An Excerpt From LIFT, Chapter 3

Speaking of firsts, Santos=Dumont's pioneering efforts were not limited to airships and wristwatches. He also led the way for women in aviation. The first woman in history to ever fly a powered aircraft did so in his *Number 9*, at his invitation. Her name was Aida de Acosta, and she was the only other person he ever allowed to fly one of his creations.

It happened in June of 1903, in Paris, a full six months before Orville and Wilbur's first flight. After three lessons in a tethered airship, she flew untethered for upwards of 90 minutes, soaring over the city and landing near a polo field where a game was underway. The event was captured on film, as you can see in Figure 20.

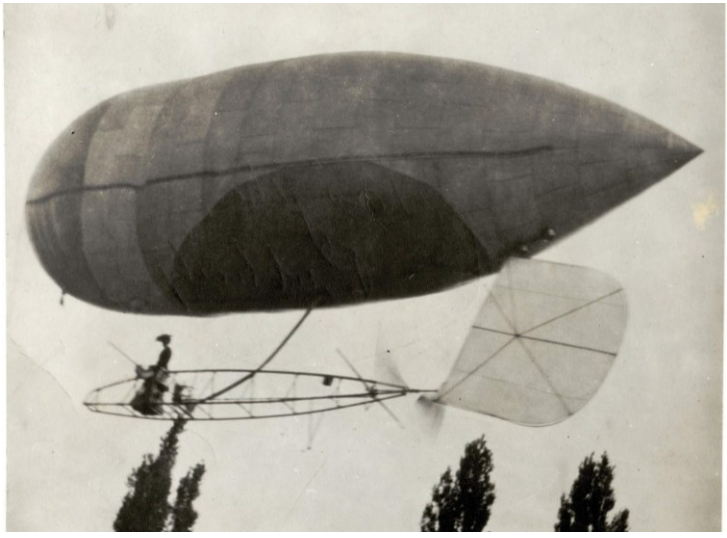

Figure 20: Acosta piloting *Number 9* (1903)

The details of her flight are almost impossibly delightful. As Mademoiselle de Acosta toured Paris by air, Alberto rode his bicycle through the city streets below, waving a handkerchief to indicate whether she should turn right or left and guiding her to the aforementioned polo field, although surely she had a better view of the fields from above than he did from below. Nevertheless, Alberto was fully aware of the significance of her achievement, and when she landed he exclaimed "*Mademoiselle*, *vous êtes la première aero-chauffeuse du monde*" ("Miss, you are the first woman aero-driver in the world!").

Her high-society parents were horrified by their daughter's achievement and managed to keep the whole thing secret, out of concern that no man would want to marry a woman who had done such a thing. She herself seldom spoke of it during her lifetime. That might explain why so few people today have heard of her. I sincerely hope she would not object to me telling her story now, since more than a century has passed and the possibility of scandal is safely behind us.

Which brings us to the elephant in the room: the nearly total absence of women in the annals of early aviation, including this book (so far). I hope you noticed, dear reader, that we have not yet mentioned a single female aviation pioneer, and I hope you agree that's a problem.

You may recall from this book's introduction that one of the reasons for studying failure is to avoid being misled by survivorship bias. When our data is limited to successful examples, we are likely to miss important data points and reach incorrect conclusions. Much the same thing happens when our entire data set is male. Call it *Sir*-vivorship bias, which creates a skewed perspective that models success based solely on what works for men and overlooks the reality that women do in fact exist.

In her book *Invisible Women*, Caroline Criado Perez points out that our data sets are too often "disfigured by a female-shaped 'absent presence.'" This massive gap creates a misleading data bias which skews our perspectives, misrepresents reality, and does a disservice to us all – men and women alike.

I am painfully aware of this situation in this book so far, and I'd like to address it now. If you've read this far already, you probably won't be surprised that I'm going to do so by first turning to the world of comic books.

