Six Female Scientists Transcript

Carrie Ann: "Hello and welcome to another episode of the Yale Journal of Biology and Medicine Podcast. YJBM is a PubMed-indexed, quarterly journal edited by Yale medical, graduate, and professional students and peer reviewed by experts in the fields of biology and medicine. Each issue of the journal is devoted to a focus topic and through the YJBM podcast, we will take you through the past, present, and future of the issue's subject matter. I'm Carrie Ann, a third-year student in the department of genetics

Kelsie: I'm Kelsie and I'm a third year PhD student in the Department of epidemiology and microbial diseases. Emma: And I'm Emma a third-year student in cell biology

Carrie Ann: In celebration of the 50th year of women at Yale College and the 150th year of women at the Yale graduate school of arts and sciences, we're recording a special series of podcasts focusing on women and science and women at Yale. Today's episode will highlight the achievements of six women in science who have inspired us.

Emma: We had a lot of fun researching for this episode and had trouble narrowing down the list of women to highlight today. There are so many women past and present who have been incredibly impactful in STEM that we encourage you to check out. So you know, go to google, search 'women in science' and see what happens. You could learn a lot of cool things just like we did.

Carrie Ann: The six women we are highlighting today are: Janaki Ammal, Barbara McClintock, Rachel Carson, Gladys West, Mae C. Jemison, and Marci Bowers. We are presenting them in a roughly chronological order beginning with Dr, Janaki Ammal.

Janaki Ammal was a pioneering botanist and geneticist. She holds the title for a lot of firsts, the first Indian woman botanist, the first woman to earn a PhD in botany in the United States, and one of the first woman scientists to receive the Padma Shri, one of the highest civilian honors in India. While you might not have known her name, you may be familiar with her work. She is most known for sweetening India's sugarcane industry. Today, India is one of the largest producers of sugar in the world (India and Brazil are a close first and second with India beating Brazil in 2018). Annually, India produces nearly 30 million tons of sugar! In the 1920s, this was far from the case. India actually had to import sweeter sugarcane from the East because the variety that grew well in India just wasn't that sweet. India wanted to be able to grow their own sweet sugarcane, which led the government to establish the Sugarcane breeding station in Madras. This institute was run by CA Barbar, with whom Janaki Ammal would work closely. Together, CA Barber and Ammal created hybrid varieties of sweetened sugarcane that would grow well in India, successfully sweetening India's sugarcane and reducing the country's reliance on imports. In her very productive career, Dr. Ammal developed numerous species of hybrid crops that are still used today.

E.K. Janaki Ammal was born on November 4, 1897 in Tellicherry, Kerala, India. She was the 10th of 13 children from her father's second wife. In total, she had 18 brothers and sisters! Her father was a judge, but also had a love of nature, which was a profound influence on her life. Her father grew a garden, kept notes on the garden, and even wrote two books on the birds of India's North Malabar region.

Dr. Ammal attended the Sacred Heart Covenant in Tellicherry, obtained her bachelor's degree from Queen Mary's College, and then received an honors degree in botany from presidency college in 1921. After graduation she taught at the Women's Christian College in Madras. She received the Barbour Scholarship from the University of Michigan which allowed her to travel to the US and earn a master's degree in 1925. Dr. Ammal went back and forth between the US and India. She taught at the Women's Christian College after obtaining her masters and then returned to Michigan with a fellowship and obtained her doctorate in 1931, becoming the first woman in the US to earn a doctorate in botany. She became a professor of botany at Maharaja's college of science from 1932-34. In 1934 she joined the Sugarcane Breeding Institute as a geneticist where she developed a sweeter strain of sugarcane that would thrive in India, this work become her most notable legacy.

