ABSTRACT

The Thomas-Taussig-Blalock Shunt: Partners of the Heart

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Three individuals played important roles in the development of the surgical procedure to fix the congenital heart defect called tetralogy of Fallot, also known as the "blue baby" syndrome. These individuals include a white doctor named Alfred Blalock, a white doctor named Helen Taussig, and a black, or African American, lab technician named Vivien Thomas. In my first chapter, I discuss the history of the tetralogy of Fallot and the setting during which the development of the surgical procedure took place in 1944. In my second chapter, I introduce Thomas and Blalock and describe the beginning of their partnership at Vanderbilt University. In the third chapter, I introduce Helen Taussig and describe how this procedure came about at The Johns Hopkins University. In my final chapter, I discuss the recognition that Thomas eventually received and evaluate the way racial and occupational hierarchies affected Thomas and Blalock's mutually beneficial 34-year partnership.

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THE THOMAS-TAUSSIG-BLALOCK SHUNT: PARTNERS OF THE HEART

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To Mom and Dad, for all your love, support, and encouragement

CHAPTER ONE

Introduction

Three individuals played important roles in the development of the surgical procedure to treat the congenital heart defect called tetralogy of Fallot, also known as the 'blue baby' syndrome. These individuals include a white, male cardiovascular surgeon named Alfred Blalock, a white, female pediatric cardiologist named Helen Taussig, and a black or African American, male lab technician named Vivien Thomas. Taussig diagnosed tetralogy of Fallot as the cause of the cyanosis that was present in her pediatric patients. She approached Blalock about a surgical procedure to repair the hearts of these children. Blalock then left it to Thomas, his lab technician, to find a surgical procedure to repair these defects. Thomas recreated tetralogy of Fallot in a dog and designed a procedure to treat the defect. At the time of the first blue baby operation in 1944, Blalock had only assisted Thomas with the procedure in the lab. During the first procedure, and many times after that, Thomas stood over Blalock's right shoulder offering advice when solicited. The name of this procedure, the Blalock-Taussig Shunt, disregards the fact that Thomas did most of the work that made this procedure possible. Thomas' lack of recognition is a direct result of his racial and occupational statuses. My thesis is that the inferiority of African Americans during this time and the inferiority of lab technicians in the medical field caused Thomas' contributions to be overlooked.

Tetralogy of Fallot

Tetralogy of Fallot is a congenital heart defect that is made up of four related heart defects: a ventricular septal defect, pulmonary stenosis, an overriding aorta, and right ventricular hypertrophy (Fig. 1).

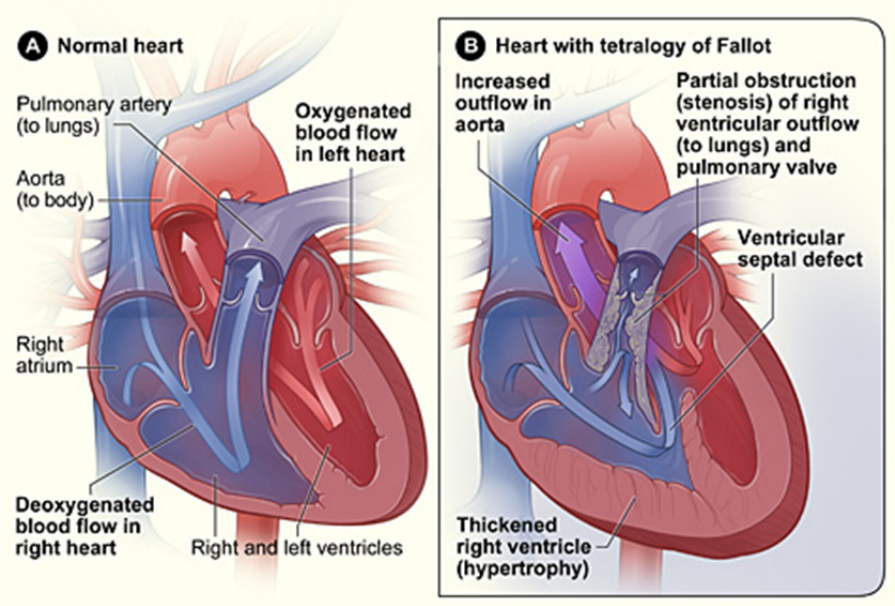

Fig. 1. Normal heart versus a heart with tetralogy of Fallot (Dept. of Health and Human Services 2011)

These defects reduce the amount of blood pumped to the lungs to receive oxygen. This lack of oxygen in the blood causes cyanosis, a blue tint to the skin. Although it is rare, tetralogy of Fallot is the most common form of cyanotic congenital heart disease. Tetralogy of Fallot represents 4-9% of congenital heart defects (BMJ). Cyanosis is not always present at birth, but sudden episodes of bluish skin, known as Tet spells, may occur during crying or feeding (A.D.A.M. Medical Encyclopedia). If cyanosis is present at birth, it only occurs in the lips and in the nail beds (Medscape). Cyanosis appears in the skin within the first six months of life in 75-90% of infants with this defect (Bonchek et al. 1973, 392).

The exact cause of many congenital heart defects is unknown, but it is thought to be due to genetic or environmental factors. Many prenatal factors have also been shown to increase the risk of congenital heart defects. These factors include alcohol use of the mother, diabetes, pregnancy over the age of 40, poor nutrition, and rubella or other viral

infections during pregnancy. Children with tetralogy of Fallot are more likely to have chromosomal disorders and DiGeorge syndrome, a condition that results in heart defects, low calcium levels, and immune deficiency (A.D.A.M. Medical Encyclopedia).

In addition to cyanosis, symptoms of this defect include clubbing of fingers, difficulty feeding, failure to gain weight, loss of consciousness, poor development, and squatting during episodes of cyanosis (A.D.A.M. Medical Encyclopedia). Clubbing of the feet begins to occur between the ages of 3-6 months (Medscape). Squatting during cyanotic episodes is an attempt to compensate for the lack of oxygen in the blood. Children with this cardiac defect are often tired and slouch when sitting, to help with the flow of oxygen. They also experience delayed growth and development, arrhythmias, and seizures if they do not have enough oxygen. After a child presents with these symptoms, various tests are performed to confirm a diagnosis. The tests include a chest x-ray, complete blood count, echocardiogram, electrocardiogram, and an MRI of the heart. A physician will also be able to hear a heart murmur when listening to the patient's heart with a stethoscope. Before surgery was available, children with this defect died before they reached the age of 20 (A.D.A.M. Medical Encyclopedia).

A number of individuals described tetralogy of Fallot before Étienne-Louis Arthur Fallot, for whom the defect is named in the 20th century. This cardiac defect was first identified in 1673 by Niels Stenson, also known as Nicolas Steno. Stenson described an abnormal heart with defects similar to those of tetralogy of Fallot. In addition to the cardiac defects, Stenson also noted a cleft palate and a harelip in a stillborn infant (Neill and Clark 1994, 272). In 1777, Eduard Sandifort gave a description of symptoms and anatomic findings that matched tetralogy of Fallot in a "blue boy." He also described the

blue color in his fingers and what he described as "sinking spells," which is most likely called a Tet spell today (Neill and Clark 1994, 273). In 1784, William Hunter described similar cyanotic spells and the unique growth pattern of a boy with tetralogy of Fallot. Hunter wrote that the boy was of normal height, but lacked normal weight (Neill and Clark 1994, 273).

Étienne-Louis Arthur Fallot was a professor at the University of Marseilles in 1888 when he published his findings on the heart defect named after him. The 98-page article titled "Contribution á l'anatomie pathologique de la maladie bleue" was published in installments in the French journal, *Marseilles Médical*. In this work, Fallot credited the individuals who had previously described the heart defects. Fallot used the French word *tetralogie* to describe the defect and divided it into four abnormalities based on anatomical and clinical aspects. The abnormalities he named were pulmonary artery stenosis, ventricular septal communication, rightward deviation of the aorta's origin, and right ventricular hypotrophy (Evans 2007, 637). Fallot also rejected the traditional notion that cardiac cyanosis was always due to patency of the foramen ovale. He also acknowledged that the tetralogy he described was the most common cyanotic cardiac defect (Neill and Clark 1994, 274).

These cardiac defects did not become known as tetralogy of Fallot until 1924, when Maude Abbott, the founder of pediatric cardiology, first used the English eponym in an article classifying congenital heart defects. French physicians had referenced Fallot's work before, but they did not usually include "*tetralogie de Fallot*" in their publications (Evans 2007, 637-638). Abbott is also responsible for circulatory and aucultatory diagrams, the chest x-ray, and the 3-lead electrocardiogram for tetralogy of

Fallot, which she illustrated in 1936. She was very influential in establishing the idea that a specific clinicopathology existed for every cardiac defect (Neill and Clark 1994, 274). Abbott's use of the term in her 1936 *Atlas* helped make it more popular. She also inspired others to study congenital heart diseases, so that they can be diagnosed and treated. Helen Taussig was one person in particular who was greatly influenced by Abbott's work.

The Setting

Racial Status

The collaboration between Alfred Blalock, Vivien Thomas, and Helen Taussig occurred at a time in the United States when race greatly dictated a person's status in society. In the early to mid-twentieth century there was a sharp division between Whites and African Americans. African Americans did not have the same status or opportunities as Whites in education or in the workplace. African Americans were second class citizens, and many laws kept it that way. Legislation like Jim Crow laws, which lasted from the 1870s to the mid-1960s, enforced segregation and sanctioned the use of separate facilities and accommodations for Blacks and Whites. The lesser quality of facilities for Blacks further emphasized their inferiority in society. Jim Crow laws regulated everything from public transportation and restaurants to interracial marriage and cohabitation (NPS). These laws worked to ensure that Blacks and Whites had as little contact with each other as possible.

Jim Crow laws also regulated education and required separate schools for Blacks and Whites. Like other facilities for Blacks, the schools were not as good as the schools

for Whites. Black schools received less funding from state governments and lacked adequate supplies, such as textbooks. The textbooks they did have were not as good as the textbooks used in white schools. The level of education that black children received was not as good as that of white children due to this lack of resources. The lower level education put black children at a disadvantage and reinforced the idea that African Americans had limited intellectual capabilities when compared to Whites. Whites were also more likely to attend school longer and start school at an earlier age than Blacks. In 1900, 72.2% of white boys from age 6-13 attended school, while only 37.8% of black boys in the same age group attended school. In 1940, the average number of years of school attended by black men aged 20 and older was 5.9 years, while the average number of school years attended by white men was 9.1 years (EH.Net Encyclopedia 2010). This lower level of education also reduced the quantity and quality of jobs available to black men. There were a higher number of African Americans working in agriculture and unskilled labor positions than in positions requiring more skill or education. In 1900, 53.5% of African American men worked in agriculture and 25.5% held other labor positions. Only 1.3% of African American men held professional or technical jobs compared to 3.8% of white men (EH.Net Encyclopedia 2010). The difference between the education and job prospects of Blacks and Whites is reflected in the average annual incomes of each group. In 1939, the average income of black men was $537.45, while that of white men was $1,234.41 (EH.Net Encyclopedia 2010). These gaps in job prospects and income are the result of a segregated education system that put black children at a disadvantage from the beginning, and instilled a sense of inferiority that followed them into adulthood.