In DC comics, Wonder Woman used to fly an invisible jet, although it has faded from view (ahem) in the Amazing Amazon's recent incarnations. The transparent flying machine is of dubious practical value since she herself is fully visible while at its controls, but it is a nearly perfect metaphor for the invisibility of women in early aviation.

Just like in the Wonder Woman comics, nobody in the history of aviation is actually invisible, but *stories* about women in aviation are conspicuously absent from the historical record. Aida de Acosta's presence is the rare exception, and her story is seldom told. In Chanute's entire book, for example, the feminine pronoun shows up only twice: once following the nautical tradition of referring to ships as she, and once referring to an actual human female (unnamed) who bravely served as a test subject for a demonstration of a what is ironically called... a man-lifting kite.

Unfortunately, despite extensive research over several years, I was unable to uncover any stories of women designing, building, or testing experimental aircraft before the Wright brothers. That can't be right. Surely they exist, and the fact that I know nothing about them says more about my shortcomings as a researcher than their actual contributions to aviation or presence in history.

While I cannot share any stories about female aircraft designers and experimenters working prior to 1903, here's what I did find.

Women in Aviation International has a list of the 100 most influential female aviators in history posted on their website. If anyone would have accurate and complete information about women in aviation, I felt sure it would be them, even though they focus primarily on pilots rather than inventors. Unfortunately, their list begins with Orville & Wilbur's sister Katherine, who first flew one of her brothers' airplanes in 1909. Prior to that year, even WAI offers no records. I have no explanation for why they failed to mention de Acosta's flight except for perhaps a bias against lighter-than-air craft.[1]

Speaking of Katherine Wright and a lack of records, it turns out she worked closely with her brothers and played a significant role in developing the Wright Flier. If we're interested in accuracy, we should give credit for the airplane to the Wright Siblings or the Wright Family, rather than only the Wright Brothers. Sadly, Katherine's contribution is largely ignored and underreported. In fact, the first book about the Wright Sister was not published until 2003 – a full century after their first flight. This is a remarkable and inexcusable oversight.

In additional to her technical and mechanical assistance, Katherine also provided a much-needed kick in the pants at a critical moment in 1902. That year the glider experiments were not going well and Wilbur was feeling particularly discouraged. Concerned that he might give up aviation entirely, Chanute sought to boost Wilbur's spirits by inviting him to speak to the prestigious Western Society of Engineers. To make the invitation even more appealing, Chanute designated the meeting Ladies' Night, perhaps

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[1] A similar bias against balloons might explain the failure to include Sophie Blanchard on their list. She was the first woman to pilot her own balloon, the first female professional balloonist and also the first woman to be killed in an aviation accident, in 1819. She was Napoleon's Chief Air Minister of Ballooning, where she developed plans for an aerial invasion of England. She was pretty awesome.

But yes, she flew spherical balloons and so she doesn't make the cut for this book, aside from this footnote. However, she was the inspiration for Felicity Jones' character in the 2019 movie *The Aeronauts*, so there's that.

in recognition of the fact that women were indeed interested in the topic. According to a letter Katherine wrote to their father, “Will was about to refuse,” but she talked him into it. One suspects this was not the only time she bolstered her brothers’ spirits, a contribution that should not be easily dismissed.

Back to historical lists, an organization of female pilots called The Ninety-Nines has a brief article about women in history that opens with the line “Women have made a significant contribution to aviation since the Wright Brothers' first 12-second flight in 1903.” I can’t help but think women also made significant contributions *before* 1903, but the historical record is maddeningly scarce.

In the larger scope of things, there are several possible explanations for the relative absence of women in the story of aviation invention and experiments, ranging from sexism to sexism. Then again, it could also be that sexism is to blame. No one knows for sure.

A closer look at the history of aviation shows that women played a much larger role in the invention of flight than is generally reported. For example, Orville and Wilbur Wright learned how to use tools from their mother, Susan. While neither boy received a high school diploma, their mom had a college degree and considerably more technical aptitude than their clergyman father. The boys get all the credit, but their mom did a lot of underappreciated work, as moms often do. Thus I nominate Susan Wright as the next addition to any list of women who contributed to aviation.