Janaki Ammal had an industrious career and worked at many different places and on many different projects. After leaving the sugarcane breeding station, Dr. Ammal moved to London to work at the John Innes Horticultural Institute from 1940-1945. Shortly after joining she publishes a paper titled "Chromosome diminution in plants" in the December 1940 issue of Nature. Chromosome diminution describes when a chromosome fragments then a fragment is lost during mitosis. This had been described in animals, particularly nematodes before, but this was the first observation in plants. At the time Janaki was working in England it was the height of WWII. Imagine continuing to go into lab each day during WWII. Dr. Ammal would have to take shelter from the bombings at night and then report to lab in the morning. Despite these challenges, she continued her research at the John Innes Horticulture Institute and later worked at the Royal Horticulture Society researching medicinal plants. In 1945 she and her friend CD Darlington co-authored The Chromosome Atlas of Cultivated Plants. As written in the dust-cover, "The book will be of service for teaching and research in economic and systematic botany, horticulture and plant breeding." This was a tour-de-force reference detailing the chromosome numbers of around 10,000 species of plants. While working at the Royal Horticulture Society, she studied the effects of colchicine on plants, particularly magnolias. Colchicine doubles the chromosome number of plants making them larger and faster-growing. Fun fact - Colchicine is also used in humans to treat gout.

Dr. Ammal returned to India to run the Botanical Survey of India. She also worked for the Atomic Research Center and as an emeritus scientist at the University of Madras after retiring. She was elected to the Indian Academy of

Science in 1935 and Indian National Science Academy in 1957. She also received an honorary degree from the University of Michigan in 1956 and Padma Shri in 1977. She died in 1984, but her legacy and plant varieties continue to be grown today. In an article written by her niece Geeta Doctor, her niece notes Dr. Ammal didn't like to talk about her life, saying quote "my work is what will survive." Her work continues to be honored today through the E.K. Kanaki Ammal National Award for Taxonomy created in 2000 by India's Ministry of Environment and Forestry and through plant species named after her.

Janaki Ammal is the eponym for a genus in the dogbane family (Janakia), a species in the meadow beauty family (Sonerila janakiana), a cultivar of Magnolia kobus that she developed, and a yellow hybrid rose.

In addition to her research, Dr. Ammal fought to protect biodiversity in India. At the age of 80, she spoke out against the building of a hydroelectric plant in Kerala, India that would have flooded kilometers of forestland. Now Valley National Park in Kerala remains one of the last large undisturbed forests in India. It is rich with biodiversity including endangered orchids. Dr. Ammal wanted to preserve Indian plants and to preserve the study of Indian plants by Indian scientists. She is remembered for both her research in cytogenetics and plant breeding but also for her activism.

There are two main articles I used in gathering information on Dr. Ammal's life and scholarship. One is an article in Scroll in by Geeta Doctor, Janaki Ammal's niece, and another is an article in Smithsonian magazine by Leila McNeill. I'd recommend reading them if you would like to learn more!

Next time you have some sugar think of Dr. Ammal, I know I'll be remembering her work the next time I eat something sweet.

**********Discussion **********

Emma: The next female scientist I'm excited to highlight is Barbara McClintock is one of the pioneers in genetics and well-known contributions to our understanding of the complex nature of genetic inheritance, which I will explain a bit later. I was really excited to learn about Dr. McClintock's work as I did research for this episode because she happens to be my PI's favorite scientist (and celebrity she would want to have come to work in our lab!) And after learning more about Dr. McClintock's elegant experimental approach, it was easy to see why she is a favorite of not just my PI, but of many scientists around the world.

Dr. McClintock was born in 1902 in Hartford CT (woot!) and moved to Brooklyn, NY in 1908. All of her educational training was done at Cornell where she received a BS, MS, and PhD in Botany. Although Dr. McClintock's degree is in botany, she became an extremely respected and influential member of the field of genetics. Ironically, Dr. McClintock pursued a botany degree because at the time women were not allowed to pursue a degree in genetics.

Dr. McClintock's groundbreaking work was done in the field of maize genetics.

That's right maize! Like corn! While this may seem like a strange choice in model system, Maize is actually a great model for learning about genetics and inheritance because each kernel of maize is from an individual fertilization event - meaning that you can analyze hundreds of offspring on a single ear of maize. This makes it ideal for trying to unravel the methods of genetic inheritance.

After receiving her PhD from Cornell in 1927, Dr. McClintock went on to Postdoctoral studies in genetics at multiple institutions (Cornell, University of Missouri, Cal Tech).