Jim Crow laws were used to maintain white supremacy and control Blacks who tried to defy the unspoken social norms dictated by racial etiquette. In addition to regulating access for Blacks, these laws had a more subtle effect on the way Whites and Blacks interacted with each other. Blacks were expected to accept their inferior place in society and not to attempt to rise above it. Aspiring to rise above this status could result in harassment, assault, or even death. Positive qualities such as confidence, intelligence, and economic success could be very dangerous for African Americans, especially in the South (Shmoop Editorial Team 2008). Their words, actions, and etiquette toward Whites were expected to reflect the notion that Whites were superior to Blacks. Blacks were expected to have a submissive attitude in their encounters with Whites. Civil Rights activist, Clifford Boxley recalls his experience interacting with Whites during the Jim Crow era in a first-hand narrative account:

> But then, there were times in growing up here in Jim Crow Natchez where you had to use survival psychology…we call it "black psychology." That's the time when I would grin, shuffle, say "Yes Sir" or "No Sir," look down. All of those things that said that you were inferior…but, that was a survival tactic. Even at a very young age, we understood how to survive in a racist and very violent system [,]…what the codes of social relationships were between white and black, and the demand that blacks be submissive to white dominance. (The History of Jim Crow)

This submissiveness can be seen in the names that Blacks used to address Whites and vice versa. Blacks were expected to address white men in authority positions as "Boss" or "Cap'n". White men and women whom Blacks were more familiar with were addressed with Mister or Miss, respectively, in front of their first name. Instead of their first names, black men were referred to as "Boy," "Uncle," and "Old Man," with no regard for their actual age. Black women were called "Auntie" or "girl" instead of their

first names. Black men and women were never addressed as Mister or Miss because it implied a sense of respect. A white person might also use "nigger" or "nigger-fellow" to refer to a black person that he did not know, but some Whites were uncomfortable with the term because most Blacks were offended by it. It was also common for Blacks to be reduced to the word "Negro" in news stories to imply a lack of significance to their lives and to their deaths (The History of Jim Crow). Boxley recalls his experiences with Jim Crow etiquette:

> The Jim Crow norm was to say, "Yes Ma'am," and "No Sir," especially to whites here in Natchez, Mississippi. In 1955, I dropped out of school and went to work at Gilbert's Drugstore…I went to take some drugs down there, and I didn't say "Yes Ma'am" to the lady, and she called and tried to get me fired. (The History of Jim Crow)

There were also certain social norms to be observed in casual encounters between Whites and Blacks. Blacks were not allowed to correct or challenge Whites, even if the white person made a mistake. Out of courtesy, Black men had to remove their hats when speaking to a white person. Blacks were also expected to move off of the sidewalk if a white person was walking toward them (The History of Jim Crow). All of these laws and social norms required Blacks to demonstrate their inferiority, and upheld the notion of white supremacy. As a black man, Thomas had a lower status in society than Blalock or Taussig. His racial status greatly influenced the lack of recognition he received for his medical contributions.

Occupational Status

Thomas' occupational status as a lab technician also greatly affected the way his contributions were overlooked. Lab technicians are on the lower end of the medical hierarchy. They are only as valuable as the work that they do for their superiors, who

direct the lab. Stefan Timmermans writes that lab technicians "do not exist with a name, race, gender, or identity, only a function" (Timmermans 2003, 197).

It is the norm for lab technicians not to receive credit or recognition for their work. Lab technicians were invisible contributors, and no one knew of their contributions except other people who worked in the lab. They did much of the work and even helped to write papers, but did not receive authorship. In Blalock's lab, Thomas would set up, conduct, and write up the results for experiments that stemmed from one of Blalock's "what if" questions. Thomas would leave the results for Blalock to look over when he returned to the lab. Blalock would then use Thomas' notes to write a paper about the experiment. In his autobiography, *Partners of the Heart: Vivien Thomas and His Work with Alfred Blalock*, Thomas describes the way Blalock relied on his notes and his advice when writing a paper:

> Inasmuch as he was able to spend only limited time in the laboratory to observe experiments, he was almost completely dependent upon my notes. Over the Hopkins years, it was not uncommon for him to call me while writing a paper. On these calls he would say something like, "Vivien, I want you to listen to this." He would then proceed to read two or three sentences from his manuscript and then ask, "Is that your impression?" On other occasions he might say, "On such and such experiments, can I say so and so?" or "Is it all right if I say so and so?" (Thomas 1998, 78)

In the 34 years that they worked together, Blalock and Thomas only shared authorship on two papers; one with Dr. Raymond Heimbecker and the other with Dr. Jerome H. Kay. One endnote in a paper and one sentence in the forward of one of Blalock's books make up the entirety of Blalock's references to Thomas in his publications (Timmermans 2003, 197). The sentence in the forward and the endnote in which Thomas received recognition are usually the best that a lab technician can hope for. Even if they do receive an acknowledgement, Timmmermans notes that it is usually "in an aside under 'valuable

assistance' or overshadowed by their employer's authority" (Timmermans 2003, 198). Lab technicians are reduced to "valuable assistance" without regard to the significance of their contributions.

Status Dilemma

Thomas' racial status as a black man and his occupational status as a medical lab technician presented what American sociologist Everett Hughes described as a social dilemma. The idea originally came from Robert E. Park when he described the "marginal man." The marginal man refers to a "racial hybrid-who, as a consequence of the fact that races have become defined as status groups, finds himself in a status dilemma" (Hughes 1945, 353).

Hughes elaborates on this concept of status dilemma in his essay "Dilemmas and Contradictions of Status":

> In the struggle for achievement, individual traits of the person stand out as separate entities. And they occur in peculiar combinations which make for confusion, contradictions, and dilemmas of status. (Hughes 1945, 353)

Thomas' racial status and his occupational status were a contradiction. In the 1940s, the racial status of African American and the occupational status of medical professional did not fit the stereotype that most Americans were comfortable with. When Americans pictured their ideal physician, they pictured "a white, male, Protestant physician of old American stock and of a family of at least moderate social standing" (Hughes 1945, 354). People in certain professions were expected to be of a specific race, sex, origin, and religion. All of these traits determined the status of an individual, but "membership in the Negro race" was considered the "master status-determining trait. It tends to overpower…any other characteristics which might run counter to it" (Hughes 1945, 357).

The progress of a group of people with a particular trait to a new occupational level is accomplished by placing these individuals in places where they would be hidden from most people; places such as libraries and laboratories. Hughes writes that places like the library and the laboratory are "where they get the prestige of research people but are out of the way of patients and the public" (Hughes 1945, 359). Placing individuals in places like these reduced their status dilemmas by separating the outside world from the occupational world. When these individuals are separated from the outside world, they are constantly invisible to the public. Timmermans writes that "in science, this invisibility manifests itself as a lack of credit" (Timmermans 2003, 201). Thomas' experience provides an example of this concept. Lab technicians work behind the scenes, which makes it easier to overlook them and their work. During the Jim Crow Era, a time when Blacks were considered inferior to Whites, it was even easier to overlook the contributions of a black lab technician.

CHAPTER TWO

The Partnership

Vivien Theodore Thomas

Vivien Theodore Thomas was born on August 29, 1910, in Lake Providence, Louisiana. He was the fourth of five children born to William Maceo and Mary (née Eaton) Thomas. Because of the persistent annual flooding of the Mississippi, William and Mary moved their family to Nashville, Tennessee in 1912. The family settled in the northwest part of Nashville, where the majority of the population was black and extended beyond the city limits. Thomas' father, who was a carpenter and a contractor, bought a plot of land over half an acre on which he built the family house. Thomas and his brothers learned carpentry from their father. They had to work with their father for two and half hours every day after school and five hours on Saturdays. Thomas started learning carpentry under his father at the age of thirteen, and he was able to perform tasks unassisted by the age of sixteen. Working under his father in carpentry taught Thomas a marketable skill, as well as the value of hard work. Work with his father also gave Thomas dexterity and the skill to work with tools, which would eventually contribute to his success when performing surgical procedures.

William Thomas made sure that his children knew the value of a dollar, and he wanted them to understand that nothing in life is free. William paid his sons hourly wages for the work they did for him and docked their pay if they showed up late after school. After giving his sons their pay each Saturday, he reminded them to give their mother something for cooking them dinner and doing their laundry. In his autobiography, *Partners of the Heart: Vivien Thomas and His Work with Alfred Blalock*,

Thomas writes that his father did not expect them to pay room and board, but they were responsible for their own clothing. He adds, "no one ever bought any wearing apparel for me after I was fourteen years old" (Thomas 1998, 6). Thomas made a habit of working for his father all day during the summer, so that he would have money to buy new clothes for school in the fall.

Thomas also praises the public school system and the institutions of higher learning that were present in Nashville, when he was growing up. Thomas began his schooling at the age of six, when he attended kindergarten at Fisk University. The public school system did not take kids until they reached the age of seven, which was not early enough to satisfy Thomas' parents. After kindergarten, Thomas entered the public school system and remained there until he graduated from high school. Thomas observes that the teachers were very concerned that their students receive a good education, and they did not tolerate mischief in their classrooms. The teachers encouraged competition amongst the students in the form of spelling bees, gold stars, and the honor roll. He also admires the "unbelievable cooperation between parents and teachers," and the way they kept in contact with each other to monitor the progress of each student (Thomas 1998, 5). Thomas attended all black schools, and recalls that "[the students] were not different from any other children, but [they] were encouraged, motivated, and stimulated by both parents and teachers" (Thomas 1998, 5).

Nashville was also home to many institutions of higher education for Blacks. One such institution, Fisk University, was located two blocks from the Thomas home. Nashville was also home to Meharry Medical College, which was one of only two medical schools in the country that granted admission to qualified African Americans.

(Howard University School of Medicine in Washington, D.C. was the other medical school that accepted Blacks.) Other schools for African Americans included Tennessee Agricultural and Industrial State College and a Methodist school named Walden College. Nashville was also home to many schools that only accepted white students. One of the best known institutions was Vanderbilt University, where Thomas would eventually be employed as a technician in Blalock's lab.

After graduating from Pearl High School in 1929, Thomas got a job on the carpenter's crew at Fisk University. His talent and good work ethic ensured that his job would last through the fall instead of ending at the end of the summer. Thomas planned to save enough money to attend Tennessee Agricultural and Industrial State College and then continue on to medical school. He thought that he would have enough money to enroll in February of the following year, but the stock market crash in October of 1929 led to the termination of his carpentry job. Thomas took a series of small jobs to help support the household. He did not touch the money that he had saved for school, but he knew that he would need another full-time job to afford school in the spring.

Charles Manlove, Thomas' friend, worked at Vanderbilt University in the Department of Bacteriology. Thomas asked Manlove if he knew of any job openings at the university. Manlove said that he knew of one job opening in the lab of Dr. Blalock, but he warned Thomas that Blalock had a reputation of being "hell to get along with and didn't think [he'd] be able to work with him" (Thomas 1998, 9). Thomas was desperate for a source of income and decided to take his chances with the job. In February of 1930, Manlove took Thomas to meet Dr. Alfred Blalock.

