

## **Sidedoor Season 3, Episode 16: The Feather Detective**

[INTRO MUSIC]

Haleema Shah: This is Sidedoor. A podcast from the Smithsonian with support from PRX. I'm Haleema Shah.

[MUSIC]

Haleema Shah: On October 4, 1960, at 5:39 pm, Eastern Airlines Flight 375 took off from Boston Logan Airport, bound for Philadelphia. Just six seconds after takeoff, the plane lurched, spun, and plummeted into the muddy shallows of Boston Harbor. 62 people died. In the hours and days following the crash, investigators scoured the wreckage for clues, trying to find a cause. And, in three of the plane's four engines, they found... bits of dark feather. Investigators had no idea what to do.

[MUSIC]

So... they boxed the evidence up and sent it to the only place they could think of: The Smithsonian. The head of the Fish and Wildlife lab asked one of his top bird experts to take a look. Her name... was Roxie Laybourne.

Carla Dove: He gave the case to Roxie because he knew that Roxie was an expert in these subtle plumage differences.

Haleema Shah: This is Carla Dove. Yes... her name is Dove and she works with birds.

Carla Dove: Um, yeah, my name is very appropriate.

Haleema Shah: She's heard that one before. Anyway... Dove is a research manager who works at the National Museum of Natural History, and she's kinda become the in-house Roxie historian.

Carla Dove: So, she was really into looking at the subtle differences in these birds and their plumages as she was skinning them and putting them away.

Haleema Shah: Roxie had skinned countless birds to prep them for preservation in the museum's collection. But now? She was being asked to solve a mystery: how do you take tiny bits of feather, and figure out which bird crashed a 110,000 pound plane into the ocean? Airline investigators needed to know what kind of bird downed their jet so they could try to stop it from happening again. Using a microscope, Roxie Laybourne examined the feathers of bird specimens in the Smithsonian's extensive collections, comparing them with the mystery feathers from Boston. Before long... she had her suspect.

Carla Dove: She determined that the birds were European starlings, which is a small bird, but they occur in huge flocks.

[MUSIC]

Haleema Shah: Starlings weigh about 3 ounces, and fly in these dense flocks called murmurations.

Carla Dove: It's like a school of fish in the air.

Haleema Shah: And, that day in 1960 -- this group of small birds took down an airliner.

Carla Dove: So, that's when Roxie really became totally into this forensics feather thing, is that she realized the practical application that these collections can provide, which was genius.

Haleema Shah: This time on Sidedoor, we'll hear how Roxie Laybourne took this "forensics feather thing" and pioneered an entirely new field of study: turning the Smithsonian's massive bird collection into a world-renowned forensics lab.

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Haleema Shah: Roxie Laybourne was a small woman -- just five foot three -- but she cast a huge shadow. She died in 2003. But, for the people who knew her best, "Roxie stories" are still fresh in their memories.

Carla Dove: There will never be another person like Roxie Laybourne on this earth...She had a laugh that echoed through these hallways.

Haleema Shah: Carla Dove spent 14 years learning from Roxie at the National Museum of Natural History's Forensic Feather Lab. Today, she and her colleague Marcie Heacker carry on Roxie's bird-related investigative work. And... when they talk about Roxie, it feels like you're listening in on a family reunion, where two siblings talk about a beloved aunt. I asked them about their favorite Roxie story -- the kind where they just think, "That's so Roxie." And their answer... might gross some people out. So, if you're squeamish about blood or just don't want to hear a story about a dead horse, maybe skip ahead two minutes.

[MUSIC]

Marcie Heacker: That was the first story that popped into my head

Haleema Shah: So, Roxie worked at the Smithsonian for 59 years. But, despite this, she never felt at home in D.C. She kept a big farm out in Virginia, about 30 miles from the city. Marcie Heacker tells us that story.

Marcie Heacker: She had horses out there on her property and one of them passed away. So in Roxie's practical way, she's like..you know...I'll just bury it myself. She hand digs a hole the size of a horse, which, you know.. and took quite a while. And... remember she's like pretty small woman.

Carla Dove: She never was very tall.

Marcie Heacker: No, not very tall; but, tough as nails.