Dr. McClintock's work was in the field of cytogenetics. Cytogenetics is the observation of genes (or DNA) under a microscope. This is a simple and elegant, yet extremely powerful system. As a cell biologist, I rely on imaging a lot in my work, and appreciate the power of observing a biological phenomenon by eye. Overall, Dr. McClintock's work provided key insight into the concept that DNA within chromosomes can move. All of the DNA in our cells is divided into chromosomes, each containing many functional units, or genes, along their length. The prevailing idea at the time that Dr. McClintock was beginning her career was that DNA was stationary and could not be rearranged within chromosomes.

Dr. McClintock's early work in the 1930s began to push against this idea. She, along with graduate student Harriet Creighton, provided the first experimental evidence of chromosomal crossing over during meiosis (or the cell division that leads to the production of gametes). We all have two copies of each chromosome (one paternal and one maternal). During gamete production, pairs of chromosomes will swap portions of DNA to increase genetic variation of the gametes produced. This groundbreaking work was the first to show that physical movement of DNA occurred during this key biological process.

In 1941, after leaving a professorship position at the University of Missouri at Columbia for fear that she would not receive tenure, Dr. McClintock was offered a one-year position at the Carnegie Institution of Washington's Department of Genetics at Cold Spring Harbor. This turned into a full-time position and she retired 26 years later in 1967, however remained affiliated with CSH as a research scientist until her death in 1992.

Dr. McClintock's most groundbreaking work was her discovery of transposable gene elements (or transposons). These are called "jumping genes" because transposons are pieces of DNA that can move themselves throughout different regions of the genome. Combined with her work on crossing over events, Dr. McClintock began to show that the genome is not stationary, but is in fact subject to alteration and rearrangement. She made this discovery while working to understand the DNA elements and genes that regulate the color of each kernel in an ear of maize. She studied a locus called dissociation or "Ds" located on chromosome 9 of maize. In the late 1940s, she first described that Ds was able to change its position within the chromosome, publishing this finding in the 1947-1948 Carnegie Yearbook. She also described activator (Ac) which was another

DNA element capable of moving throughout the genome that was required for Ds movement within the genome. Years later, in the 1980s, scientists finally discovered that Ac encoded a transposase enzyme that facilitated movement of both loci. Dr. McClintock showed that the Ac and Ds loci could move in and out of the genes coding for kernel color, turning them off and on, resulting in changes of kernel color.

This work was not initially well received. At the time, scientists believed that genes were fixed linearly along chromosomes and that any sort of mutation of a gene was considered permanent. The concept that genes could be disrupted by these jumping genes and repaired when they removed themselves from the gene did not fit into this more static idea of genes. It wasn't until the 1960's that these mobile genetic elements were discovered in other organisms and today scientists know that transposons are present in the genome of many species, including a large percentage of the human genome.

Dr. McClintock continued to work on transposons and other genetic elements throughout the entirety of her life. Today, her discovery of mobile genetic elements is recognized as one of the groundbreaking discoveries of genetics. As such, her career has been full of many impressive awards, achievements and firsts. In 1944, she was the third woman elected to the national academy of sciences. In 1945 she was the first female president of the genetics society of America (let me remind you again that she was prohibited from getting a genetics degree when she was in school). In 1971 she received the national medal of science award from President Nixon. In 1981 she was the first recipient of a MacArthur Foundation grant and received an Albert and Mary Lasker Award (sometimes referred to as the pre-Nobel prize." In 1983, Dr. McClintock won the Nobel Prize in Physiology or Medicine for her work on "mobile genetic elements." She was the first woman to have an unshared Nobel prize in this category.

Dr. McClintock received many other awards and honors and her discovery of fundamental genetic principles shaped the way we understand the genome. She has also inspired many other women to pursue science enthusiastically and passionately. She passed away in 1992, leaving behind a massive scientific legacy.

**********Discussion **********

Carrie Ann: One of my favorite science mantras is, Science does not happen in a vacuum. The data we generate are always part of a larger story, our findings are put out into the world to be interpreted by others and used to guide further research. The inventions we develop and make available for general use can affect more things than we intend. The natural world is complex and full of multiple interlocking variables, unlike the controlled environments we set up in our labs. Rachel Carson not just recognized this but brought it to the attention of the entire world. She believed that all American citizens should be made aware of the risks and benefits of new technologies, particularly synthetic pesticides. She implored society to understand humankind is part of nature, not separate from it. She trusted that people without formal scientific training can understand

and evaluate scientific concepts when communicated properly. Now, at a time when accurate scientific communication is more important than ever, it is a great opportunity to take a look at the influential life and legacy of Rachel Carson.