Alfred Blalock

Alfred Blalock was born on April 5, 1899 in Culloden, Georgia. He was the oldest of five children born to George and Martha (née Davis) Blalock. George Blalock ran the local general store and was the head of the local bank. He also owned a large amount of land that was farmed by tenant farmers, who produced mainly cotton. After he married Martha, who was almost thirteen years his junior, he had a large, two-story house built in which they would start their family. In a letter written by Georgia Blalock, the youngest Blalock child, to Dr. William P. Longmire, Chief Resident during the blue baby operation and author of *Alfred Blalock: His Life and Times*, Georgia wrote that her father was a strict disciplinarian who placed a great value on education. She also describes him as an honest, demanding, and difficult man to please, who held his children to a high standard (Longmire 1991, 23). In 1911, when Blalock was eleven, the family moved to Jonesboro, Georgia. This move was motivated by George Blalock's stomach and intestinal problems. The move gave him better access to the good medical care that was provided in Atlanta. Blalock wrote that the move was also motivated by his father's desire to retire from business and by the presence of relatives in Jonesboro.

In an interview with Longmire at his home in Jonesboro, Edgar Blalock, the second oldest of the Blalock children, recalls a time when his father traveled to The Johns Hopkins University to have part of his stomach or intestines removed (Longmire 1991, 25). George was so impressed by Hopkins that upon his return home, he told Alfred that he wanted him to be a doctor, and that he wanted him to go to medical school at Hopkins. Edgar could not think of anything else that could have motivated his brother to attend Hopkins and become a doctor. Georgia Blalock and Elizabeth (née Blalock) Blackford,

the third Blalock child, gave the same explanation to account for their brother's interest in medicine. Georgia writes, "I grew up knowing that Father felt Hopkins was the best medical facility in the world. In my opinion, it was his influence on Al that led to Al's decision to study medicine at that institution" (Longmire 1991, 25). In a letter to Longmire, Elizabeth recalls that their "father had been a patient there and was pleased with his treatment" (Longmire 1991, 25). Blalock himself was never able to name his motivation for pursuing a career in medicine, claiming that his "interest in medicine arose at such a young age that [he could not] trace its development" (Longmire 1991, 32).

Blalock was very studious and popular when he was growing up, especially with the ladies. He also enjoyed sports and played on the tennis and baseball teams in high school. Blalock also had a paper route in the afternoons, when he was in school. At the age of fourteen, Blalock attended Georgia Military College, a preparatory school for the University of Georgia, located in Milledgeville. He enrolled as a senior and already had credits that applied toward his freshman year in college. In 1915, he graduated from Georgia Military College and started taking classes at the University of Georgia over the summer. That fall he started at the University of Georgia as a sophomore at sixteen years of age. Blalock enjoyed zoology more than any other subject, when he was in college. In addition to attending school, Blalock helped at home. He helped with "diverse duties such as milking cows, working in the garden, and cutting the grass" (Longmire 1991, 30). In 1918, at the age of nineteen, Blalock graduated from the University of Georgia with a Bachelor of Arts degree. That same year, Blalock reached the high standard his father set for him when he was accepted at The Johns Hopkins School of Medicine.

In his book, Longmire observes that because Blalock earned above average grades in high school and college, he might have expected to experience the same level of academic achievement in medical school without an increase in effort. Blalock recalls that his "first year in medical school was a rather difficult one and [he] worked exceedingly hard" (Longmire 1991, 30). He goes on to say that he "did not study as much as [he] should have during the last three years in medical school and [his] grades suffered somewhat as a result" (Longmire 1991, 30). In medical school, Blalock had an active social life, was involved in extracurricular activities, and held a job at The Johns Hopkins bookstore to help pay for school. Tinsley Harrison, Blalock's close friend and roommate, describes Blalock's interests and personality in medical school:

> While Al Blalock was in medical school he ran the student book store and…he was devoted to tennis and golf…He was very much the ladies' man and often had social engagements…two or three evenings a week. On the other hand, he never wasted a minute…he worked at his medical studies continuously. I never saw him stop in the living room of the fraternity house just to sit around and gossip…Because of these several interests, Al was not an outstanding student when it came to grades. (Greevy 2003, 160-63)

Harrison and Blalock shared a love of tennis and would eventually win the doubles championship of Nashville in 1925. Harrison will be very influential in Blalock's appointment as the first Chief Resident of Surgery at Vanderbilt. Longmire recalls golfing with Blalock on many occasions. Blalock did not have a very good golf game at first, but he improved with each game. Longmire writes that Blalock's improving golf game along with his reliance on his caddy, display two of his strongest characteristics: "(1) his desire to do whatever he does well, and (2) his custom of utilizing, in a very gracious manner, the skills and abilities of those about him" (Longmire 1991, 35). When golfing, Blalock often consulted his caddy, an African American boy named Richard,

about which club was most appropriate and ways to improve his swing. Blalock's relationship and dependence on his caddy has parallels to his future relationship with Thomas. Longmire writes that Blalock's dependence on Richard was typical of his relationships with individuals who were in positions of assistance. He comments on Blalock's dependence on people who assisted him and the way others perceived his dependence:

> His apparently unabashed reliance on the help and advice of those about him was easily misunderstood by the casual acquaintance as evidence of insecurity or even incompetence, and has led some to give much greater credit than is justified to the role of assistants and associates in some of his contributions. Blalock did not necessarily need other people, but as a facet of his generous personality he liked to elicit their help and support. He was magnanimous to a fault in recognizing the efforts of others. (Longmire 1991, 36)

Throughout his book on Blalock, Longmire emphasizes this idea that too much credit was given to supportive players who were involved in projects with Blalock. At first it seems like he is referring to Thomas, which is interesting because he did not receive credit for his involvement in the blue baby operation until thirty years later. It became clear that Longmire was referring to Helen Taussig's involvement in the blue baby operation. Many cardiac surgeons believed that she received more credit than she deserved for developing the operation, which is covered in more detail in the next chapter. Even if Longmire was referring to Taussig, some of his statements still appear problematic. Specifically, the accuracy of his statements that "Blalock did not necessarily need help," and that he was "magnanimous to a fault in recognizing the efforts of others" can be debated. Blalock only recognized his superiors for their efforts, but overlooked his subordinates. In the context of the blue baby operation, Blalock had only assisted with the procedure in the lab before performing it on a patient for the first

time. During the first operation, he needed guidance from Thomas, who had performed the surgery on dogs multiple times. The fact that Thomas was not an author on the publication of the blue baby operation and did not receive any significant recognition for his efforts until 1971, seven years after Blalock's death, shows that Blalock was not as "magnanimous to a fault" at giving recognition as Longmire suggests.

When Blalock graduated from Hopkins in 1922, he was hoping to earn an internship in general surgery. However, his grades were not high enough and instead he was offered an internship in urology, his second choice. The urology internship rotated between urology, gynecology, and general surgery. He spent six months in urology and three months in each of the other two fields, so he was not completely out of general surgery. Blalock's first two publications, which were about the gallbladder and biliary system, gained the attention of acting Chief of Surgery Dr. J.M.T. Finney. Finney was so impressed that he offered Blalock the position of first-year assistant resident in general surgery for the next year. Blalock's hard work allowed him to put his career back on track. An incident surrounding the appointment of the new chief of surgery would derail his career again. The surgical residents did not like the man who would most likely become their next Chief Resident. All of the residents met and made a pact that they would turn down appointments to the residency program the next year, if this man was to become the next Chief Resident. Finney offered Blalock a residency position for the next year and after Finney confirmed who would become Chief Resident, Blalock turned down the offer. After talking with another resident, Blalock discovered that they called off the pact the night before when they heard who would become Chief Resident.

Blalock was the only one who followed through on the pact and the only one who lost his position at the end of the year.

Blalock's relationship with Samuel Crowe, founding chief of the otorhinolaryngological service at Hopkins, led to his appointment as an extern the next year. At the end of this position, Blalock went to Boston in hopes of finding a position at the Peter Bent Brigham Hospital. Before he could unpack, he received a call from Tinsley Harrison about an opportunity at Vanderbilt University. Harrison was going to be the first Chief Resident in medicine of a new hospital that was being built at Vanderbilt, and he wanted Blalock to join him as the first Chief Resident in surgery. Blalock accepted and headed to Nashville in 1925. Harrison was very influential in stimulating Blalock's interest in research and experimentation. Blalock had done research during his year as an extern, but he did not focus on it until he arrived at Vanderbilt.

Vanderbilt Years

On February 10, 1930, Thomas and Manlove went to Vanderbilt University to meet with Blalock about the position in his lab. Manlove showed Thomas around the bacteriology lab while they waited for Blalock to finish a surgery. When Manlove introduced Thomas to Blalock, Thomas recalls that "he was very cordial and polite," and that "his manner was very easygoing, quiet but serious" (Thomas 1998, 9). Blalock invited Thomas into his office and asked him about his education and his family. Thomas said that he had graduated from high school and explained his financial situation, and that he hoped to go on to medical school after college. Blalock then began to describe what type of person he was looking to hire as a technician in the lab. Blalock

would be spending more time with patients and would have less time to spend on his research. He wanted someone in the lab to continue his research and experiments, when he was working with patients at the hospital. Thomas remembers how Blalock described what type of person he was looking for:

> I want someone in the laboratory whom I can teach to do anything I can do and maybe do things I can't do. There are a lot of things that haven't been done. I want someone who can get to the point that he can do things on his own even though I may not be around. (Thomas 1998, 10-11)

Blalock gave Thomas a tour of the lab and explained what he was working on. He also introduced Thomas to two other men who worked in the lab, Samuel Waters and Isaac Bodie. Thomas was hesitant to accept the job after learning that he would be paid $12 a week, which was significantly less than the $20 a week he received on the carpenter's crew at Fisk University. To help convince Thomas, Blalock told him that there would be a salary increase in three or four months. Telling himself that this job was only temporary and that he would return to the carpenter's crew in the spring, Thomas accepted the job.

The next day, Blalock showed Thomas how to weigh and anesthetize a dog for an experiment. At the end of the day, Blalock told Thomas that he could get the dog set up for the experiment the next day. Thomas was shocked; he did not expect to have to work on his own so soon. When Thomas asked Waters if he was really expected to set up the experiment on his own Waters replied, "Sure he expects you to do it; he won't show you but once" (Thomas 1998, 13). Thomas was able to set up the experiment with Waters' help. Each day Blalock showed Thomas another task that would become his responsibility. Thomas paid very close attention to each lesson in order to know how to perform on his own the next time. Most of the experiments that Thomas worked on were

part of Blalock's research on hemorrhagic shock. The current ruling theory on shock was that of Cannon and Bayliss, which stated that shock was caused by an agent that circulated throughout the body. Blalock published a paper that disproved this theory in 1927. By inducing shock in dogs and measuring cardiac output, he was able to prove that shock is the result of an excessive loss of fluid. This discovery caused a decline in the mortality rate of shock and greatly reduced the number of soldiers who died from shock during World War II.

