

AT: Welcome to the Infinite Women podcast. I'm your host, Allison Tyra, and today I'm joined by engineering historian Dr. Nina C. Baker, who regular listeners may recall from her previous episodes on aviation engineer Beatrice Shilling and merchant navy sea women during the World Wars. And she's back to tell us about inventor Margaret E. Knight. So first, could you introduce us to Knight and her work?

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NB: Margaret was one of America's most prolific female inventors and patent holders. She came from a very modest background. At the age of 12, she had to go out to work to help the family, and she worked in a weaving factory. She died at the age of 76, by which time she was pretty well known. She was on her 89th invention. I've been trying to track all these patents. I haven't even found all of them yet. There's still quite a lot. So when she was 12, working in a weaving mill, she saw a dreadful accident where a shuttle got loose and impaled a fellow worker. And she thought this shouldn't happen. And bear in mind, she was only a teenager. She devised a way to stop this very common accident by restraining the shuttle. And her design would become a standard feature and looms across the country. But she was a kid. She knew nothing about intellectual property or patents or anything. So she never got any benefit out of her very first invention.

AT: Her best known invention was a machine that made flat-bottomed paper bags, which I've actually done a short episode years ago before I got completely into interviews. And she's also in my book, [Uncredited](#), because of the legal case around this patent. So would you like to tell us that story?

NB: Still a very young woman. She worked in a variety of factories, not just weaving mills. She was working for the Columbia Paper Bag Company. And she was just an assembly line worker making paper bags. So at this time, there were two kinds of paper bags. Machine-made ones, which is what the Columbia Paper Bag Company was making. And they were quite weak. They didn't have the flat bottom that we are accustomed to when you get a paper bag at the supermarket. The flat bottom kind were made in the UK, but they were individually handmade, not made by machine. So in 1868, she invented a machine that cut, folded and glued paper to form, first of all, a tube, and then it would fold the flaps at the bottom to make the flat bottom brown paper bag we're used to. So this could be made, mass production with machinery. By this time, she had some understanding of how to protect her invention. And so in order to file a patent application, she needed a working model. And while that was being made, somebody else, a chap called Charles Annan, visited the machine shop where the model was being made and stole the design and patented it first. So that when she went to file her own patent, she found what he'd done and she filed a lawsuit. Now she, by this point, had quite a number of years worth of her own drawings, her descriptions, her models, and different records of the work that she'd been doing. And he basically had stolen it and didn't know enough about what he'd stolen to even make a convincing case to the judge. And although the designs were apparently clearly identical, she was able to prove that she was the first inventor and she won the case. There was a wooden working model of her first design for a paper bag machine in the Smithsonian. It's hard to imagine how she even achieved this. I think she must have had help because the cost of the lawsuit were very considerable. 16 days hearing, and it was costing her \$100 a day. So that would be the equivalent today of \$32,000. It's hard to imagine how she was able to get hold of that money to pursue it, but she was successful. That's amazing. And that's how paper bags started to be made. If you look into the history of paper bags, which is interesting all by itself, there are still paper bag patents being issued to this very day, and many of them quote her original patent.

AT: And I have to point out that he argued that as a woman, "she could not possibly understand the mechanical complexities of the machine." And yet, in court, he was struggling to remember details and explain things, because obviously he had just stolen it. He had not actually created it himself. He genuinely thought he could just go in and bluff his way through with misogyny, and that would be enough. (NB: Well, that was probably a

fair assumption at the time, I'm afraid to say.) So, most contexts in which I've seen her story, it really focuses on that lawsuit, I think because it was so blatant. And it's such a clear example of this type of situation where this guy thought he could just steal something and get away with it, and she won. And so it's a very satisfying story, where a lot of women's stories that we hear don't have that satisfying ending. But I wasn't aware until you mentioned it to me that her work also extended to the automotive field.

NB: I should say that she had a lot of patents and different things. Patents for cutting out the soles of shoes, a dress protector for long dresses so they didn't get wet in the mud, for a spit roaster, for something for boring out cylinders. On the automotive side, she had quite a lot of patents for internal combustion engines of the reciprocating kind, which is what is in petrol cars today where a piston goes up and down, and also rotary engines. And that's where the piston equivalent is actually a rotating thing, and they're called rotary engines. She had a patent for packing rings. Those are the rings within cylinders of combustion engines. A kind of sprung wheels. So the early wheels on motorcars, to begin with, they were like cart wheels. They were rigid and must have been very uncomfortable. Then Mr Dunlop of Scotland invented the inflated wheel. But they were still very uncomfortable rides. And a lot of the early motorcars had solid rubber wheels. And her idea was to have a wheel that basically had the car suspension within the wheel itself. So it was full of springs to make it bouncier. She had a lot of knowledge. And the automotive patents all come from the last 12 years of her life when she was in her 60s and 70s, and had a lot of experience with patents and with machinery generally. And she was still experimenting and inventing right up to the end of her life.