When I say the name Rachel Carson you may already think of her book Silent Spring or you may think about the synthetic pesticide DDT and the consequences for baby bald eagles. (I know that's the only part I learned in history class.) But the legacy and achievements of Rachel Carson's career span far beyond the effect of one chemical on the environment. Carson was one of the first people to publicly argue that science does not happen in a vacuum and that we cannot separate humans from the environment. What we design, and build, and put out into the world can have far-reaching, long-term, and delayed consequences. And we need to be aware of these consequences to make informed decisions. Carson's scientific training gave her the skills to synthesize numerous publications into a single story for general audiences. Anyone who has gone through qualifying exams knows how difficult it is to keep track of the literature, place each publication in context, and to evaluate scientifically sound, robust studies. Yet Carson does this seemingly effortlessly, leaving a legacy that outlasts the specific crisis she was addressing.

I learned a lot of this information from PBS American Experience documentary on Rachel Carson. I cannot recommend the documentary highly enough. It is very thorough and entertaining. It is also almost 2 hours long, so there is a lot I cannot cover about Rachel Carson's life in this short episode that is covered on the documentary. If you are interested, please check it out! It is free on amazon prime.

Rachel Carson was born in Springdale, Pennsylvania on May 27, 1907. Her mother was an admirer and student of nature and passed this love for the natural world to Carson. Carson attended Pennsylvania College for Women (now Chatham University) and graduated in 1929. It was here she discovered a love of biology. After graduation, she took a research position at the Woods Hole Marine Biological Laboratory where she fell in love with the ocean and marine biology. She then attended Johns Hopkins University for graduate school. She graduated with a masters in zoology in 1932, but unfortunately, she was unable to stay in school to earn her PhD. She had to leave graduate school and get a job that would provide enough money for her to care for her mother and her sister. She found that job with the US Bureau of Fisheries where she wrote radio scrips and supplemented her income by writing articles for the Baltimore Sun. Carson worked in federal service for 15 years and even became the editor-in-chief for all US fish and Wildlife Service publications. The PBS documentary calls her a "writer by nature, biologist by training." In was in combining these two skills, writing and biology, that her work became and remains so influential.

In 1941 she published her first book, Under the Sea-Wind, however its release coincided with the attack on Peral Harbor and it wasn't that popular. In 1951 she published The Sea Around Us, which was an international best-seller, it topped non-fiction best seller charts for a record number of weeks and remained

an NYTimes bestseller for 86 weeks. It received the National Book Award for Nonfiction and Burroughs Medal in nature writing. It is described as a biography of the sea, and I'm really looking forward to reading this soon! Her third book was published in 1955 called The Edge of the Sea which focused on ecosystems of the eastern Coast of the US. She focused on human's relationship with nature and our impact on the world around us while sneaking in important facts about the environment and climate change with amazing descriptions of sea life, submarine technologies, geology.

At the time Carson was writing and researching, the relationship between humans and nature was changing. People believed the goal of science was a triumph over nature, and that human were separate beings, not part of nature. Instead the role of humans was to control and dominate our surroundings. Just think – this was the time of the atomic bomb and use of chemical warfare during the world wars. Out of this development of new chemicals and the desire to control nature came the invention of synthetic pesticides. These chemicals were sprayed widely without caution and without investigation into their broader, long-term consequences. If you didn't die immediately from exposure, they were considered safe.

I recently finished reading Silent Spring, which was published in 1962. It was one of those books I've heard about and referenced forever, but never actually read – I though because we don't use DDT anymore that it wouldn't be relevant – I was wrong. Carson writes beautifully with clarity and lyrism in her descriptions of nature, and her words are more relevant today than you might expect. I won't say it is the easiest read, some parts really get you down; Carson follows beautiful descriptions of an animal and its important function in the environment with a description of death by pesticide. She also describes the negative long-term impact of synthetic pesticides on human health.

I would like to read a quote from the last paragraph of the book, don't worry I'm not going to spoil the ending, "The 'control of nature' is a phrase conceived in arrogance, born of the Neanderthal age of biology and physiology, when it was supposed that nature exists for the convenience of man."