Haleema Shah: Next, Roxie rolls her beloved, but very dead horse into the hole she's dug. Then... she realizes she has a problem. The hole (pause) is not big enough.

Marcie Heacker: So, the now rigid, rigor mortis legs of the horse were sticking straight up out of the hole... And this is very Roxie. This is like, okay, what am I going to do? Uh? And the most practical thing for her to do was to cut the legs off..... So, she did, she cut the legs off of it... Buried the horse. And, that horse is still on the property, I believe. And, that is a classic "Roxie story". Problem solved. She did.

Carla Dove: And... she loved the horse.

Marcie Heacker: Oh, she loved her animals.

Haleema Shah: So that's Roxie Laybourne... Smart. Practical. And not the slightest bit squeamish. Roxie started working at the Smithsonian, in the Fish and Wildlife Lab on June 6, 1944 as a taxidermist. It's an easy date to remember, because... it was D-Day.

NBC radio broadcast: This is the invasion of Hitler's Europe. The zero hour of the second front. (dip under) The men of General Dwight Eisenhower are leaving their landing barges, fighting their way up the beaches, into the fortress of Nazi Europe.

Haleema Shah: While the Allies stormed Normandy's beaches, Roxie began learning her lifelong craft: skinning birds and stuffing them for research and display in the museum. As she skinned these birds, she began to take notice of the very subtle differences in the feathers. And that goes way beyond the obvious. Roxie Laybourne is no longer with us. But after a bit of searching in the Smithsonian's Archives, we found some rare audio of her from 2001 discussing that very subject. So here's Roxie.

(R.Laybourne, interview, 2001)

Roxie Laybourne: You have to know breast feathers from back feathers. Underwing coverts from upper wing coverts and feathers around the legs, all that you must know. Learn... where the feathers come from. So, that way, you'll be able to identify the type of feathers you're dealing with.

Haleema Shah: When most people think about feathers, we think about color or size. But, Roxie could see much more than that. To her, a feather is full of details: their shape hints at their function, or its color might change from quill to tip. In 1957, Roxie's lab -- and her birds -- became part of the newly formed National Museum of Natural History, where it remains today. I wanted to see it first hand, so, Carla Dove and Marcie Heacker took me behind the scenes for a look around.

[Entrance sound]

Haleema Shah: Oh my goodness. Okay. Wow. What is this smell?

Carla Dove: What does it smell like? I don't smell anything.

Marcie Heacker: Haha. I don't either.

Carla Dove: It probably smells like an attic...It's probably just the smell of preserved things.

Haleema Shah: The collection is huge. There are 620,000 birds in the collection, making it the third largest in the world. There are 80 percent of all bird species represented. It was almost overwhelming to walk through rows of cabinets filled with stuffed birds -- some more than a century old. It'd be easy to get lost in there. Here's Carla.

Carla Dove: It's a specimen collected by Teddy Roosevelt right here.

Haleema Shah: Wow. What kind of bird is it?

Carla Dove: This is a fox sparrow, and this is from his childhood collection. Oyster Bay, New York is where it was collected. It's got the Roosevelt label on this side.

Haleema Shah: Is that his handwriting?

Carla Dove: That's his handwriting.

Haleema Shah: Wow.

Carla Dove: It was very good.

Haleema Shah: Very good. Nice, delicate cursive.

Carla Dove: He wasn't the greatest preparer.

Haleema Shah: Rather than gawking at presidential penmanship, the original point of this bird collection was to provide a place for scientists to study birds up close. But, Roxie took it in another direction. In her job, she skinned birds and stuffed them for future study, which is important to the museum. But, all the while, her brain absorbed every detail; she got to know each bird, feather by feather.

Carla Dove: You kind of have to have a photographic memory in a way to keep up with all of the variation in the birds.

Haleema Shah: It's also worth noting that, at the time, Roxie was one a few women who worked in a scientific capacity at the museum. Marcie Heacker has a story about that too...

Marcie Heacker: You know, sometimes, like, when we were doing the archives, I would kind of be interested to..there's a kind of leading her to go there.... You know? How did you feel about being one of the early women kind of working in an all men's field?

