Patricia Era Bath: a community Ophthalmologist

Denis GUILHOT
ExploitDriver, Barcelona, Spain
* denis@exploitdriver.eu

Dr. Patricia Era Bath was not only a medical doctor but also an ophthalmologist, a laser scientist, a surgeon, a researcher, an inventor, an activist, and a humanitarian. She is best known as the inventor of laser cataract removal but also proposed a new discipline in medicine to promote technical, medical, and social aspects of eye care and blindness prevention. As such, she passively and actively allowed millions of people across the world to recover their sight.

https://doi.org/10.1051/photon/202110724

Dr. Patricia Era Bath. © UCLA

Patricia Era Bath was born on the 4th of November 1942, in Harlem, New York City, in the United States of America. Her father Rupert was a merchant seaman from Trinidad who went on to become the first Black motorman for the New York City subway system. Her mother Gladys was a housewife and domestic worker who used to "scrub floors so that her daughter could go to medical school". She is said to have sparked her daughter's interest in science by buying her a chemistry set. This interest, combined with her admiration for both her family physician, Dr. Cecil Marquez, and the humanitarian work of Dr. Albert Schweitzer with lepers in Africa, led her to pursue her ambition to become a medical doctor and help underserved communities. At the age of 16, she received a scholarship from the US National Science Foundation to join a research project on cancer at Yeshiva University. She contributed to the results through her derivation of a mathematical equation for predicting cancer cell growth which was included in a scientific paper presented by Dr. Robert O. Bernard at an international conference held in Washington, D.C.. This led her to win in 1960 one of ten Merit Awards from *Mademoiselle*, a woman's magazine aimed to the smart young woman. She went on to complete high school in two and a half years instead of four, before studying physics and chemistry as an undergraduate at Hunter College, New York City.

In 1964, she enrolled at Howard University College of Medicine in Washington DC, which she graduated from as a medical doctor (MD) in 1968. Dr. Bath joined the Harlem Hospital as an intern and completed

KEY DATES

1958:
Scholarship from the US National Science Foundation.

1968:
Graduates from Howard University as a medical doctor (MD).

1970:
Performs her first major eye surgery.

1976:
Co-founds the American Institute for the Prevention of Blindness.

a fellowship in ophthalmology at the Columbia University. By working in two different eye clinics, so close yet so different, it struck her that the rate of blindness in patients at Harlem Hospital was about twice as high as that at Columbia. She identified that that difference was mainly due to the lack of access to ophthalmic care of the black community, since no surgery was performed at Harlem Hospital. She convinced Columbia professors to perform surgery on blind patients at the hospital for free as part of Dr. Martin Luther King's Poor People's campaign and volunteered herself as an assistant surgeon. She performed her first major eye surgery in 1970 and started drafting her new concept of Community Ophthalmology, which she published in 1979 [2]. This new discipline aimed at promoting eye health and blindness prevention through programs leveraging public health, community medicine, and ophthalmology strategies in chronically underserved communities, and is now operative worldwide. Dr. Bath joined New York University in 1970 and became its first African American resident in ophthalmology. During this final step of her academic training, she married Dr. Beny J. Primm and gave birth to her daughter Eraka in 1972. In 1974, she moved to Los Angeles to simultaneously become an assistant professor in surgery at the Charles R. Drew University and in ophthalmology at the University of California, Los Angeles (UCLA). In 1975, she became the first female faculty member in the Jules Stein Eye Institute and the first African American female surgeon at the UCLA Medical Centre. In 1976, she co-founded the American Institute for the Prevention of Blindness (AIPB), a non-profit organization dedicated to the prevention of blindness through programs designed to protect, preserve, and restore people's sight. It advocates that eyesight is a basic human right and that primary eye care must be a component of basic health services provided for free, when necessary, to everyone. She then established the keratoprosthesis program at UCLA, to remove damaged corneas and replace them with artificial ones. She started experimenting on laser ophthalmology with a Lasag Microruptor II Nd:YAG lasers in single pulse and multiple pulse modes, with 12-ns pulse durations and energy levels between 1.1 and 4.0 mJ. Her experience in this field led her to direct the first national keratoprosthesis study in 1983. That same year, she became the first woman in the USA to he ad a postgraduate ophthalmology training program as Chair of the King-Drew-UCLA ophthalmology Residency Program. Meanwhile, she started working on a new concept, based on laser technology instead of the standard ultrasound probes, to remove cataract. *"When I talked to people about it, they said it couldn't be done"*, she later recalled. She could not pursue this idea satisfactorily since her funding proposals were not granted and she could not get access to the required lasers. Thus, she decided to take a sabbatical and was accepted as visiting professor on merits in several laboratories. First, she went to the Rothschild Eye Institute of Paris, where she was Dr. Danièle Aron-Rosa's mentee. She worked with her mainly on laser ophthalmology with mode-locked picosecond pulsed Nd:YAG lasers for a summer, before moving on to the Loughborough Institute of Technology, in the UK, and the University of Free Berlin's laser medical centre, Germany, where she began her study of laser cataract surgery and performed her first experiment with excimer laser phaco-ablation in human eyes. She went back to the USA and completed her research in 1986. She was also awarded the US patent No. 47,444,360 for the LaserPhaco probe in 1988, the first medical ● ● ●