Importantly, Carson didn't just write everything that was wrong with the world; instead, she offered concrete suggestions for ways to use science and how to perform scientific research to do better. She writes, "The best and cheapest controls for vegetation are not chemicals but other plants" and she gives examples of the relationships between marigolds and nematodes, beetles and weeds, the natural balance in the environment to control what we consider pests. I could talk for hours about everything in silent spring that she brought to light, but instead I would just encourage you to read it and think about how her arguments apply today.

After the release of the book, Carson was considered a, quote, "hysterical female luddite" and communist according to the PBS documentary. Her revolutionary support for studying the broader consequences scientific advancements was not

seen fondly by chemical industries. At the time she published Silent Spring, Carson had been diagnosed with metastatic breast cancer. She kept her diagnosis secret so her book wouldn't be seen as simply an angry woman taking her diagnosis and impending death out on chemical industries. She wanted her evaluation of the scientific literature to stand on its own.

One story that I think highlights how women including Carson were treated at this time, was that she went to the doctor for a lump and the doctor said it wasn't cancerous and that she didn't need to do anything or worry. Turns out, the doctor knew her cancer had metastasized and believed he should tell a husband this fact, a woman couldn't handle it. So he lied to her about her health! She then sought a second opinion months later after feeling a second lump and this doctor told her the extent of her diagnosis. She quickly started radiation treatments, but that first doctor denied her 6 months of treatments because he thought she as a woman was too weak to know the truth.

Carson died in silver spring, Maryland on April 14, 1964. Her work challenges us to continue to think about the impact of humans on the natural world and challenges scientific research to fully investigate the long-term and unexpected consequences of advancements. Remember, science doesn't occur in a vacuum. Humanity is not separate from the natural world, we are a part of it, and we must respect it. Carson knew the importance of passing this on to the next generation. Carson's fourth book, a Sense of Wonder, was published in 1965 shortly after her death. The book captures the importance of sharing nature with children and argues that adults should nurture children's sense of wonder for the world. In remembering Caron's legacy, we as adults should keep this childlike sense of wonder alive. It can drive new ways of seeing the world, new scientific discoveries and advancements and new ways to increase respect and support for our environment.

**********Discussion **********

Kelsie: Gladys West was born in 1930 and grew up in a rural area south of Richmond VA. Her family were sharecroppers, also working in tobacco factories and on railroads. Gladys graduated as valedictorian and earned a full ride to Virginia State College (now Virginia State Uni, an HBCU)' She earned a BS in Mathematics in 1952 and taught math for a couple years before returning to earn her MS in Math in 1955 •

After earning her MS, she was hired (without interview!) at a naval proving ground in VA in 1956; at the Naval Surface Warfare Center Dahlgren Division where she was a programmer. She was only the 4th black hire at the facility and one of the few women working there at the time. o At this same time, she was earning a second master's degree in public administration from the university of Oklahoma through distance education o In an interview with a reporter, Gladys recalled that "'[she] did hand calculations on a [mechanical] Marchant calculator'," and that while she was hired as a mathematician, Dahlgreen purchased the Stretch computer as she was starting her job so she started programming.

She became the project manager for the Seasat radar that could remotely sense oceans after she was recommended for commendation 1979 after putting in hours of overtime. Gladys is now well known for the complicated work she uses the stretch computer and calculating estimates of the earths shape and altitude using data from satellites. Gladys programmed an IBM 7030 'Stretch' computer (described to be the most powerful computer of the time) to calculate precise estimates of the shape of the earth -- which became the basis for GPS technology. o I suggest you google this computer because it is a literal black box. It's chunky and dark with switches everywhere and a token needle that bounces back and forth over the speedometer looking thing. This was not the programming that we think of today. • Unlike computers today, the computers Gladys was using couldn't always be trusted. When describing how she had to analyze all output and double check calculations, She said ""Nine times out of 10 they weren't completely right so you had to analyze them and find out what was different to what you expected."" "In 1986, West published Data Processing System Specifications for the Geosat Satellite Radar Altimeter, which is a 51-page technical report from The Naval Surface Weapons Center (NSWC). The guide was published to explain how to increase the accuracy of the estimation of geoid heights and vertical deflection, important components of satellite geodesy." o I tried to skim through this and it is just a behemoth. "The primary mission meets the geodesy requirement to provide the Department of the Navy (DON) with a global data base of 10 cm precision radar altimeter measurements. This data will allow for improvements in the gravitational models required by advanced Submarine Launched Ballistic Missile (SLBM) systems." This eventually led to the more precise estimates of GPS used today. After 42 years at Dahlgreen Naval base, Gladys retired in 1998.