Haleema Shah: This is the most Roxie would say about that...

Roxie Laybourne: Do the work, keep your mouth shut, and they will respect you, no matter whether it's a man or woman... That was my attitude and that's why I got along as well as I did in a man's world back in those days.

[MUSIC]

Haleema Shah: Roxie was a tireless worker who regularly worked seven days a week. One gripe she had of working at the Smithsonian? They didn't let her work long enough.

Roxie Laybourne: Of course, back in those days, we were only allowed to stay at the museum until 10 o'clock at night, everybody had to clear out as far as regular staff were concerned. Of course, later they extended the time so you could stay 'til 12. You weren't encouraged to spend the night, but, occasionally, it happened.

Haleema Shah: And, it was Roxie's work ethic, combined with her attention to detail, that allowed her to identify the birds from that first big Starling Case back in Boston. And, that discovery made her famous... at least, to one very specific group.

Carla Dove: You know...That was a big turning point for Roxie because, then, the Smithsonian started getting requests for the data from engineers who were designing aircraft...not just engines, but, windshields and other parts of the aircraft. And, so, that is one of the qualifying factors now for certifying an engine is, is the bird weight. What is that optimal bird weight to design your engine for.

Haleema Shah: As in: engineers want to design airplanes to withstand strikes from large birds that are often hit by planes. For some planes, hitting a robin or sparrow is fine. But, if it were to hit an albatross... that is trouble. It also depends on where a bird hits a plane: their engines are particularly vulnerable to bird damage.

Carla Dove: So, she began getting requests and doing contract work for engine manufacturers and for the FAA and the military shortly after that.

Haleema Shah: After the Boston case, airports also started sending Roxie feathers and other bird bits, asking for her skills of deduction to figure out, “What bird did this plane hit?” And this interest in birds wasn’t just casual curiosity. Here’s Roxie:

Roxie Laybourne: It’s always nice if you know what birds are hanging around the airfield. You have to know the habits of birds. Forest birds are not apt to be hit by aircraft because they’re not around and in the way.

Haleema Shah: Planes hitting birds is a problem as old as aviation itself. The first recorded bird strike happened in 1905. The pilot? Orville Wright. But as the aviation industry grew, so did the problem of planes hitting birds. In 1930, planes owned by commercial airlines collectively flew nearly 400,000 miles. By 1960? They flew 10 million. Airlines couldn’t have planes crashing just as the industry was booming. As the 1960s wore on, requests for bird identifications began to flood Roxie’s office. And this gave Roxie the chance to breathe new life into this immense collection of dead birds. She used the samples to create a bird-strike solving method that could be replicated. But... Roxie says it wasn’t easy work.

Roxie Laybourne: Of course, in the beginning, it was what I called “going fishing”. You had your material, you didn’t have too much of an idea where you were going in the collection to match your feather material up with... It was quite a long process but you kept struggling along.

Haleema Shah: Once Roxie had it worked out, she taught her method to Carla Dove and Marcie Heacker, among others. She created what is known today as “The Roxie Method.”

Carla Dove: This is the classic method that we still teach students today.

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Haleema Shah: Here’s how it works. Step one: Look at all the physical evidence: feathers and bird parts. But, also, think about: What time of year is it? Where were the feathers collected?

Carla Dove: Roxie actually told me once, “You would never identify a tree with your nose on the bark. You have to step back and look at the whole picture.”

Haleema Shah: And, then, what was step two?

Carla Dove: Step two was to go for the whole feather material. This would be anything with color pattern if we would be lucky, would be an entire intact feather. If we needed to, we would wash material. Feathers are made of Keratin, similar to hair. They respond very well to just a good general hot water washing in a detergent and blowing them dry.

Haleema Shah: Next...Step three: This is where the science kinda kicks up a notch. Roxie taught Dove and Heacker to look at the feather's microstructure. If you look really closely at a feather, you'll see the thin hair-like pieces called barbs. The barbs hook to each other, creating a zipper effect. And, that's how feathers work, on every single bird.

Carla Dove: Beautiful, amazing evolutionary item. But, unfortunately for us, it all looks the same.