Despite prohibition, Blalock kept a ten-gallon keg of whiskey in the laboratory storeroom. Thomas did not discover it until Blalock needed help siphoning it off one night. Thomas recalls only two or three occasions when Blalock offered him a drink of whiskey and Coke, "each time being when we were working far past 5 o'clock and everyone had left the laboratory" (Thomas 1998, 17). In the Jim Crow era, an empty laboratory would have been the only place where Blalock and Thomas could have a drink together. They would never cross the color line in a social setting and did not socialize outside of the lab. Blalock was only willing to challenge the color line if it involved his research.

Thomas and Blalock did not have any problems and worked well together for about two months. They had their first problem when Thomas made a mistake in the lab. Blalock became angry and "sounded off like a child throwing a temper tantrum. The profanity he used would have made the proverbial sailor proud of him" (Thomas 1998, 16). Thomas did not react while Blalock was yelling at him. When Blalock was done, he went to his office. Thomas went to his locker to change into his street clothes and then went to Blalock's office. Thomas remembers that Blalock appeared surprised to see him,

as if the preceding incident never occurred. Thomas describes the subsequent conversation in his autobiography:

> I told him that he could just pay me off, that I was trying but if it was going to be like this every time I made a mistake and I couldn't please him, my staying around would only cause trouble. I said that I had not been brought up to take or use that kind of language he had used across the hall. He apologized, saying that he had lost his temper, that he would watch his language, and asked me to go back to work. (Thomas 1998, 16)

Thomas went back to the lab and told Waters about the conversation. Waters laughed and said that the same thing would happen again, but he would be proven wrong. Blalock was true to his word and never spoke to Thomas that way for the remainder of their thirty four year relationship. The fact that Blalock did keep his word speaks volumes about his respect for Thomas, despite their differing racial and occupational statuses. Looking back on this incident, Thomas felt that it "set the stage for what [he] consider[ed] [their] mutual respect throughout the years" (Thomas 1998, 17).

Thomas' Responsibilities

In addition to shock research, Blalock also focused on routine surgical procedures. This research included studies on the effects of many procedures, such as the perforation of peptic ulcers and the division of the cervical esophagus. The experiments with these chronic surgical procedures allowed Thomas to develop his surgical skills. He became accustomed to assisting Blalock on a procedure only once before performing it on his own. Throughout the years, Thomas became more skilled at performing surgeries. In 1939, Blalock became a member of the Committee on Surgery of the National Research Council, and he began to make frequent trips to Washington, DC. Blalock told Thomas to hire someone to help him in the lab since he was gone so often. Thomas hired

Andrew Manlove, Charles' younger brother, who had just graduated from high school. Thomas began to teach Andrew, the way Blalock taught him. Andrew learned how to set up experiments and assisted in surgical procedures. Thomas had been working with Andrew for about a year when Blalock accepted a job offer from The Johns Hopkins University. At this point, Thomas began to have Andrew perform more procedures on his own so that he would develop the skills necessary to succeed when he was working under a different doctor. Andrew Manlove went on to become a surgeon at Vanderbilt Hospital. He was the first of many surgeons that Thomas trained.

Thomas' responsibilities included performing surgical experiments and teaching, but they did not include assisting other doctors. Blalock was very possessive and protective of Thomas. When Blalock found Thomas assisting another doctor, he said to Thomas, "you are my technician and you are not to help anyone" (Thomas 1998, 40). Thomas still helped other doctors when he knew that Blalock was busy or out of town because he was "interested and curious about everything that went on in the laboratory" (Thomas 1998, 40). Blalock knew that Thomas was talented and was of great value to him. Thomas once had ganglia on the back of his hand, which was cured by hitting the ganglia with a Bible. Thomas consulted Blalock about this supposed cure. Blalock told Thomas not to let anyone touch it because "your hands are more valuable to me than my own" (Timmermans 2003, 217).

Financial Problems

In May of 1930, Thomas asked Blalock about the salary increase he mentioned when Thomas was hired. Blalock had forgotten but promised to look into it. Over a week had gone by and Thomas had not heard back from Blalock. Thomas found out that

there was an opening on the carpenter's crew and planned to leave Blalock's lab. Thomas told Blalock that he was going back to construction because the pay was better. Blalock wanted Thomas to stay, but he knew that the department could not match $20 a week. Blalock tried to convince Thomas to stay by pointing out all of the advantages of working in a lab over working in construction (working inside, no strenuous physical duties, etc.). Blalock met with the Professor of Surgery, Barney Brooks, and was able to get $17.50 a week for Thomas. Thomas agreed to stay.

In November of 1930, Thomas lost his life savings when The Peoples Bank closed. This opened Thomas' eyes to the economic crisis in the United States at this time. He was very angry that he lost his money, but he was still thankful that he had a job. Thomas and Blalock discussed his career options, in the event that Thomas was able to go to college but not to medical school. Thomas said that he would probably be a teacher. Blalock replied that he could make more money as a technician. Thomas noted that Blalock "never encouraged [him] to attempt to continue [his] education" (Thomas 1998, 43). In his later years, Blalock expressed regret at not sending Thomas to college.

In 1934, Harrison hired a new technician, James E. Lewis, who was a close friend of one of Thomas' brothers. When Thomas and Lewis were working one day, they wondered if their salaries and job classifications matched their job responsibilities. After some investigation, they discovered that all of the black men were classified as janitors without regard to their actual jobs or their particular skill set. They also discovered that there was a significant gap between their salaries and the salaries of white technicians. Thomas and Lewis approached their respective bosses about their classifications. Thomas told Blalock that he should be classified as a technician for the kind of work that

he was doing. Blalock said that he was unaware of his job classification and said that he would talk to the secretary of the department. Thomas and Lewis saw an increase in their salaries a few pays days later, but they never found out whether they "were reclassified or whether they just decided to give [Thomas and Lewis] more money to keep [them] quiet" (Thomas 1998, 44).

Job Offers

In 1937, Blalock was considering taking a Chief of Surgery position at the Henry Ford Hospital in Detroit. Blalock wanted Thomas to go with him, if he got the job. Thomas wrote to his sister, Olga, and told her that there was a chance he would be moving to Detroit, where she lived. She told him that he should not get his hopes up because "Henry Ford was strictly lily white, and that it was worse than anything she had seen, even though she had grown up in the South" (Thomas 1998, 38). After some time passed, Blalock told Thomas that they would not be going to Detroit and did not bring it up again. Blalock became Professor of Surgery at Vanderbilt a short time later. Thomas later discovered that Henry Ford Hospital had a strict policy against hiring Blacks, and that Blalock had presented Thomas and himself as a package deal. They would not accept Thomas under any circumstances, so Blalock rejected their offer. While his subsequent promotion at Vanderbilt may have been a factor, Blalock's rejection of the position at Henry Ford shows his dependence on Thomas, and how important Blalock felt Thomas was to his research.

In December of 1940, Blalock told Thomas about another job offer. This offer was for Surgeon-in-Chief and Chairman of the Department of Surgery at The Johns Hopkins University. Blalock said that there was a very good chance that he would accept

the offer, and he wanted Thomas to go with him to Baltimore. The offer from Hopkins meant a great deal to Blalock because of his unceremonious departure in his residency days, and because it was his alma mater. Blalock accepted, and Thomas began to seriously consider moving to Baltimore. By 1940, Thomas also had a family to consider when making this decision. In 1933, Thomas married Clara Beatrice Flanders from Macon, Georgia. In 1934, their first child, Olga, was born and their second child, Theodosia, followed four years later. Clara left the decision about moving completely up to her husband. Thomas considered returning to construction, but he enjoyed the work he was doing in the lab and wanted to continue it. Brooks told Thomas that there would be no place for him at Vanderbilt after Blalock left. The only way he could continue his work in the lab was to move to Baltimore with Blalock. He told Blalock that he would join him at Hopkins and moved to Baltimore in June of 1941.

CHAPTER THREE

The Procedure

Helen Brooke Taussig

Helen Brooke Taussig was born on May 24, 1898, in Cambridge, Massachusetts. She was the fourth and last child of Frank William Taussig and Edith (née Guild) Taussig. Frank Taussig was a well-known professor who held the Henry Lee Economics Chair at Harvard University. Edith Taussig was one of the first students at Radcliffe College, the women's college associated with Harvard, where she studied zoology and other natural sciences.

Helen Taussig experienced many difficulties during her childhood. At the age of eleven, Taussig lost her mother to tuberculosis. Taussig herself also suffered from tuberculosis, which caused her to miss school regularly for almost three years. An episode of whooping cough also left her partially deaf. In an interview with Dr. W. Proctor Harvey, Taussig states that she was "a weak and very sickly baby, but [her] mother assured [her] father that [she] *would* grow up to be strong" (Interview with Harvey 1978, 28). Dyslexia made school difficult for Taussig, and she routinely brought home bad grades. She struggled with reading more than other subjects, but she was able to become a better reader with the help of her father. Taussig states that her father "was *extraordinarily* patient" when he was helping her with lessons (Interview with Harvey 1978, 29). Taussig goes on to explain how well her father hid his discouragement with her school work:

> In later years, my father said that he was discouraged of my ever getting through grammar school-but he never *once* complained to me, he never *once* chided me, he never *once* said "Helen, can't you do better?" or "What is the matter" I don't

> believe he ever told my mother how discouraged he was by my school work. (Interview with Harvey 1978, 29)

Taussig became a proficient reader as she got older, but would always struggle, and claimed that she "couldn't read you six telephone numbers correctly without reversing some numbers" (Interview with Harvey 1978, 29).

Taussig went to Radcliffe College in 1917, but transferred to the University of California at Berkeley after two years. Because her father was a very well-known professor and economist, Taussig wanted a chance to "stand on [her] own two feet," and not be known simply as Frank Taussig's daughter (Interview with Harvey 1978, 30). Taussig graduated from the University of California at Berkeley in 1921 with a Bachelor of Arts degree. When she returned home, she told her father that she was interested in medicine and he suggested that she talk to Dr. Rosenow, Dean of Harvard's new School of Public Health. Rosenow told her that women were allowed to take classes, but they would not be awarded degrees for their studies. Despite this injustice, Taussig enrolled in histology with Dr. Bremmer. Bremmer suggested that she take an anatomy class at Boston University, where she would actually earn credit for her work. The Professor of Anatomy, Dr. Alexander Begg, was also Dean of Boston University Medical School. He encouraged Taussig to study the bundles of the heart and gave her a cow's heart to work on. She began to study the physiology of the heart and took physiology and pharmacology to earn a year's worth of credit. Begg then suggested that she go to The Johns Hopkins School of Medicine, one of the few medical schools that accepted women as candidates for a degree. Hopkins had a policy of accepting women because a group of women donors helped found the School of Medicine in 1893, and that was one of the stipulations of their donation.

Taussig was accepted to The Johns Hopkins School of Medicine in 1923. She worked at the heart station at the hospital under Dr. E.P. Carter and took a fellowship in his clinic for a year after she graduated in 1927. Around this time, Taussig's hearing began to decline further. In addition to wearing a hearing aid and learning to read lips, she also used an amplified stethoscope and relied more on her hands to listen to a patient's heart. In 1928, Dr. Edwards Park became the Chair of Pediatrics at Hopkins and started the first pediatric specialty clinics in North America during his first year. He also started psychiatric, tuberculosis, epileptic, and cardiac clinics. The cardiac clinic at the Harriet Lane Home, where the specialty clinics were located, was run by Dr. Clifford Leech for two years. During this time, Taussig completed an internship in pediatrics. In 1930, Park appointed Taussig the Director of the Harriet Lane Home's cardiac clinic, where she remained for the rest of her career.