I guess it took all that time for somebody without a formal engineering education, who came from a very modest background, to get that kind of knowledge both by practicing and self-educating and probably talking to other people in the field. She never had a great financial background because of where she came from. And she was very lucky that she had a niece, Mrs Anna Flora Davidson, who was very wealthy. And right at the end, when she wanted to develop these motorcar ideas, Mrs Davidson and her daughter, so that's Margaret's niece and great-niece, Beatrice, they together set up the Knight-Davidson Motor Company in 1896. And I assume that Mrs Davidson and her daughter put up the money or most of it. And Margaret's capital in it would have been her intellectual property. But they started the company with \$100,000 and were eventually able to have a car made to implement some of Margaret's ideas. Now, one of the reasons I think Margaret Knight is so interesting is that in the long history of women's involvement with designing cars and trucks, it became rarer and rarer that anyone, male or female, had a hand in developing the whole vehicle, the engine, the suspension, the body, everything. But in this case, the car that the Knight-Davidson Motor Company produced was something that Margaret had a hand in everything. They didn't make the body themselves. They outsourced that to a carriageworks, but it was to her design.

And this car was exhibited at the 1912 Boston Automobile Show. And the reason that she was able to show that it was so innovative was that it had a particular kind of valve. Now, to keep things simple, there are two basic kind of valves. There are valves which go up and down or in and out, and they're called poppet valves. And that's what most cars have today. And the other kind, which is what she used on this car, is called a sleeve valve. So a sleeve valve is a cylinder on the outside of the combustion cylinder. And it works by either sliding up and down or rotating so that two holes coincide and let petrol in and exhaust fumes out, which is what the poppet valves do, too. But sleeve valves are potentially quieter because they don't bang around. Today, they're still used in some aero engines, but you don't see them in cars anymore. So she was marketing this as the Knight Silent Motor. Now, not to be confused because we will come to something that sounds almost the same. There's a very understandable confusion in lots of places, including places like Wikipedia, which I must go through and make some corrections. So our heroine, Margaret G. Knight, and a Mr. Charles Yale Knight, also an American auto engine designer, who also invented sleeve valves. And he called at least one of his cars the Silent Knight. And if you go looking for Margaret Knight and Charles Knight, you will often find some confusion over which car is named what. There's nothing in the advertisements for her car that calls it the Silent Knight, but there are mentions of it being called the Knight Silent Motor. So his design had sleeve valves as well, which

makes it even more confusing.

But the description of Margaret's engine goes thus: The Knight split sleeve valve engine designed by the KD car company, which has no connection with Charles Yale Wright's double sleeve valve design, was designed by Margaret G. Knight and employed something called a Scotch yoke, a simple mechanism which converts rotary motion into linear motion. So her 90 horsepower car was constructed for her by the president of the Society of Engineers, Swiss-born automobile engineer, Charles G. Greuter. And the body was built for them by Moore and Munger Company, which was a carriageworks. And we can see that they didn't use her patent internally sprung wheels, but the ordinary kind, which was common at the time with thin spokes, a bit like a bicycle. This was quite a common design of wheels at this time. The car was sold for \$6,000, which would be about \$200,000 today. It's a lot for a car, but actually at that time for a high-end car, that was about typical, which is why motoring in the early years of the 20th century was very much a rich person's game. It was successfully advertised at the Chicago Motor Show. Unfortunately, she died a year later in 1914. And with her passing, the Knight-Davidson Motor Company lost its heart really, its resident genius, and it closed down. And World War I had already started in Europe. Tiny motor car companies like hers didn't survive the war, and it's very unlikely hers would have done either. But it's an amazing story of a talented woman who really had to fight her corner at every turn to make sure that, as a woman, her inventions weren't ignored by the misogyny of the male engineering world.

AT: Do you think that, given the timing, if she had been born later, she would have been younger when she started working in automobiles? Or do you think it was more, she was just at that point in her life where she had the knowledge and experience that she would have taken it on?

NB: Well, if she had been born quite a bit later, let's say in the late 1890s, that was the period when women born then were at last able to get engineering educations if they really fought for it. So women born in the 1890s, they were coming of age during the First World War when a lot of openings came available for women to move into engineering. She clearly had some kind of innate talent. Maybe she would have done better, but she would still have had to fight jolly hard. The only other person who had a successful engineering career which started in automobiles was the Englishwoman Dorothea Pullinger, and she had to fight hard too and had the benefit of her father in the business. So given Margaret's modest background, I think she made the most of having come up from the weaving mill shop floor and through other manufacturing industry. She clearly kept her eyes open and learnt everything she could. I bet she talked to everybody that would stand still long enough trying to learn from them.