In an interesting coincidence (or not-such-a-coincidence!), Otto and Gustov Lilienthal’s mother Caroline Wilhemina Lilienthal played a similar role in their lives. Gustov described what happened after their father died in 1861:

> *Our mother fostered in every way our mechanical proclivities, and never refused us the means to purchase*

the requisite materials for our experiments, however hard it may have been for her at times.

Let's hear it for moms, am I right? I'm adding Caroline Lilienthal to my list too, alongside Susan Wright. We may not know many details about either Caroline or Susan's lives, work, or contribution to aviation, but their sons' testimonies are compelling and worth amplifying.

Are there other women whose contributions have been overlooked, diminished, ignored, or otherwise buried? Almost certainly, and I don't mean almost. It took a lot of digging, because she wasn't on the WAI list either, but I found one more aviation pioneer I'd like to tell you about.

Emma Lilian Todd was featured in a New York Times article dated November 28, 1909, which described her as the first woman to invent and build an airplane. The article says she spent three years on her design. That means she started in 1906, only three years after the Wrights' first flight. Pretty sure that makes her one of the first airplane designers *of any gender*, so let's get that right.

The Times article described her as "a little woman who has invented and built one of the handsomest aeroplanes in existence." I'm sure the Times made a point to comment on the physical appearances of airplanes designed by men as well. The article goes on to explain that Miss Todd had created a Junior Aero Club, "for boys who are interested in aeronautics." The journalist does not explain why Miss Todd's clubs were not open to girls, presumably because in 1909 such a restriction needed no explanation.

The article includes a photograph of Todd at the controls shown in Figure 21, although her aircraft's first flight would not occur until November of the following year.

Figure 21: Emma Lillian Todd and her airplane (1909)

The diminutive Todd lacked the physical strength necessary to work the manual controls, so her friend Didier Masson served as her test pilot for a modest 20-foot hop which was apparently never repeated. It may not sound like much of a flight, but frankly that is 20 feet further than any airplane I ever designed and built with my own two hands.[2]

What's the point of that story? Well, a close read of *any* field's history inevitably reveals hidden female figures making significant and unheralded contributions. A closer read of *aviation's* specific history uncovers women such as Katharine Wright, Susan Wright, Caroline Lilienthal, Aida de Acosta, Sophie Blanchard, and Emma Todd who helped advance the field but whose names are obscure, whose presence is overshadowed,

[2] Be sure to check out a short film titled *Miss Todd* for a cinematic retelling of her story. It's a gorgeous musical stop-motion animation, directed by Kristina Yee and released in 2013. It won the Foreign Film Award Gold Medal at that year's Student Academy Awards. More details at MissToddFilm.com.

downplayed, or deliberately covered up. Their stories should be told, not only because these women deserve to be included but because we all benefit when we understand their experiences.

Pardon me while I get all science-y and nerdy for a moment, but as an engineer I feel the need to make an important observation based on the data we've seen so far. Having examined the evidence, I confidently conclude that women throughout history have been capable of making profound contributions to technical fields such as aviation. This is based on the simple fact that women have made profound contributions to every technical field in the history of humanity (including aviation). As a man, I feel a bit funny even writing this paragraph, because it is so obvious that I fear stating it this bluntly might sound patronizing. If I'm mansplaining a bit here, please believe me when I say my intended audience for these words is other men. Let's get it together guys, shall we?

For centuries the idea of building a flying machine belonged to the realm of mad scientists and delusional dreamers. People were often slow to believe the Wright brothers' claims even after they proved flight was possible, and despite the proliferation of newspapers and telegraphs, word of their achievements travelled relatively slowly.

The challenges inherent in 19th century communication technology aside, the men involved in aviation tended to do their work in secret, and the entire cadre of pre-Wright aviators are typically overlooked, so this situation is hardly limited to women. However, female inventors were granted even less respect and had more reason than their male counterparts for keeping things under wraps. As we saw with de Acosta's story, women faced tremendous pressure to keep their activities out of the public eye. Thus it should not be terribly surprising that female names are absent from the rolls.