All pediatric patients with congenital heart conditions were referred to Taussig, especially the cyanotic, or blue, babies. All cyanotic patients had their blood pressure taken, were x-rayed in three positions, received an electrocardiogram, and were examined using fluoroscopy. The fluoroscope images showed the way the blood moved through the heart and revealed that most of the cyanotic patients had a deviation of the right septum and a thickened muscular wall of the right ventricle. A thickened right ventricle, called right ventricular hypertrophy, results in its decreased capacity, and the constriction of the pulmonary artery, which together allow less blood to move to the lungs for oxygenation. Before birth, the pulmonary artery and the aorta, which carries blood to the rest of the body, are connected by a vessel called the ductus arteriosus to keep blood away from the baby's lungs. Within the first few days after birth, the ductus arteriosus

closes and the blood passes through the pulmonary artery into the lungs. Seeing the fluoroscope images in 1935 ignited Taussig's interest in congenital heart disease.

Taussig's friendship with Dr. Maude Abbott, the founder of pediatric cardiology, contributed to her interest in congenital heart disease. When Taussig met Abbott in Boston in 1935, she told her about the hearts without right ventricles. From 1935 to 1936, Taussig and Abbott exchanged letters that included questions and observations about congenital heart malformations and their physiological effects. They also discussed the possible methods of left-to-right shunting and enlarging chambers of the heart. The fluoroscope images and Taussig's correspondence with Abbott helped her diagnose the tetralogy of Fallot as the defect present in her cyanotic patients. Taussig soon realized that cyanosis was due to decreased blood flow to the lungs through the pulmonary artery, which resulted in inadequate amounts of oxygen in the blood. She realized that the children died when the ductus arteriosus closed off, and she wondered if there was some way to create a similar shunt to increase circulation to the lungs.

In a normal heart, the blood passes through the pulmonary artery to the lungs and the ductus arteriosus closes. In a heart with tetralogy of Fallot, right ventricular hypertrophy and pulmonary stenosis result in a reduction of the amount of blood that reaches the lungs and the rest of the body. The ductus arteriosus connects the pulmonary artery and the aorta. When the ductus arteriosus closes, there is only the pulmonary artery to carry blood to the lungs and the rest of the body. Creating a pathway that circumvents the pulmonary stenosis to get more blood to the lungs would increase the chances of survival for blue babies suffering from tetralogy of Fallot.

Tetralogy of Fallot is not the only congenital heart disease that results in cyanosis. There are many different abnormalities, such as non-closure of the ductus arteriosus, which can result in decreased levels of oxygen in the blood and, therefore, cause cyanosis. These congenital defects are treated in different ways. Taussig's idea was a way to treat tetralogy of Fallot only, not other cyanotic congenital heart diseases.

In 1939, Dr. Robert Gross, Chief of Surgery at Boston Children's Hospital, reported the first successful ligation of a patent ductus arteriosus, or a ductus which had not closed after birth. Taussig traveled to Boston to ask if he would be interested in helping her build a patent ductus between the pulmonary artery and the aorta to increase blood flow to the lungs. Upon hearing her request, Gross' replied, "Madam, I close ductuses, I don't create them" (Evans 2009, 122). In 2006, Dr. W. Hardy Hendren, a surgical resident under Gross at the time, wrote that Dr. Gross regretted dismissing Taussig's idea of building a ductus to treat cyanotic babies. Taussig did not pursue building a ductus further until 1941 when Dr. Alfred Blalock arrived at Hopkins as Chief of Surgery.

The Hopkins Years

Thomas arrived in Baltimore on June 20, 1941, to find a place for him and his family to live. While he was there, Blalock showed him around Hopkins and took him to the old Hunterian Laboratory, where Thomas would be working. Thomas remembers that the building had "a depressing and almost revolting atmosphere," and repainted it in an effort to liven up the place (Thomas 1998, 56). Thomas was to start working at the lab on July 1, but did not until July 7 due to a housing shortage in Baltimore. He eventually found a suitable apartment for his family.

Blalock only came to the lab two to three times a week, and Thomas performed the majority of the experiments on his own. The other people working in the lab were surprised to see that Thomas performed procedures without Blalock's help. Most lab technicians were only expected to set up experiments for doctors to perform. Thomas realized that other surgical research technicians did not do the kind of work that he did, and he wondered if his position was something of Blalock's own creation. Occasionally, Blalock called the lab and asked Thomas to bring his notes on their latest experiments to Blalock's office at the hospital. As Thomas walked through the main corridor of the hospital wearing his white lab coat, some people "actually stopped in their tracks and stared at [him]" (Thomas 1998, 63). The next time he went to Blalock's office, he changed into his shirt and tie and wore his suit coat. When he arrived, Blalock asked him why he was dressed that way. Thomas recounted his most recent trip to Blalock's office:

> I told him how I had stopped traffic in the main corridor on my previous visit to his office. I had had a long white coat on. A Negro with a long white coat? Something unseen and unheard of at Hopkins! (Thomas 1998, 64)

It was indeed unheard of. Before Thomas arrived at Hopkins, the only black employees were members of the housekeeping staff, who wore blue uniforms. Thomas did not consider his employment at Hopkins to be an issue of race; it was a way to make a living and to support his family. This was his response to a reporter during an interview when asked if he was allowed to use the same facilities at Hopkins. To Thomas, his race had nothing to do with his employment. Blalock hired him at Vanderbilt because he thought he could do the job, not because of the color of his skin. Members of the surgical department already had doubts as to whether or not Blalock was capable of running the department because of his youth. Those doubts were multiplied when he arrived with a

black lab technician. Thomas writes that he "didn't know if Hopkins had a policy about hiring or not hiring Negroes in certain positions or capacities, but if [he] delivered, they couldn't use [him] as an excuse to not hire Negroes in any capacity" (Thomas 1998, 64). Thomas told the reporter not to run the article. He did not want Hopkins to think too much about his employment and decide to make a policy against hiring Blacks in certain positions. Although Thomas never answered the question in the interview, in his autobiography he wrote, "for those who might wonder what the answer would have been- yes, I was allowed to use the same facilities" (Thomas 1998, 65).

Thomas and Blalock worked well together at Hopkins, just as they had at Vanderbilt. A mutual colleague, Dr. Alan C. Woods, Jr., said that "it was extremely difficult to tell if Dr. Blalock had the original idea for a particular technique or if it was Vivien Thomas, they worked so smoothly together" (Thomas 1998, 77). Thomas ran the lab, and Blalock allowed Thomas to set up experiments in whatever capacity he felt was best. Blalock constantly asked Thomas what he thought and valued his opinion.

Finding a Surgical Solution

Blalock's arrival at Hopkins presented Taussig with the opportunity she had been waiting for. In 1943, Taussig decided to ask Blalock for help. After watching Blalock close a ductus arteriosus, she said to him, "I stand in awe and admiration of your surgical skill, but the really great day will come when you build a ductus for a cyanotic child, not when you tie off a ductus for a child who has a little too much blood going into his lungs" (Interview with Harvey 1978, 35). Blalock agreed to try to build a ductus and set up a time for him and Taussig to meet with Thomas. Taussig met with Blalock and Thomas in the lab to discuss the procedure. Thomas recalls that "she was tall and slender with a

pleasant personality and spoke with a distinct New England accent" (Thomas 1998, 80). She explained the physiology of the defect and how insufficient amounts of blood traveling to the lungs resulted in a cyanotic tint to the skin. She also described the physical symptoms of tetralogy of Fallot, such as clubbed fingers and toes, blue mucous membranes and nail beds, the inability to exercise, and the habit of squatting to rest. There was no known treatment to help these blue babies. She told them that she believed that something could be done to get more blood to the lungs, but did not offer any suggestions as to how.

A failed experiment at Vanderbilt presented a possible solution. At Vanderbilt, Thomas and Blalock attempted to produce pulmonary hypertension by dividing the sublcavian artery and attaching it to the pulmonary artery, a procedure called a subclavian to pulmonary artery anastomosis. Instead of raising the pressure of pulmonary circulation, the procedure rerouted arterial blood into the lungs. Before Thomas could test this procedure, he had to recreate tetralogy of Fallot in a dog. He started by studying the collection of congenitally defective hearts that Taussig had collected, which were located in the museum of the Pathology building. Thomas spent days studying these hearts and trying to figure out how, or if, it would be possible to recreate the defects. For over a year Thomas worked to recreate successfully the congenital malformations in a canine heart in addition to his work for the Army's shock research program, which kept him out of the draft. At this time, there were no cardiac experts and no research that he could consult for help with this project. Thomas had to resort to trial-and-error to find a surgical solution for tetralogy of Fallot. By 1944, Thomas was able to recreate the tetralogy of Fallot in a dog and apply the subclavian to pulmonary artery anastomosis to

increase blood flow to the heart. By suturing a part of the subclavian artery to the pulmonary artery, Thomas created an artificial ductus arteriosus. Figure 2 illustrates subclavian to pulmonary artery anastomosis.

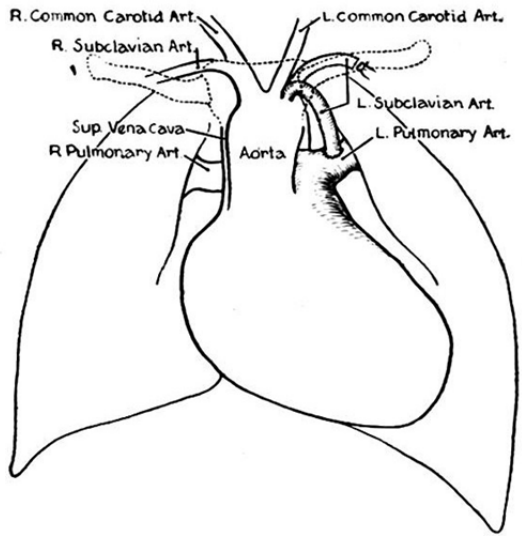

Fig. 2. Sublcavian to pulmonary artery anastomosis (Blalock and Taussig 1945, 4)

Putting it to the Test

In November of 1944, Blalock told Thomas that he had to learn the subclavian to pulmonary artery anastomosis to perform it on a patient. Up to this point, Blalock had only watched Thomas perform the procedure. Blalock planned to assist Thomas with the procedure once or twice before performing it on his own. However, he only got the chance to assist Thomas once before the time came to perform the procedure. The condition of the patient Blalock had planned to perform the procedure on was quickly becoming worse, and they could not afford to wait any longer to perform the procedure. In preparation for the surgery, Thomas went to see Elizabeth Sherwood, the General Operating Room Supervisor, to make sure that they had all of the necessary surgical

instruments. In his experiments for the surgery, Thomas had to modify surgical needles because the existing ones were too large to be used on a baby's heart.