AT: Speaking of that approach, shall we say, I feel like there's two narratives that we often see with inventors. It's either all about communal collaboration or it's this lone genius, which I think the lone genius is often a myth. It's just that the other people who may have been involved get left out. So like you were saying, if she's asking everybody around her how stuff works and gaining that knowledge and you mentioned earlier, given her background, it's unlikely that she would have been able to produce that much money to pay the court fees for her lawsuit on her own. So there's a good chance someone was helping her out with that. This brings me to your book, *Sisters Behind the Wheel: A Global History of Women's Motoring Clubs, Driving Schools, and Garages*. And Margaret is not in that book. But interestingly, I previously did an episode about Alice Anderson and her all-girl garage in Melbourne. So if anybody wants to know about Alice Anderson, they should definitely get your book and listen to my podcast. Do it all (laughs). But what's interesting about that is because you were really focusing on that community of women in automotive activities, women like Margaret, who were doing sort of individual work, were not included. So do you think that that difference in narrative is more that we just don't really know about the community that women like Margaret likely had? Or do you think I am

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wrong about the lone genius and they're totally out there?

NB: Lone genius isn't a thing. If you think of arguably Scotland's most famous engineer, chap called James Watt, you may have heard of him. Even he didn't achieve things entirely on his own because things had to be made to his design. He relied on talented workers to make things that he wanted made. The lone genius is extremely rare. And we all stand on the shoulders of giants. You can't suddenly come up with ideas about the internal combustion engine unless the internal combustion engine is already there for you to have ideas about. So it would be lovely to know more about who Margaret Knight's network was. In the north of the USA, there probably were a lot of wealthy women starting to take an interest in motorcars. And in Australia at the same period, there was Women's Automobile Club of Australia with a charming little badge. Clubs in Boston and Pittsburgh and Philadelphia. And I would think that given her family connections were quite wealthy, she probably knew quite a lot of women who were drivers, even if she wasn't involved in clubs herself.

AT: Well, this actually came up in an episode that I did with Lainie Anderson, who wrote a book about the first policewoman in South Australia, Kate Cox. And she wrote it as fiction specifically so that she could introduce this community of women around Kate Cox and push back against that only woman idea. And that's much harder to do with nonfiction because like with Margaret, we just don't have nearly as much documentation because particularly when you are a trailblazing woman, a woman doing something outside of the norm for women at that time, it's very easy for history to paint you as the only woman in the room. And even on our previous conversation about Beatrice Shilling, she might have been largely surrounded by men in her work environment, but she also had a professional community of other women around her. And so the idea that, like the lone genius is a myth, the idea that a given woman is the only woman doing something is very rarely true.

NB: Absolutely agree. It's often the case that particularly in older publications, they say, this person's the first woman to do a thing. It's rarely the case, rarely true. You've really got to do a lot of work to show that somebody was the first person to do a thing. But the other thing is, part of the reason we don't know much about her is perhaps because she didn't marry, didn't have a family. The stuff that might be passed down through children is gone. Beatrice Shilling, although she married, didn't have a family. So the personal recollections of, "oh, yeah, my mom's house was always full of these women talking about cars." We just don't know any of that, because that kind of memory is gone.

[Listen to Dr. Lainie Anderson on Kate Cocks](#) or [read the transcript](#).

AT: And that actually comes back to that communal aspect being beneficial when we're trying to reclaim those histories. Because in my conversation with Loretta Smith about Alice Anderson, she was fortunate enough to be able to interview women who had worked in this all-girl garage in Melbourne decades and decades earlier. And in some cases maybe talking to their kids or talking to people who were kids at the time. So like maybe their moms worked at the garage. So hung out there a bit when they were kids. And she was able to get those recollections because Alice Anderson, sorry, spoiler, died young, tragically.

NB: But the garage carried on. The garage carried on for quite a long time after. So that's why there were people still alive when Loretta needed to talk to them.

AT: Exactly. And because she had built that community, there were people carrying on her memory and her legacy and all of that. And so it doesn't necessarily have to be family. A lot of times it is family. But it can also be found family or created family.

NB: I mentioned earlier a woman called Dorothee Pullinger, and she lived to extreme old age. So I was able to meet her children and grandchildren and people who'd worked for her and have get direct memories from

people who had known her. And that was really helpful. I don't know how far down the line we are, but one of these days there's going to be a book about her.

AT: Well, and you got to come back and talk about her as well.

NB: Yeah, we're going to do that.

AT: One of the other things that I find really interesting about her story that we've indicated already is that she was a mill girl growing up. She didn't come from a wealthy family, even if some of her relatives may have married into wealth later. She probably didn't have a significant education, even the level that a lot of girls were able to achieve at that time, and particularly in engineering. And this is one of the things that I find really fascinating about inventing and engineering more broadly, is that it does seem like it's one of those areas where you can be self-taught. It doesn't depend on someone having a lot of privilege to succeed in this field. A lot of it does have to do with both your, I guess innate talent, perhaps, but also curiosity and problem solving and all of these other traits that can't necessarily be taught easily. And so it's not dependent on coming from a rich family and having the right connections.

NB: Well, implementing your creative idea might have the need for some money, but certainly engineering is absolutely a creative activity. And when we're talking to girls today to encourage them to think about engineering for their careers, a great mix of school choices is maths, physics and art. Because actually, the creative mind is needed to see how you get beyond what already exists to something that doesn't exist.

AT: Join us next time on the Infinite Women podcast. And remember, well behaved women rarely make history.