Haleema Shah: But... if you look at the short, fluffy tufts toward the feather's bottom, where it connects to the bird -- Roxie noticed that different birds have different fluffy down.

Carla Dove: It's called the plumulaceous down - that's a big word. And, basically that's just the fluffy down at the base or at the bottom of a feather. That's what we want.

Haleema Shah: So, in a case where Dove and Heacker get just a plain brown feather -- no stripes, no spots, nothing distinct about it...

Carla Dove: We would make a microscopic slide of the little fluffy part.

Haleema Shah: This is where that photographic memory kicks in.

Carla Dove: And, then, all of a sudden your head's kind of...you know...the Rolodex in your head's going; and, then, my gosh, plain brown goose. And, in Virginia in the summer, let's go look at Canada goose and then we'll go back out to the collections.

Haleema Shah: Obviously, it takes years to learn the birds this well. And, by this point, we've reached step four of the Roxie Method. Which is basically summed up as: trust your mind Rolodex.



Carla Dove: You know, you've looked at the material, you've looked at the incident, you have an idea, you've done microstructure. You've gone out into the collection and you start..like I said...putting all of these pieces of the puzzle together.

Haleema Shah: This is where having the collection really makes their job possible.

Carla Dove: It's really when you get down to two or three possibilities, it's using your expertise, your experience and being honest with yourself, with your confidence: are you willing to make a certain species call? To really confidently say, yes, this is this species of bird.

Haleema Shah: So, this is how Roxie Laybourne solved that Boston's starling strike of 1960. And, the Nebraska mallard strike at 23,000 feet. And the case of the loon that went through a plane's windshield, killing the pilot. And thousands of other cases.

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Haleema Shah: Coming up, Roxie's methods get an update -- and an assist from DNA analysis -- to solve one of the most perplexing plane strike cases in history: the case of the flying deer.

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Haleema Shah: Roxie Laybourne was a Smithsonian bird expert who became something of an aviation industry sensation in the 1960s and 70s when she invented what is today known as "forensic ornithology." It's basically the science of identifying birds that have hit airplanes, based on the scantest remains. If a four pound bird hits a jumbo jet flying at cruising speed, it will hit with a force of 14 tons. You might see a blue jay; but pilots see little blue grenades with wings. And sometimes? Planes hit much bigger animals....

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In January 2008, just north of Pensacola Florida -- a fighter jet hit something 1500 feet in the air. It made an emergency landing. And when a mechanic checked the plane, they sampled a greasy smear -- made of blood, fat, and microscopic bits of feather. This residual goo is what Carla Dove and her team likes to call... snarge. It was a term they invented in the lab.

Carla Dove: It's snarg-y stuff. So, I think, you know, it's kind of is a combination of snot and garbage. [Laughs]

Haleema Shah: Oey. It sounds pretty gross.

Carla Dove: It is gross. And it is. I mean that's the key word that everybody in the bird strike world knows now. And, so, snarge is basically tissue samples. It's..it might be fat, it might be blood, it might be a combination of, you know, when a bird smacks into an airplane, there's "ick".

Haleema Shah: Roxie says that sometimes... the "ick" isn't even all that obvious.

Roxie Laybourne: Sometimes the bird doesn't leave anything, but, they use the dark lamp and if they have organic material it shows up under this black light...

Carla Dove: If you can collect that and send it in, we may be able to get species levels identifications using DNA.

Haleema Shah: So, the Air Force mechanic swabbed a sample of the snot-garbage, and sent it to Carla Dove.

Haleema Shah: So, we send it over to the lab and it came back as white tail deer, which was surprising for us. I mean we, we weren't completely blown away because you can hit deer on takeoff and landing.

Haleema Shah: Carla thought: ok, must be a fluke.

Carla Dove: So, we sent the sample back again and again; and it came back three different times as white tailed deer. When we looked at the report closer....and this occurred, like, in the middle of January. We're like, what in the heck is going on here? We called the pilot or the airfield and we got some more information on the report. We wanted to be sure that the altitude on the report was correct.

Haleema Shah: Essentially: when you hit the deer, were you actually flying in the air? Or, did you hit something on Interstate 10 when you parked the jet at the Seven Eleven for snacks?