Legacy • In 2018, she was inducted into the highly selective Air Force Space and Missile Pioneers Hall of Fame and the same year she was included in the BBCs 100 Women 2018. I would also like to point out that Gladys never seemed to stop learning. Even twenty years after her retirement, and after a severe stroke and breast cancer, she completed a PhD in Public Administration from Virginia Tech (2018). This woman cannot be stopped!!! She is now Dr. Gladys West. • How women were called "computers" and just used to compute at times.

**********Discussion **********

Emma: The next woman in STEM I'm excited to discuss is Mae C. Jemison. She has had a varied career in STEAM but is most well known for being the first African American woman to go to space. Dr. Jemison was born in 1956 in Decatur, Alabama. Her family moved to Chicago a few years later. She graduated from high school in 1973 at the age of 16. In addition to her strength in academics, Dr. Jemison was also a talented dancer and ultimately had to choose between a career in STEM or dance. Dr. Jemison then went to Stanford University for her undergraduate. She graduated in 1977 with a BS in chemical engineering and a BA in African American studies. Dr. Jemison then pursued a medical degree from Cornell. During medical school, she worked at a Cambodian

refugee camp in Thailand and lead a study in Cuba for the American Medical Students Association. After receiving her MD in 1981, Dr. Jemison joined the peace corps in 1983 and worked as a medical officer in Sierra Leone and Liberia.

In 1985, Dr. Jemison opened her own private practice in Los Angeles. That same year, Sally Ride became the first American woman to go to space. This historic space flight re-sparked a desire that Dr. Jemison had had since she was young: to become an astronaut. So she applied to NASA that same year. However, the Challenger disaster on January 28, 1986 left all seven crew members on board dead and NASA halted all new applications for its astronaut program. This tragic loss did not deter Dr. Jemison from pursuing a position at NASA and in 1987 she re-applied to the astronaut program and was accepted. She was part of the first group to be accepted to NASA after the Challenger Disaster.

Dr. Jemison was selected to join the STS-47 crew as a mission specialist. There were seven astronauts total on this mission travelling on the space shuttle Endeavour. (Side note - this space shuttle is on display at the California Science Center in Los Angeles). The mission was a collaboration between the US and Japan. On September 12, 1992 Dr. Jemison became the first African American woman in space. The crew returned to earth September 20, 1992 for a total of 7 days, 22 hours, 30 minutes and 23 seconds in space. This mission involved 44 research experiments in a range of fields from materials science to biotechnology. The life science experiments occurred in a range of experimental systems including Japanese Koi fish, cultured cells, flies and more! Dr. Jemison was a co-investigator on two bone cell experiments. I work with cultured cells on Earth and I can only imagine how much more challenging it would be to do in space! Dr. Jemison left NASA in 1993.

Interestingly, it was the hugely popular Star Trek tv show that sparked Dr. Jemison's interest in becoming an astronaut. She watched African American actress Nichelle Nichols play Lieutenant Uhura and set her sights on becoming an astronaut herself. After fulfilling this goal, Jemison was asked by actor LeVar Burton if she would be interested in appearing on Star Trek: Next Generation. Dr. Jemison became the first real life astronaut to appear on the show! I can only imagine how many other young people she inspired to literally shoot for the stars just as she was originally inspired by the show!