"You can achieve your dreams. And even though there may never have been a girl or woman in that field, that should not be an obstacle to prevent you from achieving that. It's the impossible dream that I hope my work will make possible for all girls".

1979: Publication of the Community Ophthalmology Rationale paper.

1986: Completes research on the LaserPhaco technology.

1988: LaserPhaco probe patent granted.

2000: Ultrasound cataract removal patent granted.

2003: Combination of ultrasound and laser cataract removal patent granted.

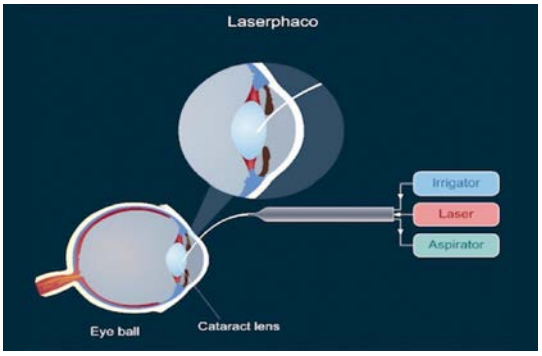

Figure 1. Schematic view of the excimer laser ablation of cataract with the LaserPhaco probe.
Step 1: Laser pulses change the crystalline lens material structure through ablation, fragmentation and/or disruption.
Step 2: Mechanical hydraulics fluid is injected to emulsify the lens fragments.
Step 3: Mechanical suction forces are applied to aspirate the emulsified lens fragments.

patent granted to an African American female doctor. That same year, she was elected to the Hunter College Hall of Fame.

But what is the LaserPhaco probe invention about? Cataract occurs naturally over time, when the lens of the eye, located behind the iris and the pupil, becomes opaque. It is very common amongst the senior population and leads to distorted vision and ultimately blindness. It accounts for more than half of all avoidable blindness cases in the world [3]. Patricia Bath invented the excimer laser ablation of cataract and the LaserPhaco probe, that allows an excimer laser emitting at 308 nm to ablate the cataract through a fibre optic probe and a 1mm insertion into the eye so it can be removed and replaced by an artificial lens. She initially used a Lambda Physik 102 xenon chloride excimer laser and a quartz silica optical fibre (see Fig. 1). This laser was selected over the 193 nm excimer laser since it was more difficult to transmit through optical fibre while there was no evidence that it was preferable for the human eye. The laser was operated with 17-ns pulses at a repetition rate of 1 to 100 Hz, with energy output of 0 to 230 mJ. She discovered that ablation of tissues occurred for human lenses at a threshold of 0.5 J/cm^2. The LaserPhaco technology was a major breakthrough in cataract surgery. It also laid the foundations of all laser-enabled cataract surgery techniques developed since, such as femtosecond Laser Assisted Cataract Surgery (FLACS), the most widely used technology amongst laser cataract surgeons. This has enabled techniques which will account for an estimated 1.1 million surgeries globally per year by 2022 [4]. This represents a 1 billion US dollar market in equipment only.