The first patient to receive this procedure was fifteen-month-old Eileen Saxon. Eileen weighed less than ten pounds and was constantly in an oxygen tent. If she was ever outside of the oxygen tent, she would lose consciousness. Dr. William Longmire, Chief Resident during the operation, recalls that Eileen was "much more cyanotic than any patient [he] had ever seen before: the lips were a deep purple; the face was suffused with dilated veins; the conjunctiva were almost purple" (Longmire 1991, 101). The surgery took place on November 29, 1944. Blalock would be performing the surgery on his own for the first time, having never gotten the chance to practice unassisted in the lab. Thomas planned to watch the surgery from the gallery, but Blalock had other plans. He called Thomas down to the operating room and asked him to stand someplace where he could see what Blalock was doing. Thomas stood on a step stool and looked over Blalock's right shoulder. Throughout the procedure Blalock consulted with Thomas to make sure that his technique was correct. With each move he made, Blalock asked Thomas if it was correct. As Blalock made an incision in the pulmonary artery, he asked for Thomas' confirmation that the incision was long enough, and when Blalock started a suture in the wrong direction, Thomas quietly told him to go the opposite direction. Thomas continued offering guidance over Blalock's shoulder for six months after the first operation.

Many believe Blalock's reliance on Thomas was due to his inexperience in vascular surgery and a lack of confidence in his own surgical skills. In an oral history interview for the U.S. National Library of Medicine, Dr. Peter Olch, who interviewed

Thomas in 1967, stated that he had "always had the feeling that Dr. Blalock was perhaps a little insecure and [Blalock] was the sort of person that literally needed the support of the man with him at the table. He is not what you would consider a great cutting surgeon" (Interview with Olch 1967, 22). Thomas agreed with Olch's assessment, adding that he "didn't think Dr. Blalock, by any stretch of the imagination, was a great technician" (Interview with Olch 1967, 23). Further, Dr. Denton Cooley, a surgical resident during the blue baby operation agreed with Olch's and Thomas' assessments of Blalock, stating that "Dr. Blalock was a great scientist, a great thinker, a leader, but by no stretch of the imagination could he be considered a great cutting surgeon. Vivien was" (*The Washingtonian* 1989, 228).

With Thomas' help, Blalock performed the surgery correctly. When the two vessels were connected, the deoxygenated blue blood was shunted toward the lungs to be oxygenated, and Eileen turned from blue to pink. Longmire noted that "the cyanosis had almost completely disappeared from the lips, skin, and conjunctiva and was replaced almost immediately with a cherry red coloration" (Longmire 1991, 103). The surgery was a success. Two months after her surgery, Eileen was discharged from the hospital. Unfortunately, the cyanosis returned several months after the surgery. The surgery was attempted again but was unsuccessful, and Eileen died less than a year after the original surgery. Two more children received the surgery in February of 1945, both older than Eileen and in better condition. In May of 1945, the *Journal of the American Medical Association* published an article written by Blalock and Taussig titled "The Surgical Treatment of Malformations of the Heart in Which There is Pulmonary Stenosis or Pulmonary Atresia." The article described the research that was done to create the

procedure, as well as the first three cases. Thomas' contributions to the procedure were overlooked, and his name did not appear on the manuscript.

The story was spread throughout the world by the Associated Press. There was finally hope for the survival of these blue babies. As news spread, parents and their blue babies traveled to Hopkins from all over the world to receive this groundbreaking, new surgery.

Impact of the Surgery

Many of the families that wanted the surgery for their children showed up at Hopkins with no appointment at the cardiac clinic. The cardiac clinic was flooded with blue babies. Rooms on six floors of the hospital were needed to accommodate the number of pediatric cardiac patients. Blalock and Taussig were shocked by the number of patients they had and unaware of how much this treatment had an impact on so many lives. In his autobiography, Thomas comments on the Taussig's demeanor before and after the surgery:

> When Dr. Taussig had presented the case for Blue Babies in the old Hunterian Laboratory, she had seemed depressed at having to stand helplessly by, watching the condition of these patients deteriorate until they finally died. Her spirits improved when we did the preoperative studies on the second and third patients. Later, when patients began to flood the clinic, she seemed extremely happy. She no longer had to stand by helplessly and acted as if a great burden had been lifted from her shoulders. (Thomas 1998, 98)

Blue babies that constantly had difficulty breathing now had "the ability to play actively after surgery" and could tolerate exercise well (Neill and Clark 1994, 275). This procedure was the first successful treatment of tetralogy of Fallot and marked the beginning of modern cardiac surgery (*The Washingtonian* 2003).

Surgeries were scheduled twice a day, and occasionally three times a day, in order to accommodate the number of cyanotic patients. Both Blalock and Longmire performed the procedures. Blalock was very particular about the set up of room 706, which became known as the "heart room." He had to have the fan and lights situated a certain way, and the space behind his right shoulder was strictly reserved for Thomas. At first, Blalock relied on Thomas just as much as he did during the first operation, pleading "now you watch, Vivien, and don't let me put these sutures in wrong!" (*The Washingtonian* 1989, 288) As time went on, Blalock asked fewer and fewer questions. After about six months, Thomas did not show up for a surgery, and Blalock did not page him, like he had on a previous occasion when Thomas stepped out of the operating room. Thomas figured "that by that time [Blalock] knew the answer to any question that might arise," and felt that his "presence had been mostly for moral support anyway" (Thomas 1998, 102).

The hospital was also overrun by doctors who wanted to watch the procedure and reporters covering the story of this new procedure. Doctors from all over the world traveled to watch Blalock perform the procedure and to learn how to perform the procedure themselves. Thomas gave tours of the old Hunterian Laboratory and helped visiting doctors understand what type of equipment they would need to perform the procedure at their own hospitals.

Thomas, Blalock, and Taussig had contact with cyanotic patients. Psychologist and former patient, Sandra Stoltz, gives her impressions of each of these individuals:

> I met Dr. Taussig when we came to Hopkins to be evaluated for surgery…She struck me as a very kindly, soft-spoken lady and I like how she talked to me. She didn't talk down to me…I remember her being very reassuring and her calm, quiet voice was very soothing. [Blalock] was more remote; he was like God. The big surgeon…I remember Vivien Thomas as this very kindly, gentle, soothing

> man…He described the procedure step-by-step. He told me exactly what to expect and he made it unscary (Evans 2009, 125)

Recognition for Blalock and Taussig

The Blalock-Taussig shunt, as it would later be called, earned recognition for Blalock, Taussig, and The Johns Hopkins University. Aspiring surgeons across the country wanted to attend Hopkins, and they wanted to be trained under Blalock. Blalock and Taussig gave lectures throughout the United States and Europe. In November of 1945, Blalock gave the Harvey Lecture for New York City's Harvey Society about the operation and the research that had made it possible. In the Harvey Lecture, Blalock acknowledged Taussig for her ideas about increasing blood flow to the lungs, but did not mention Thomas' involvement. Only a year after the first operation, the Harvey Lecture was one of the first lectures Blalock gave on the operation in an important, public forum. His omission of Thomas' contributions set a precedent for designating who deserved recognition for their involvement in the project. Only a year after the presentation in New York, the procedure was called the "Blalock-Taussig operation" in literature for the first time, following one of Blalock's presentations to the American Surgical Association. The procedure was not called the "Blalock-Taussig shunt" until 1966.

In 1947, Blalock and Taussig traveled throughout Europe giving lectures on the procedure and performing the surgery on children. Blalock performed the procedure on ten children at Guy's Hospital in London and gave a lecture with Taussig to the British Medical Association. Thomas did not go with them.

Blalock received nine honorary degrees and became a member of many prestigious surgical and scientific societies. He became president of the American

Surgical Association and many other societies. He also won many awards for his work, such as the Rene Leriche Award in 1949 and the Rudolph Matas Award in 1950.

In 1947, Taussig published a book titled *Congenital Malformations of the Heart*. In 1954, she and Blalock received the Lasker Award for their work on the blue baby operation. She was not awarded full professorship at Hopkins until 1959, and she was the first woman to reach that rank at the medical school. She was elected president of the American Heart Association in 1965 and was awarded the Medal of Freedom in 1964 and the National Medal of Science in 1977.

There was some disagreement about whether or not Taussig deserved to have her name attached to the procedure. Many of Blalock's surgical residents, Longmire included, believed that Taussig's name should have been dropped from the name of the procedure. Thomas disagreed. He believed that she deserved just as much credit as he and Blalock:

> If she suggested it, even though she didn't give the direct method of doing it, if she presented the problem the way she presented it, she is due as much credit for having presented it, as he is or I am, of being able to do anything about it. If you could have heard her tell it; it was something that anyone not familiar with the field never would have thought up. [Blalock] never would have come up with it; nobody else would have come up with it at that time unless somebody had presented the full blown idea as she presented it that day. (Interview with Olch 1967, 28)

I agree with Thomas. Even though Thomas had done the procedure when he and Blalock were working on pulmonary hypertension, they would have never thought to use it to treat congenital heart malformations if Taussig did not present them with the problem first. Pediatric cardiologists tend to believe that Taussig deserves more credit, while cardiovascular surgeons believe that Blalock deserves more credit. Thomas' involvement

in the project and the credit he clearly deserved would not be given to him for another thirty years.

CHAPTER FOUR

The Recognition

Hopkins after the Procedure

Financial Struggles

In 1946, the growing need for housing at the end of World War II prompted Thomas to consider leaving Hopkins and returning to Nashville to work as a carpenter with his father and brother. Thomas could make more money as a carpenter than he could with his current salary at Hopkins. Thomas' father offered to let Thomas fulfill the contract on a house that he had yet to start. After discussing it with Clara, Thomas decided to return to Nashville. When Thomas broke the news to Blalock, Blalock asked if Thomas no longer liked working at Hopkins. Thomas replied that he wanted to give his children the opportunity to get as much education as they wanted and needed, which he could not do if he stayed at Hopkins. In a "whining" tone, Blalock argued that Thomas was already making more than anyone else without a degree at Hopkins. Thomas replied, "that's the problem," and "that's the reason I plan to be able to let my children get all the degrees they want" (Thomas 1998, 131). Thomas had no degree and, therefore, could not be considered for a promotion to a greater salary bracket. He did not want his daughters to be in the same predicament one day. He could make two to four times more money as a carpenter than as a lab technician. Thomas emphasized that he was not asking for more money; he had "just gone ahead and made [his] plans to get it elsewhere" (Thomas 1998, 131). Blalock told Thomas that they would discuss it later. Blalock offered Thomas salary increases, which Thomas did not accept. One day,

Blalock made an offer that was significantly greater than his previous offers. Thomas agreed to stay for the next year and a half, which was the time period covered by the offer. Thomas told Blalock that if he was still experiencing financial difficulties after that time, he would give thirty days notice and there would be no negotiations for a salary increase. Thomas later learned that he had been placed in a newly created salary bracket for employees without a degree who deserved a higher pay scale.