However, thanks to Chanute's book and a few other sources, we at least have *some* stories, drawings, and data about male

experimenters. To have zero information about women looks suspiciously like a conspiracy.

Most readers do not need me to explain why this is a problem and can safely skip the next few paragraphs. For those who are unconvinced about the negative impact of leaving women out of this or any field, let me express my point as clearly and simply as I can, in extra-large font so nobody misses it:

Over filtering the talent pool limits people's ability to contribute and restricts the advancement of the field as a whole.

Any questions?

Removing barriers to entry, leveling the playing field, and inviting non-contributors to become contributors – these are proven strategies for fostering an innovative climate and achieving important breakthroughs faster. As the stories throughout this book show, the people who made the most progress were the collaborators and bridge builders, the includers and inviters, the broad-minded generalists and discipline blenders. The people who had the hardest time were the isolated excluders, the narrow-minded specialists, and the arrogant purists.

Excluding women meant the whole field of aviation developed much slower than it would have under more inclusive circumstances. One need not be a feminist to know this is true, but it takes a profoundly closed mind to deny this basic fact about creativity, collaboration, and humanity.

Diversity of thought, experience, ideation, and perspective is a vital ingredient for innovation. As Dr. Patti Fletcher demonstrates in her wonderful book *Disrupters*, "Diversity *of all kinds* makes companies better."

When a filter keeps people out because of their gender, geography, nationality, religion, orientation, physical ability, or some other category, the result is the same: less advancement, less learning, less achievement. If we want to do amazing, never-been-done-before things, we should make sure everyone who wants to participate is encouraged to do so.

I'm not saying this just because I am trying to advance a social agenda of equality and fairness (although yes, I am 100% doing that, without hesitation or apology). Nor am I saying this just because I'm a feminist, although I happily accept that label. Along with those reasons, I am also saying this because it is my professional opinion as an engineer and technologist and military officer. We get better tech – and we get it faster – when everyone who wants to contribute is able to contribute.[3]

Humanity failed to fly for thousands of years before the Wrights finally cracked the code. There are many factors involved: flying is difficult, too many people were committed to dead-end ideas like flapping and feathers, people treated inventors like they were insane, etc. But one of the prime contributions to the delay is surely the fact that women were left out and/or ignored. As Caroline Criado Perez pointed out in *Invisible Women*:

> *When we exclude half of humanity from the production of knowledge we lose out on potentially transformative insights.*

[3] Sadly, I know full well some readers will respond to this section with a variant of "I wish he would just write about innovation and not all this gender / diversity / inclusion stuff." If that thought occurred to you, allow me to respond with every ounce of love and respect I can muster by saying "Shut your stupid face, this IS all about innovation. Go back and read it again. Also, don't be such a jerk."

Would someone have beaten Orville and Wilbur into the sky if women played a more prominent role as aviation experimenters? Yes, absolutely. Chanute's analysis shows that even 9 years before Kitty Hawk, powered flight was just a matter of time, attention, and imagination. Involving more people on the problem could only serve to accelerate progress. Excluding women delayed things overall, and as the stories in this book show, the men who made the most progress were those who collaborated most closely (albeit discretely) with women. But there is no need to accept anecdotal evidence or historical speculation. Science backs this up as well, and I literally mean *Science*.

The October 2010 issue of the journal *Science* published a paper titled "Evidence for a Collective Intelligence Factor in the Performance of Human Groups." It basically said that a group's collective intelligence is positive correlated with the proportion of females in the group. Groups with more women were simply smarter. The converse is obviously true as well – a group made up of only men is dumber than a group that includes women.[4]

That lack of intelligence corresponds with an inability to solve hard problems, such as the problem of flight. So yes, excluding women from aviation is a contributing factor for why it took so long to invent the airplane. More women equals smarter groups equals faster progress solving difficult problems.