Carla Dove: And, the pilot confirmed, 'no, I was up in the air. Something hit my wing, knocked a big hole in my wing. It costs \$40,000 to repair. So I know I was up high when this happened."

Haleema Shah: And, then a thought occurred to Carla. Use the Roxie Method. Step three... Feather microstructure.

Carla Dove: We hadn't done that yet. We were depending on DNA. So we made a micro slide and we brought it in here to the microscope and we're poking around, looking around and we did find some deer hair in there, but we also found a tiny little feathered barbule.

Haleema Shah: A single, microscopic piece of feather that happened to stick to the plane...

Carla Dove: That matched up perfectly with a black vulture... So, we were able to solve that problem by knowing that vultures are scavengers. Right? And, so, the vulture was most likely feeding on a deer carcass. And was scared by the aircraft. So, there were no flying deer. There was a logical ending to that story.

[MUSIC]

Haleema Shah: And, this case of the flying deer slash vulture is proof that DNA evidence isn't infallible. Dove stresses that it's best used alongside Roxie's methods. It rarely replaces them entirely.

Carla Dove: We use Roxie's methods for microscopic identification, but we have also now expanded, so we do DNA identifications and we use our wonderful collections here at the Smithsonian to identify whole feathers from these bird strike remains.

Haleema Shah: In her day, Roxie didn't really trust DNA. She thought: "I have my methods... and they work!"

Carla Dove: Roxie knew about it in the beginning. She was not in favor of it because it was expensive. It required special laboratories. It, it was time consuming, but very quickly, DNA developed into becoming an affordable, reliable way of quickly doing tissue samples.

Haleema Shah: In her career, Roxie solved thousands of bird strike cases. By inventing the field of forensic ornithology, she also changed how we look at museum collections, showing that they can be used in ways that the earliest collectors never could have imagined....When did Roxie retire?

Carla Dove: When she died.

Marcie Heacker: She never did. She never did. She never did. That was never a word in her vocabulary, I don't think.

Haleema Shah: Did anyone ever tell her it's time to go on a vacation or take a break?

Carla Dove: Are you kidding?

Marcy Heacker: I think...It was probably suggested there towards the end, but, probably...promptly.. ignored. it's what kept her going. It really was her life. Swas still working cases right up to the end. Yeah.

Haleema Shah: When it came to her cases, Roxie was a forensic ornithologist, but she also saw herself as a teacher.

Roxie Laybourne: I had been given the opportunity to learn, and, to me, I feel that when you are given an opportunity to learn, why then you have a responsibility to share it with someone else... so that you can have them build on your knowledge and go farther forward than you could by yourself. It's like we're at the bottom of the ladder and each student we go a little higher -- we'll never get to the top, but we'll keep climbing.

Haleema Shah: Roxie worked right up until her death, at the age of 92. Today, Carla Dove and Marcie Hecker are solving a ton of cases: in 2018 alone, the lab identified nearly 11,000 birds that had been struck by planes..... and, like Roxie, they're passing their knowledge on to a new generation of forensic ornithologists.

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Haleema Shah: You've been listening to Sidedoor, a podcast from the Smithsonian with support from PRX. This week's story was part of the Smithsonian American Women's History Initiative. If you want to see some of the cute, but, very dead birds, and Teddy Roosevelt's handwriting on a bird he shot himself, check out our newsletter. You can subscribe at [si.edu/sidedoor](http://si.edu/sidedoor).

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make all the amazing work you hear about at the Smithsonian possible.....We're also supported, in part, by the Alfred P. Sloan Foundation, enhancing public understanding of science, technology, and economic performance. More information at Sloan DOT org.....Our podcast team is Justin O'Neill, Jason Orfanon, Lizzie Peabody, Jess Sadeq, Lara Koch, Laura Krantz and Greg Fisk. Extra support comes from John Barth and Genevieve Sponsler. Our show is mixed by Tarek Fouda. Our theme song and other episode music are by Breakmaster Cylinder. We wanted to share a special thanks to Emily Niekrasz and Pam Henson at the Smithsonian Archives. If you want to sponsor our show, please email sponsorship at prx dot org.

I'm your host Haleema Shah. Thanks for listening.

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