In an effort to convince Thomas to stay, Blalock suggested that he subsidize his income in addition to working in the lab. Through Thomas' friendship with Dr. Ralph J. Young, the only black physician working in the clinic at Hopkins, he was introduced to Dr. Ben Gaboff, pharmacist and president of the Ralph Winton Company. Gaboff was interested in a black "detail man" to introduce the company's pharmaceutical products to black doctors in Baltimore. There were only thirty five black doctors in Baltimore, and Thomas visited each one every two or three months. When Thomas visited the doctors, many of them questioned him about his knowledge of medical terminology. After a series of questions, they eventually learned that Thomas worked for Hopkins and recalled hearing his name in association with Blalock and the blue baby operation. Many of them commented on Thomas' need to subsidize his income while still being employed at Hopkins:

> Numerous doctors said they would prescribe products to help me, but two of them bluntly stated that I was crazy. I also heard expressions such as "You're being made a fool of"; "if they want your services, let them pay you"…and "Hopkins is making money as a result of work you've done-they have the money to pay you." The remarks I heard in the first two or three weeks of making detail calls on the Negro doctors in Baltimore only bolstered by determination to leave Hopkins. (Thomas 1998, 141)

The doctors that Thomas visited had a valid point. Thomas' work resulted in a groundbreaking, new surgery that brought prestige and money to Hopkins. The procedure brought an influx of new patients, and Hopkins had the resources to pay Thomas a salary that would allow him to live more comfortably. Hopkins had the reputation of having the lowest paying jobs for African Americans in Baltimore. Thomas' neighbors knew that he worked for Hopkins but did not know what he did there. Many of them wondered how he was able to make ends meet with Clara not working and Thomas working at Hopkins.

When Thomas and Blalock reached a salary negotiation in 1946, Thomas told Gaboff that he would not have the time to continue his work as a detail man. Gaboff offered Thomas a full time job. The offer was better than the one he had just agreed to at Hopkins, but Thomas felt he "could not be sure of long-term security, and detailing wasn't nearly as interesting as research" (Thomas 1998, 141). Though Thomas was not with the Ralph Winton Company for very long, his employment had lasting effects. Six months after he was hired, another black "detail man" appeared in Baltimore representing a competitor. Soon after that, many national pharmaceutical companies sent black representatives to solicit the business of black doctors in Baltimore. Once again Thomas was the first of his kind, and helped open a new field of employment for Blacks in Baltimore as pharmaceutical representatives for nationally known companies (Thomas 1998, 142).

Thomas' Role Expands

In 1950, Blalock was scheduled to perform the one thousandth blue baby operation. Many of Blalock's residents believed that this occasion should be remembered in some way. Dr. Mark Ravitch, a surgical resident, contacted Canadian portrait photographer Yousef Karsh, to take photographs of Blalock to commemorate the occasion. Knowing that Blalock would be hesitant, Ravitch told Blalock that the photos were for Karsh's book on notable figures in medicine. Karsh did publish a book of portraits titled *Portraits of Greatness* which included five men of medicine, one of whom was Dr. Alfred Blalock. Ravitch received the photographic proofs on the day of the one thousandth operation. Everyone gathered at Blalock's house to see the portraits and celebrate. The picture that Mary, Blalock's wife, liked the most became the official Blue Baby operation portrait.

Shortly after the one thousandth operation, Dr. Raymond P. Heimbecker came to Hopkins to work in Blalock's lab. He and Thomas worked on the reversal of circulation, with Blalock monitoring their progress. When the time came to publish their findings, Heimbecker submitted a draft of the paper with Blalock, Thomas, and himself as co-authors. Heimbecker was "unaware that [Thomas'] name hadn't been offered in the publication of Dr. Blalock's scientific papers" (Thomas 1998, 153). Thomas comments on sharing authorship with Blalock:

> Dr. Heimbecker…thought my contribution to the project warranted the inclusion of my name. To my knowledge, none of Dr. Blalock's numerous co-authors of laboratory reports had ever acted or thought along this line. The Professor, for whatever reason, did not remove it; as a result, this was the first paper on which my name appeared as co-author with that of Alfred Blalock, M.D. (Thomas 1998, 152)

This paper, "Experimental Reversal of the Capillary Blood flow," was published in 1951. In 1950, Dr. Jerome H. Kay came to Hopkins to work in Blalock's lab. In 1953, Thomas co-authored a paper with Kay and Blalock on intraventricular septal defects. In 1954, Thomas co-authored two papers with Kay on pulmonary stenosis and pulmonary insufficiency.

When Blalock promoted Thomas to Laboratory Supervisor, he became responsible for ordering laboratory supplies and hiring and supervising all laboratory personnel. Many vendors who came to sell supplies to the lab were surprised that they were doing business with a black man. When supervising lab personnel, Thomas emphasized that they would be working with him. Thomas felt that "the *with* was very important, inasmuch as there was no opposite position to take, whereas if they were supposed to be working *for* [him], they might take the opposite position and work against [him]" (Thomas 1998, 179-180). Thomas worked well with those whom he supervised and he looked out for their best interest. He encouraged them to take job offers elsewhere if they were paying more than Hopkins. In this new position, Thomas was able to hire African Americans and train them as lab technicians. Many of the African Americans he hired were working in service positions at Hopkins. Raymond Lee was working as an elevator operator at Hopkins, when Thomas asked him if he would like to work as a lab technician. A position opened up in the lab, and Lee was hired in 1963. Lee went on to become a lab technician at the University of Pittsburgh before returning to Hopkins as a physician's assistant (Thomas 1998, 181). Jean Queen worked in the laundry room at Hopkins, before Thomas hired her in the lab. She eventually became a laboratory manager at Hopkins (Timmermans 2003, 225). Thomas also kept positions

open in the summer for high school students, who aspired to a career in research or medicine.

In addition to his role as laboratory supervisor, Thomas also acted as "animal caretaker, experimental anesthesiologist, statistician, pathologist, instrument maker, protocol developer, veterinary surgeon, scientific article author, and phlebotomist (Timmermans 2003, 207). The use of dogs for all of the experiments in the laboratory made Thomas very experienced in canine surgery. He became "resident surgeon to the pets of numerous members of the Hopkins faculty and staff" (Thomas 1998, 208). Thomas' services as a veterinary surgeon were so widely acknowledged that his activities were cited in a meeting of the local veterinary association. Veterinarian Dr. Burton, Thomas' friend and member of the association, told his colleagues that "he doubted that any of them could perform the procedures he'd seen [Thomas] perform and that working full time in the laboratory, [Thomas] was not likely to damage anyone's practice, whether or not [Thomas] was a licensed veterinarian" (Thomas 1998, 208). Thomas was much respected in the veterinary community and many veterinarians went to Thomas for advice on more complicated surgeries. Thomas also taught surgical technique to medical students and Blalock's residents. Every medical student training to be a surgeon was required to study with Thomas in the surgical research lab.

Blalock Retires

In the fall of 1963, Blalock's research was slowing down and coming to a close. Blalock was not working on any major projects, and he was set to retire in the summer of 1964. On February 12, 1964 Dr. George Zuidema was announced as Blalock's successor. Thomas was not sure if he would still have his position at Hopkins after

Blalock retired, and he made employment plans at other universities just in case. Thomas' job search turned out to be unnecessary; Zuidema kept Thomas as the supervisor of the laboratory.

In May of 1964, the Johns Hopkins Hospital celebrated the seventy fifth anniversary of its founding. At a ceremony to commemorate the occasion, it was announced that the Clinical Science Building would be renamed the Alfred Blalock Clinical Science Building. This was the first time an individual faculty name had been placed on a building since the Halsted and Osler buildings were built in the 1920s (Longmire 1991, 264-265). Blalock's portrait hangs in the lobby of this building.

Blalock's health began to decline. He had been experiencing back pain for several months, and he had a laminectomy in May. A hepatomegaly, or enlarged liver, was found in August. A formal diagnosis had still not been made. His condition continued to decline, and he became confused and began not to recognize people. Alfred Blalock died on September 15, 1964. The autopsy revealed that Blalock's severe back pain was the result of a cancerous mass that originated from the stump of the left ureter, which was left from a nephrectomy in 1923. The cancer had metastasized to the tissue of his lumbar vertebrae, the liver, lungs, and lymph nodes (Longmire 1991, 271).

Thomas' last conversation with Blalock was in June, two weeks before Blalock's retirement. Blalock, in a wheelchair from his laminectomy, asked Thomas to take him to visit the heart room, which had just received new lighting, and to see his portrait in the lobby. After visiting the heart room and the lobby, Thomas headed toward the entrance of the building. Thomas describes Blalock's departure in his autobiography accordingly:

> He had me stop so that he could get out of the wheelchair. Seeing that he was unable to stand erect, I asked if he wanted me to accompany him to the front of

> the hospital. His reply was "No, don't." I watched as with an almost forty-five degree stoop and obviously in pain, he slowly disappeared through the exit from the main corridor. When I returned from vacation on September 1, I learned Dr. Blalock was in the hospital. A day or two later I went to see him, but he was asleep. Learning of his general condition from his son William…I made no further attempt to see him. (Thomas 1998, 214)

This is the only mention of Blalock's death in Thomas' autobiography. According to the PBS Documentary "Partners of the Heart", Thomas suffered from depression after Blalock's death. He did not start another research project until 1970. His difficulty with Blalock's death may explain the lack of attention it receives in his autobiography.

Overdue Recognition for Thomas

In the 1970s, Thomas began to receive recognition for his contributions to the blue baby operation. The Old Hands Club, a group of Blalock's former residents who were also trained by Thomas in the laboratory, commissioned the painting of Thomas' portrait in 1969. This honor was "usually reserved for university presidents and professor-scientists of exceptional merit who contributed to the institution of the field of medicine" (Timmermans 2003, 218). Thomas' portrait was unveiled on February 27, 1971. After working behind the scenes for thirty years, Thomas stood center stage to convey his gratitude to a standing room only audience. He was particularly touched by the words of Dr. Russell Nelson, then president of the hospital. Nelson stated that "there are all sorts of degrees and diplomas and certificates, but nothing equals recognition by your peers" (*The Washingtonian* 1989, 231). Thomas wondered where his portrait would hang, and was "astounded when Dr. Nelson stated, 'We are going to hang your fine portrait with Professor Blalock. We think you 'hung' together and you had better continue to hang together'" (Thomas 1998, 220). Because Thomas was very humble and

did not talk about his work, many of his closest friends did not know about the presentation of his portrait until they read about it in the newspaper the next day.

In 1974, clinical team coordinator Elaine Gaze approached Thomas about teaching a group of students in a training program for physicians' assistants. Thomas taught basic aseptic technique and minor surgical techniques, such as suturing and performing intubations.

On April 16, 1976, Thomas received a letter from Steven Muller, the president of the Johns Hopkins University. This letter stated that the Board of Trustees had voted to award Thomas with an honorary degree at the one-hundredth commencement ceremony, which would be held on Friday, May 21, 1976. As news spread throughout the university, friends and strangers offered Thomas their congratulations. A few days before the ceremony, Thomas was discussing the degree with Dr. Norman Anderson, Assistant Professor of Medicine and Assistant Professor of Surgery. Jokingly, Thomas said to him, "Hopkins is really a tough place-it has taken me thirty-five years to get a degree out of them" (Thomas 1998, 229). Anderson replied, "Yes, but look what kind you are getting. That's the deluxe model. That means you have already accomplished something. There are people around here with all kinds of degrees that never have and never will accomplish anything. You've already made a contribution" (Thomas 1998, 229). Thomas considered Anderson's words to be "among the highest compliments [he] received" (Thomas 1998, 229).