After leaving NASA, Dr. Jemison has done a wide range of things in STEM. She has held professor positions at Dartmouth and Cornell. She has authored books for children and adults. She started an international space camp called The Earth we Share through her nonprofit the Dorothy Jemison foundation for excellence. This camp is for students ages 12-16 to improve their science literacy and problem-solving skills. She has also created many other events through this foundation. Dr. Jemison also created the Jemison group which is a quote "Technology consulting firm integrating critical socio-cultural issues into the design of engineering and science projects." She is currently the lead of the 100-year starship project whose goal is to make human travel outside of our own solar system possible within the next 100 years. This project is a highly

collaborative effort working to push innovation in a wide range of fields to make this goal a reality. The technologies invented as a result of this project could also help us improve our lives here on Earth. Dr. Jemison is doing even more than this - if you want to learn more about her, I encourage you to check out the website for the Dorothy Jemison foundation for excellence.

Dr. Jemison has also received many awards and honors for her work. She was inducted into the national women's hall of fame, national medical association hall of fame and Texas science hall of fame. She has also received many other awards including the national organization for women's intrepid award, the Kilby science award and more!

Dr. Jemison is admirable for her willingness to push the envelope throughout her career. I admire her perseverance and commitment to improving scientific literacy and moving our technological capacities forward. I know that she has inspired many young girls to pursue a scientific career and has opened up doors that will make it easier to do so.

**********Discussion ********** Kelsie: The Sixth and final woman we're going to discuss is Dr. Marci Bowers, a pelvic and gynecological surgeon. Dr. Bowers is the first trans woman to practice transgender surgery. She began her career as a gynecologist at the University of Washington before transitioning genders in 1997. She has stated that she "doesn't identify as a transgender woman but rather, a woman who has a transgender history". She trained under the famous surgeon Dr. Biber in Trinidad Colorado. At the time, Trinidad Colorado was considered the sex change capitol of the world due to the number of surgeries taking place there and the innovation and research on gender affirmation surgical technique. It was here that Dr. Bowers became a pioneer in gender affirmation surgery (also called sex reassignment surgery) and clitoral restoration after female genital mutilation. She developed the "Simple Metoidioplasty" where the labia and clitoral tissue is used to construct a penis as well as an innovative penile inversion surgery that is part of gender affirmation surgery for trans women.

Her one-stage procedure that is part of male to female transition is noted for "QUOTE" o utilizes tissue that is a) sensory, b) secretory, c) pink (a critical detail for anyone of color!), and d) non-hair bearing to line the inner labia. Embryologically, this mucosal tissue is derived from what did line the inner labia when all fetuses are female. To discard this critical tissue, as is done in Thailand and in two-stage procedures, is not what happens in nature and does not look truly natal. For example, hair should never grow between the labia minora! Quite simply, the procedure we perform is most compatible with the normal developmental process had the MTF been born female. Anything less embodies dinosaur technique that the world is slowly abandoning" Her webpage has many positive testimonials to how great the surgery is --- and more striking, is just how much the surgery has changed the lives of those who undergo it! From my understanding, this is a very personal and pivotal surgery for those transitioning and having a surgeon who specializes in it and is willing

to perform these surgeries and research new surgical methods, is just so pivotal to the patients. Patients discuss how they can feel comfortable in clothes and in themselves, in their sexual lives and daily lives. She has also helped to create some of the first medical education programs for gender transition surgeries in the US. Initiatives located at Mt Sinai in NY is 2016, Denver Health in 2018, and Women's College Hospital in Toronto in 2019. As of summer, 2019, she had performed over 2,300 sex reassignment surgeries; primarily male - to - female surgeries. She has been critical to proving that gender affirmation surgeries are not experimental, an argument once used to limit insurance coverage for the procedure. Additionally, she was a longstanding GLAAD Board member and A member of the National Board of Directors for Transgender Law Center. Her efforts in the transgender community are clearly not limited to her surgical skills. I'll end this piece with a quote that Dr. Bowers provided to a reporter. • I really like this quote ""Assigning gender identity on the basis of genitalia makes about as much sense as assigning it on the basis of height," Bowers said. "Biologically, we're much closer to each other because everyone starts out with a primordial female anatomy, so everything a male has, a female has, and vice versa. It's just a matter of how the cards are shuffled." • "And Marci can reshuffle them," Rohr responded with a smile."

**********Discussion**********

**********Closing Statements/Reflections**********

Kelsie: There are many people behind this podcast that you never get a chance to hear. Thank you to the Yale School of Medicine for being a home for YJBM and the podcast. Thank you to the Yale Broadcast Center for help with editing and publishing our episodes.

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