Linus Torvalds, the Finnish software engineer responsible for launching the Linux open source operating system, made much the same case when he coined a precept now known as Linus' Law. This law states "given enough eyeballs all bugs are shallow." In other words, problems get easier to solve when more people are

[4] The only reason for this footnote is that I really wanted to write that line again: *a group made up of only men is dumber than a group that includes women*. Because, science.

looking at them, because *you* may notice things that *I* overlook or you may think of things I did not come up with.

Torvald's observation is relevant well beyond the field of software development. Difficult challenges in any field have a longstanding tendency to crumble beneath the weight of concerted effort. Bringing new eyeballs to bear on a problem often presages a flurry of new discoveries.

The lesson for modern innovators is simple: let everyone play.

Strike that last line – we must be more proactive and fiercer than that. The idea is not merely to *allow* participation but to actively go out of our way to invite and encourage participation, to foster strategic partnerships with people who don't look or think like you do, people with different experiences and perspectives.

Let me be super clear for any guys in the room who haven't quite grasped the point - it is not enough to "let the girls play" and begrudgingly tolerate their presence. If we want to achieve great things, solve difficult challenges, and soar to new heights (literally or metaphorically), we need to actively pursue multiple dimensions of diversity with focused enthusiasm. We need to *invite* and *welcome* and *pursue* people with different perspectives and backgrounds and orientations and pigmentations and chromosomal arrangements.

To do otherwise is a strategic error of the highest magnitude. Also, stop referring to women as "girls."

Burning down the patriarchy is good for everyone, including old white dudes like myself. *Especially* for old white dudes like myself. We don't pursue inclusion and diversity just to help people who would otherwise be marginalized and left out, although yes please, let's be kind and supportive simply for the sake of being kind and supportive. We also need to pursue inclusion and diversity for the sake of improving things for *everyone*… even old white dudes. When everyone wins, everyone wins. That's just math.

Not sure where to begin? I heartily recommend embracing Tom Peters' longstanding advice to "hang out with people who are weird" (i.e. have different experiences and attributes than you have). Combine Tom's advice with Seth Godin's frequent observation that "we are all weird." The result: hang out with everybody, and do it on purpose. When everyone plays, we all benefit. Inviting everyone to play is one of the best things any of us can do. That just might be the most important recommendation in this whole dang book. Yes, more important than the recommendation to "study failure." Of course, you could combine those two ideas and study organizations that failed to be inclusive. They're not hard to find.

While the idea that diversity and inclusion are creativity amplifiers sounds like a modern idea, it is hardly a recent discovery. This passage from Lilienthal's 1894 book *Birdflight* could practically come from a recent TED Talk:

> *...the author also entertains the hope that not only the science of aviation but also that of dynamics, her indispensable handmaid, may gain new adherents, stimulating some of his readers to gain a closer insight…*
>
> *No clergyman, officer, medical man, philologist, agriculturalist, or merchant would think of devoting himself to a specialized study of steam engines, of mining, or of textiles; they are aware that these departments of industrial investigations are in capable hands; but they are all interested in the promotion of flight, every one of these several professions and trades being anxious to assist, and, possibly by a lucky inspiration, to bring nearer the time when man will be able to fly…*
>
> *This must explain why this volume addresses itself to all…*

That's right – in the late 1800's, Otto Lilienthal addressed his book about flight "to all," inviting interested parties from "several professions and trades" to explore this new field of aviation. His language is regrettably male-centric ("devoting *him*self to a specialized study…"), so clearly there was room for more progress, but his broad invitation to enthusiastic amateurs from all walks of life was a step in the right direction, a model worth imitating and expanding, and an acknowledgement that progress is accelerated by diversity.

As we saw in this chapter, Alberto went even further than Lilienthal, and invited a woman to pilot his airship. Imagine how different history would have been if others had done the same.

Now imagine how different *your* story will be as you expand your circle.