Thomas received an honorary doctorate of laws because Hopkins did not allow honorary doctorates of medicine. Thomas reflects on the ceremony in his autobiography:

> I thought that having my portrait presented to the medical institutions five years earlier would have been the full extent of any honor or public recognition ever

> bestowed upon me…To have an honorary degree conferred upon me was far beyond any hope or expectation I could imagine. Yet, here I was in an academic procession, my first ever, marching with Dr. Milton Eisenhower, former president of the university, wearing the gold and sable robe of Johns Hopkins University and joining the notables on stage. The ovation on the awarding of the degree was so great that I felt very small. In returning to my seat on stage, I thought of what Dr. Anderson had said about an honorary degree being the deluxe model and thought that possibly this was the type of ovation that went along with such an honor. (Thomas 1998, 229)

On May 21, 1976, Vivien Thomas became Dr. Vivien Thomas, Doctor of Laws. Taussig was among Thomas' many supporters at the ceremony.

On January 26, 1977, Thomas received a letter from Dr. Richard Ross, Dean of the Medical Faculty. The letter informed Thomas that he was appointed to the faculty of The Johns Hopkins University as Instructor in Surgery, his appointment having officially begun the previous July.

Thomas Retires

Thomas served as Instructor of Surgery for three years and was Supervisor of the Surgical Research Laboratory for two of those years. He retired on July 1, 1979, with emeritus status. After relentless encouragement from The Old Hands Club, Ravitch in particular, Thomas wrote his autobiography with the editorial help of Ravitch. He continued to work on it through his battle with pancreatic cancer, "indexing the book from his hospital bed following surgery" (*The Washingtonian* 1989*,* 231). Thomas was able to finish his autobiography before pancreatic cancer took his life on November 26, 1985. Thomas titled his autobiography *Presentation of a Portrait: The Story of a Life* (*The Washingtonian* 1989, 231). However, it was published under the title *Pioneering Research in Surgical Shock and Cardiovascular Surgery: Vivien Thomas and His Work*

with Alfred Blalock, two days after his death. A second edition was published in 1998 under the title *Partners of the Heart: Vivien Thomas and His Work with Alfred Blalock*.

Thomas' Legacy

Through his work at Hopkins, Thomas trained many world-class surgeons and helped pave the way for African Americans at Hopkins. He helped train well-known surgeons such as Denton Cooley, founder of the Texas Heart Institute and the first person to perform a successful human heart transplant in the United States. Dr. Levi Watkins, Jr. saw Thomas as a mentor when he arrived at Hopkins in 1971. Watkins was the first African American to graduate from Vanderbilt University Medical School and the first African American cardiac resident at Hopkins. Watkins introduced himself to Thomas after recognizing him from his portrait. Thomas helped Watkins with his first research project as a member of the medical faculty, testing an Automatic Implantable Defibrillator, or AID, on a dog in the lab. Watkins performed the first successful human implantation of the AID in 1979, a few months after Thomas retired (*The Washingtonian* 1989, 231). When Watkins joined the medical school admissions committee that same year, minority enrollment quadrupled (*The Washingtonian* 1989, 233). He went on to become Hopkins' first black Chief Resident in cardiac surgery. In 1987, Thomas' nephew Koco Eaton graduated from Johns Hopkins Medical School. Thomas did not live to see Eaton graduate, but was very excited by his admission. Watkins recalls Thomas' excitement and "how much it meant to [Thomas] to have all the doors open for Koco that had been closed to him" (*The Washingtonian* 1998, 233).

Not only does Thomas' legacy live on through the people he mentored, but his work has inspired the creation of many programs and awards. In 1993, the Congressional

Black Caucus Foundation established the Vivien Thomas Scholarship for Medical Science and Research, which is sponsored by GlaxoSmithKline. The Council on Cardiovascular Surgery and Anesthesiology started the Vivien Thomas Young Investigator Award in 1996. In 2004, Baltimore City Public School System created the Vivien T. Thomas Medical Arts Academy.

Remembered in Literature and Film

Journalist Katie McCabe learned of Vivien Thomas' inspiring story during an interview with Dr. Judson Randolph on the day of Thomas' death. McCabe did not learn of Thomas' death until a year later when she went to The Johns Hopkins Hospital to pursue the story. She considered giving up, but changed her mind when she discovered Thomas' autobiography and his oral history interview with Dr. Peter Olch in 1967 for the National Library of Medicine. She also interviewed Thomas' family, colleagues, and students (*The Washingtonian* 1989, 110). McCabe's article was published in the August 1989 issue of *The Washingtonian*. McCabe's article, "Like Something the Lord Made," won her the 1990 National Magazine Award for Feature Writing.

Broadcast journalist Andrea Kalin learned about Thomas' story from McCabe's article in *The Washingtonian*, and was "outraged" that the story of "the black man with only a high school diploma who helped a white Johns Hopkins surgeon launch the modern era of heart surgery" was not common knowledge (Ayd 2003). Kalin had just started Spark Media, her own production company, and was inspired to make a documentary about the "seemingly impossible scientific partnership" between Blalock and Thomas (Ayd 2003). Kalin's documentary, "Partners of the Heart," first aired on

February 10, 2003 on PBS. "Partners of the Heart" won the Erik Barnouw Award for Best History Documentary from the Organization of American Historians in 2004.

McCabe's article also inspired Washington D.C. dentist Irving Sorkin, who always dreamed of producing a Hollywood production, to turn Thomas and Blalock's story into a movie. It took several years, but Sorkin's dream eventually came true. The HBO film *Something the Lord Made* aired on HBO in 2004. It is directed by Joseph Sargent and written by Peter Silverman, with Sorkin as a co-producer. Blalock is played by Alan Rickman and Thomas by Mos Def. The movie was nominated for nine Emmys and won three for Best Made for Television Movie, Best Cinematography, and Best Picture Editing. The film won a Peabody Award and was named the Best Television Movie of the Year for 2004 by the American Film Institute.

The title of McCabe's story was taken from an encounter between Thomas and Blalock. Thomas had been working on an experiment that he developed entirely on his own, a procedure now known as an atrial septectomy. This procedure is used to correct transposition of the great vessels, which are the aorta and pulmonary artery. In this defect, the points of origin of the aorta and the pulmonary artery are switched. While in the lab at Hopkins in 1946, Blalock admires Thomas' work on an affected heart:

> Neither he nor I spoke for some four or five minutes while he stood there examining the heart, running the tip of his finger back and forth through the moderate-size defect in the atrial septum, feeling the healed edges of the defect. Dr. Blalock finally broke the silence by asking, "Vivien, are you sure you did this?" I answered in the affirmative, and then after a pause he said, "Well, this looks like something the Lord made." (Thomas 1998, 122)

Status Dynamics between Blalock and Thomas

Blalock and Thomas' partnership took place during a time when Blacks were considered inferior to Whites and Jim Crow laws were in place to maintain this hierarchy. Although the issue of race was never discussed of between Blalock and Thomas, Blalock kept Thomas in an inferior position in many ways. One way Blalock kept Thomas at a second-class status was by allowing Thomas to act as a bartender and a waiter at his parties. Thomas was serving drinks to the same men whom he taught in the lab. During this time period, the only way Thomas could go to the same parties as his colleagues was if he was a member of the wait staff. On one occasion, Blalock's sixtieth birthday party, Thomas did not wait tables. Five hundred guests were invited; Thomas was not one of them. Blalock "vetoed Thomas' presence" at his party (Timmermans 2003, 215). The party planners snuck Thomas in at the last minute, and he watched the party from behind the plants, feeling "deeply humiliated" (Timmermans 2003, 215). Blalock also hosted annual Christmas parties, which Thomas was never invited to attend.

Having grown up in Georgia during the Jim Crow era, Blalock was not opposed to segregation. Much like with salary issues, he only stood up against injustices where his and Thomas' work was involved. His decision to turn down the offer from Henry Ford Hospital in Detroit was not motivated by a desire to challenge segregation, but by his need to keep Thomas' valuable and skilled surgical hands. When Hopkins hospital started integrating, Blalock was reluctant to integrate the surgical ward and "insisted to the administration that his private patients remain segregated" (Timmermans 2003, 215).

Salary arguments came up a number of times throughout their partnership. Each time Blalock was able to offer Thomas enough money to stay in his position as Blalock's

laboratory technician. Blalock was not motivated by a desire to see Thomas receive a fair salary, but by the fear that he would lose a pair of valuable and skilled surgical hands (*The Washingtonian* 1989). Thomas was his surgeon, and he did not want him working for anyone else. Whenever they had disagreements over Thomas' salary, Blalock would repeatedly tell Thomas that he could make more money by staying in the laboratory instead of returning to construction. Although Blalock tried to talk Thomas out of other careers, he never tried to talk him into going back to school. Towards the end of his life, Blalock told a colleague that he "should have found a way to send Vivien to medical school" (*The Washingtonian* 1989, 230). He had often expressed regret at not helping Thomas go to medical school, but would "comfort himself by saying that Vivien was doing famously what he did well, and that he had come a long way" (*The Washingtonian* 1989, 230). Blalock's guilt was not lessened by the fact that even with a medical degree, Thomas would never have received the same standing in the medical field as members of the Old Hands Club. Blalock only told himself this to rationalize keeping Thomas in the lab. By telling himself that Thomas was better off in the lab, he did not have to acknowledge the fact that he was keeping Thomas there for his own personal gain. Dr. Rowena Spencer, a pediatric surgeon and the only woman of Blalock's surgical residents, writes that "the truth of the matter is that as a black physician in that era, [Thomas] would probably have had to spend all his time and energy making a living among an economically deprived black population" (*The Washingtonian* 1989, 230). Although Spencer does have a valid point, she assumes that Thomas would have gone on to practice medicine if he earned his M.D. Thomas could have used his degree to conduct research, which would have taken him away from Blalock and created competition.

Because Thomas was a black man and a lab technician, who worked mostly behind the scenes, his contributions to the blue baby operation were overlooked for almost thirty years. He was not recognized until the 1970s, when the status of Blacks in this country had improved significantly as a result of the Civil Rights movement in the 1960s. Many social changes had taken place during the Civil Rights movement that made it more acceptable for Thomas to receive the credit he deserved.

Although many of the decisions Blalock made on Thomas' behalf had selfish motivations, their relationship was mutually beneficial. Blalock needed Thomas for his surgical technique. Blalock's name would not be attached to this procedure if Thomas had not developed it. Blalock needed Thomas' skill and intelligence to perform experiments and to develop new surgical procedures. Thomas needed Blalock for the opportunities he could provide. During this time, Thomas would never have been able to make history in cardiac surgery with the opportunities that are presented to an African American. In 1944, Thomas would not have been allowed to operate at Hopkins, even if he had the credentials to do so. As a white man, Blalock had more doors open to him, doors that were closed to Thomas. Thomas needed Blalock to open those doors for him, just as Blalock needed Thomas to walk through those doors (Fig. 3).

Fig. 3. Above are the portraits of Alfred Blalock and Vivien Thomas that hang in the Alfred Blalock Clinical Science Building at The Johns Hopkins University in Baltimore, Maryland (The Johns Hopkins Medical Archives).

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