diseases get from one person another. It is just difficult science. You, you need just the right opportunity and, and just the right conditions. Uh, you need to design your experiments just right to get really clear, compelling evidence. And, and so, you know, if you're talking about water. Like, let's say that sewage is flowing into a river and a city is getting, its drinking water supply just downstream, and there are a bunch of typhoid cases, like this literally happened in Lowell, Massachusetts in the 1890s. You can, you know, you can say like, Hey, let's stop getting our drinking water from there, shall we? And then lo and behold, the typhoid goes away. You know, like, so like there, there's a certain

sort of control to that, whereas the air is like, it's very hard to control. It's, it's elusive. Uh, and, and while there is a lot of life in the air, like it's, it's dilute.

EW: Mm-hmm.

CZ: You know, so you might be breathing, you know, 2000 times a day. Hundreds of thousands of times a month. But you know, it could just take one of those breaths for you to take in COVID or what have you, and boom, you've got an infection. So I'll just say it is hard to study. But, you know, on top of that, I think there was this consensus that it really built in and people were very reluctant to shift away from it.

EW: Mm-hmm.

CZ: So they just, they, they, they would say like, you need to really, really persuade me that, uh, diseases can be airborne. So they really refuse to look at. Good evidence and, uh, yeah, and I, and I think with the, with the biological warfare research, it's arguable that a lot of the best evidence that diseases are, in fact, airborne was being done in secrecy.

EW: Right.

CZ: It was being done, you know, as classified research, and some of that is still classified today. So instead of being an open science, a science that was really like focused on human health and, you know, and, and understanding ecosystems, a huge amount of effort in the air biology world went into building weapons. And so maybe people thought like, well, I suppose you could build a weapon. That could really create an airborne disease, but that you'd need human intervention as opposed to just nature. So there were a lot of different, a lot of different reasons. But what's remarkable is that even at the start of the COVID Pandemic, a lot of these assumptions and a lot of these misunderstandings and so on that you can trace back a century, we're still present in public health guidelines.

EW: Yeah.

CZ: Um, and how and how public health organizations. Dealt with the COVID pandemic, they were still in place.

EW: Right. And the, the message was respiratory droplet transmission.

CZ: Well, and that, just to clarify what they were talking about is like if someone is just a cough in your face and like a big old droplet, like goes boom and just hits you in the face, that's what they're talking about. Mm-hmm. Mm. Um, uh, whereas what someone like William Wells was talking about was saying. These tiny droplets that leave your nose and your mouth just as you breathe or talk or sing, and they can float. So those big droplets, they drop to the ground because they're so heavy. The thinking was. But in fact, there's all these tiny droplets, which can all themselves have COVID viruses or influenza viruses, or you know, tuberculosis bacteria in them. And you know, they can fill a room. If it's not well ventilated, they can fill a room like smoke. Think of those as viruses.

EW: And this is something that seemed to emerge during the first SARS epidemic in 2002, 2003, with this idea that there was evidence for potential airborne transmission of this virus. Why didn't we remember those lessons? Is it just more of the same thing, like just the stickiness of this idea that airborne transmission is a minor, plays a minor role in the spread of most respiratory pathogens? Like why? Why didn't we remember that?

CZ: Yeah, it would've been great if we had, so in the SARS epidemic, what's really remarkable is that, you know, as a, as this coronavirus, another coronavirus was emerging as a human disease. There were a few scientists who were getting dissatisfied with the standard view held that these must be spread by kind of, you know, contact or, or very short. Range droplets, they're like, no, this is like spreading, seems like it's spreading through, like buildings. Hmm. And they had to rediscover William and Mildred Wells. Like these people were like, huh, I keep seeing these references to William and, and Mildred Wells. Like, who are these people? Like, nobody knew who they were. And I talked to this one, uh, university of Hong Kong researcher, uh, named Gro Lee, who is just a, you know, now is like a world expert on airborne infection. And at the time. He was trying to help understand sars and he was like, Hmm, it looks like Wells has written a book. Wells wrote a book in 1955. Nobody in Hong Kong had it. And the only place he could find it was in one, uh, university library in the United States. And he asked them to, to photocopy it. This is like the early two thousands. And so they photocopied the whole book for him and they mailed it to him. And then so he gets this big stack of photocopied pages and he starts reading it and he says, ah, okay, now this is making sense. These are droplets. Okay. And it's crazy to think that he had to go to these measures to discover what had been widely reported and widely known in the 1930s, you know? Yeah. That, that he had to dig this back up. Um, and thank goodness he did, because then he did a lot of research on sars and. Really demonstrated how the way it was spreading through buildings and hospital wards and so on, it really did look like it was behaving like what William and Mildred Wells was

talking about, an airborne disease. The problem is, among other problems, is that sars. It's sort of a good news, bad news thing. SARS was able to be controlled and then eradicated.

EW: Mm.

CZ: Because all you needed to do is as soon as people showed symptoms, they, that's when they started becoming infectious. So you'd just be real careful about isolating people, you know, supporting them. Some of them died, you know, about 800 people died of, of SARS worldwide, but they reigned it in and there is no SARS anymore. So, so it wasn't something that you could be sort of studying year in, year out. It was just this one terrible moment in history. And, you know, there were these clues, you know, these studies that said, said like, Hey, maybe this is airborne, but I, yeah, I, I'd say that it didn't really penetrate. All the pandemic preparedness that that came afterwards was all based on this idea that it would not be truly airborne.