"Many times, these days, I get asked what do I think my greatest accomplishment has been. Philosophically, I like to think that my greatest accomplishment has to be in those moments when I've helped someone see. [1].

Between 1988 and 1993, Dr.Bath also practiced ophthalmology in the private sector in Santa Monica, California. In 1993, she retired and became the first woman elected as honorary staff of the UCLA Medical Centre. She was also named a "Howard University Pioneer in Academic Medicine".

In 2004, she was dubbed one of "California's Remarkable Women" in an exhibit organised by the California State History Museum.

Even after retiring, Dr. Bath continued her work towards curing blindness in several ways. She performed more top-level research, even receiving more patents in 2000 and 2003. She also started advocating for telemedicine, which led her to be appointed to President Barack Obama's commission for digital accessibility for the blind in 2009. She remained director of the AIPB and travelled on several humanitarian missions in which she taught, donated equipment, lectured, and even restored the sight of countless people through keratoprosthesis, some of whom had been blind for 30 years.

Because of her gender, origins, and ambition, Patricia Bath faced discrimination many times, even in her professional life. When she was growing up, there were no high schools in Harlem. She did not have models of female physicians and surgeons, which were male-dominated professions. Black people were excluded from many medical schools and medical societies. At medical school, women were not allowed to seat in the front row. When she became the first woman faculty member in her department, she was offered to share an office with the secretaries since they were all women, instead of the other all-male faculty members offices. She was also offered an office in the basement, next to the lab animals, which she refused, and succeeded in getting acceptable office space. She also reached a glass ceiling in the

1980s when her research proposals were not funded, and her colleagues would tell her that her idea for laser-enabled cataract surgery would not work. *"I didn't waste time with phone calls or petitions about the unfair and discriminatory practices of the National Institutes of Health or the National Eye Institute"* she said. Instead, she opted for her sabbatical and pursued her research in Europe. She explained in an interview on Good Morning America in 2018: *"I had a few obstacles, but I had to shake it off. That's the noise and you have to ignore that and keep your eyes focused on the prize"*.
She died on the 30th of May 2019 at the UC San Francisco medical centre, California, from complications due to cancer. She was granted five patent families (three on the LaserPhaco technology, one on ultrasound cataract removal and one on a combination of laser and ultrasound for cataract removal), 25 patents globally, and co-authored more than 100 scientific papers. In 2020, she was nominated as a candidate to the U.S. Patent Office's National Inventors Hall of Fame. Although she was not one of the 2021 new inductees [5], she is expected to one day become the first Black Woman in this prestigious Hall of Fame.

REFERENCES

[1] Conversation Between Patricia Bath, MD and Eve Higginbotham, MD. The Foundation of the American Academy of Ophthalmology Museum of Vision & Ophthalmic Heritage, Orlando FL, October 23 (2011).

[2] P.E. Bath, Rationale for a Program in Community Ophthalmology, Journal of the National Medical Association **71(2)**, 145-148 (1979).

[3] https://www.cureblindness.org/cause. Retrieved on the 3rd of January 2021.

[4] https://eyewire.news/articles/steady-growth-in-cataract-surgical-procedures-is-expected-over-the-next-5-years/. Retrieved on the 3rd of January 2021.

[5] https://www.invent.org/inductees/new-inductees. Retrieved on the 3rd of January 2021.