EW: That shift did eventually happen during the COVID pandemic. What came to a head to then finally change the tides to people realizing that airborne transmission is a real, not just a real possibility, but like at the forefront of what is maybe spreading a lot of these cases.

CZ: So there were people like Hugo Lee early in the pandemic in early 2020 who would say. You know, this seems to be spreading like an airborne disease. Mm-hmm. Uh, and they were just being emphatically ignored by public health officials or, you know, people who just are brushing them off, uh, or saying, no, no, there's the evidence says, says otherwise. Um, and so this group of people at first just a, you know, just a couple dozen experts, they got together and they're, they tried to, to change the world Health organization's view on this. WHO didn't budge, so then they, they went public. They started trying to like gin up support, but it really took like a whole string of, uh, outbreaks and studies on those outbreaks to really demonstrate it. I focus on one in particular that. Uh, struck, um, a, a choir in Washington state where, uh, on March 10th, 2020, about, uh, 60 people gathered together one night to sing, and they were being careful. They were doing everything they were supposed to be doing, and no one seemed to be sick. No one was coughing, but there wasn't an infected person who was breathing. And then, you know, over 50 people came down with COVID in the next few days. It took time, unfortunately, to sort of, to become aware of these outbreaks and then for these airborne advocates to say like, Hey, we're gonna investigate these as sort of cases of airborne spread. See if we can test this hypothesis.

EW: Mm-hmm.

CZ: And then eventually. Enough evidence emerged that satisfied a lot of people and then the consensus shifted. I mean, I wouldn't, I, you know, I'm, there are people who, who will still say like, no, I'm not convinced. But you know, I would say like that most certainly, most scientific societies that are relevant to this and so on have all agreed that it's airborne. But yeah, it took a long time.

EW: It did and it, it does, I think, beg the question of what could have been different if we had recognized this before COVID, I mean, not just before sars, but just at, at least before COVID,

CZ: if we had recognized it, there would be the, at least the opportunity to deal with the disease as an airborne. Disease. Mm-hmm. You know, that takes a lot. I think another reason for the slow take up of, of, you know, recognizing this disease as airborne is that it's simpler to deal with a disease that is just caused by a short range. Droplets or by contact. It is just, it's a simpler process. If it's all around you as like a smoke, then you gotta do different things. For one thing, we might have made sure, really sure that we had a real stockpile of protective equipment. Which we didn't. So, you know, people were just desperately reusing N95 masks, which is crazy. We could have invested in, um, ventilation systems in schools and other places. We could have had, uh, ultra light in places where ventilation wasn't a good solution. I mean, you know, the, these advocates of airborne uh, disease that they were saying in the summer of 2020, like, we can get kids back in school this fall. If we take airborne infection seriously, if every classroom has an, you know, a, at least an air purifier or something. But, you know, the ventilation of schools unfortunately is terrible. So I think across the board, a lot of lives would've been saved, uh, if we had immediately responded to COVID d, recognizing the possibility that it was airborne and really acting on that.

EW: Has this recognition that not only airborne transmission of COVID is a possibility, but just the recognition of Wells's work overall. The Wells's work has that kind of revitalized the field of Abiology.

CZ: Yes, it definitely has. And these scientists who felt like they were just shouting into the wind, forgive the pun, they uh, they really are trying to, to seize the moment. There are whole research centers being built to study airborne transmission, and they are trying to translate these findings into, into real, meaningful policy that can protect people. Not just from new diseases, but from present ones. Mm-hmm. Um, you know, um, measles, tuberculosis,

influenza, chickenpox, like, there are lots of diseases that can spread through the air, at least to some degree. What it hasn't led to has been real mandates, like there's no country anywhere yet that officially has standards in place. You know, like if you're gonna build a building, this is what you have to do to keep the air safe. It doesn't exist yet. If you walk into a building, um, you kind of expect that, you know, there are building standards about the rebar and the, and, and the materials that they're used. You know, you, you don't expect that they contain poisons that are going to walk through the air and kill you because there are standards.

EW: Mm-hmm. But

CZ: there are no standards yet for how to keep the air clear of pathogens. Um, they, they've, they've suggested mandates. No one's taken them up quite yet.

EW: It'll be interesting to see what the future holds in that regard as, as long as people are allowed to continue to do basic research on, um, on this sort of thing. But, um, yeah. Mm-hmm. Which is an

CZ: open question right now. It's an

EW: open question. Yeah. Well, I, I really enjoyed chatting with you about this. I, you're loved your book Airborne, everyone. Go check it out and, uh, thanks so much for taking the time to chat with me today.

CZ: Thanks. It's been a real pleasure.

EW: Huge thanks again to Carl Zimmer for taking the time to chat with me. This was such an eye-opening conversation. If you enjoyed today's episode and would like to learn more, check out our website. This podcast will kill you.com, where I'll post a link to where you can find Airborne, the hidden history of the life we breathe, as well as a link to Carl's website where you can find his other books. And don't forget. You can check out our website for all sorts of other cool things, including but not limited to transcripts, quarantining and placebo reader recipes, show notes and references for all of our episodes. Links to merch, our bookshop.org affiliate account, our Goodreads list, a firsthand account form, and music by Blood Mobile. Speaking of which, thank you to Blood Mobile for providing the music for this episode and all of our episodes. Thank you to Liana Sci and Tom Bry Fogel for our audio mixing. And thanks to you listeners for listening. I hope you liked this episode and are loving being part of the T-P-W-K-Y Book Club. A special thank you as always to our

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