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Biography Paper:

Rear Admiral Grace Murray Hopper

When deciding who I would write this paper on I was looking for a woman in the history of computing. There were very few to choose from. So, I opted for the first female United States Navy Rear Admiral, Grace Murray Hopper. My dad was in the Navy hence the decision. Grace did many things for the evolution of computers and I was intrigued by her numerous accomplishments as well as the funny anecdotes I found in my research. This paper will discuss Grace's life and highlight her major accomplishments both in and out of the computing field. She was not only skilled in computers but was a major force in the advancement of women.

Grace Brewster Murray was born in New York City on December 9, 1906. She was named after her mother's best friend, Grace Brewster. (Dickason, "Looking") Grace was the oldest of three children. She had a sister, Mary that was two years younger than her and a brother, Roger, who was five years younger than her. (Dickason, "Looking") Her childhood was a happy one. She spent many summers at her family's cottage on Lake Wentworth in Wolfeboro, New Hampshire. (Dickason, "Looking")

At seven, Grace decided she wanted to learn how alarm clocks worked. She began to take apart several alarm clocks within her house. Her mother found the clocks and limited

Grace to only one alarm clock. (Dickason, “Looking”) Her parents provided a strong foundation for her curious spirit. (www.agnesscott.edu) Her mother, Mary Campbell Horne Murray, shared her love of math. Mary’s father, John Van Horne was a civil engineer for the city of New York. (Dickason, “Looking”) She was interested in his job and was therefore allowed to study geometry even though it was still thought of as “unladylike” to do so.

Grace’s father, Walter Fletcher Murray, was a successful insurance broker despite the double amputation of his legs. (www.agnesscott.edu) Walter had to have both legs amputated by Grace’s fourteenth birthday due to the hardening of the arteries of both legs. (Dickason, “Looking”) He advocated education for all of his children even his daughters. He made them believe that they could do anything that they put their minds to. “Grace’s father encouraged her to leave the usual feminine roles behind.” (Dickason, “Looking”) He was Grace’s major inspiration throughout her life and successes. (www.agnesscott.edu)

Grace attended the Graham School and Schoonmakers School in New York City, both private girls schools. (Dickason, “Looking”) She applied to Vassar when she was only sixteen years old. However, she failed a Latin exam and Vassar forced her to wait a year for admission.

(www.agnesscott.edu) During this year, Grace attending Boarding School, the Hartridge School, in New Jersey. (www.agnesscott.edu) She entered Vassar College in 1924. (Kokal) Grace later graduated Phi Beta Kappa honors from Vassar in 1928 with a Bachelor's Degree in Mathematics. (www.agnesscott.edu) Due to her outstanding performance at Vassar she was awarded a fellowship, which financed graduate school. Because of this Grace was able to study mathematics at Yale University earning a Master's Degree in 1930. (Kokal) It was during this time that Grace married Vincent Foster Hopper, an English instructor at New York School of Commerce. Grace was hired at Vassar as a mathematics instructor for only $800 per year. Grace taught at Vassar from 1931 to 1943. During this time, she earned a Ph.D. from Yale (1934). (www.agnesscott.edu)

It was after this that Grace decided to join the United States Navy. Grace's great-grandfather, Alexander Russel sparked her interest in the Navy. He was a rear admiral in the Navy. (Kokal) She faced many obstacles in this though. She was underweight for her age, 34, for military enlistment. Grace's age was also a problem. The military considered her too old for enlistment. (Dickason, "Looking") Another problem was that the Navy thought her position as a mathematics professor crucial to the war

effort. (www.agnesscott.edu) This however, did not stop Grace. She somehow got special permission and a leave of absence from Vassar. She also got a weight waiver. (Dickason, “Looking”) In December 1943, Grace was sworn into the United States Naval Reserve and graduated first in her class from Midshipman’s School for Women. (www.agnesscott.edu)

Grace’s first assignment as a Navy woman was to work under Commander Howard Hathaway Aiken at the Bureau of Ordnance Computation at Harvard University. Grace was greeted at Harvard by the Aiken asking her “where the hell have you been?” He continued to point at the Mark I and say “This is a computing machine. Compute the coefficients of the arc tangent series by Thursday.” (Lee) It was here she became the third programmer of the Mark I, the world’s first large-scale automatically sequenced digital computer. This computer was used to calculate ballistic trajectories. Grace immediately fell in love with this machine due to her love of gadgets. (US Navy) To her, the Mark I was the biggest gadget she had ever seen. In her own words, she described the Mark as “an impressive beast. She was fifty-one feet long, eight feet high, and five feet deep. And it had 72 words of storage and could perform three additions a second.” (US Navy) Grace mastered the Mark I, II, and III.

(US Navy) Grace and her team were even required to operate the machine for twenty-four hours a day sometimes. The machine performed these tasks by plugging wires into the back of the machine. “In addition to using the Mark I for mathematical calculations she was also assigned to drawing together all the mimeographed notes concerning the machine into a Manual of Operation for the Automatic Sequence Controlled Calculator.” This manual eventually became a 500-page book that both explained how to set up the machine and described the operations. Grace was both editor and author of three chapters. (Lee)

Grace was also credited with the computer term “bug” to mean a problem with the machinery. Her team found a moth that had been trapped in a relay, temporarily shutting the machine down. The moth was removed and taped into the logbook with the caption “The first actual case of bug being found.” (Connelly) She also extended the word to “debug” to mean fixing the glitch caused by the bug.

Grace worked at Harvard until 1949. She then made a risky choice, to work with the Eckert-Mauchly Computer Corporation as a senior mathematician. It was here that Grace learned how to add, subtract, multiply, and divide in octal. Octal is a number system with a base eight that uses digits 0 through 7, in order to facilitate the process. In

this position, Grace developed the first compiler, A-0, which translated symbolic mathematical code into machine code. Despite opposition, Grace developed the B-0 compiler, also known as FLOW-MATIC. This compiler could be used for typical business tasks such as payroll calculation and automated billing. Using FLOW-MATIC, she instructed UNIVAC I and II to be able to understand English statements by the end of 1956. The first specifications for COBOL were seen in 1959.

In 1966, Grace's age forced her to retire from the Navy. Less than one year later, she was reinstated making her the first Naval Reserve woman to return to active duty. It was then that she aided in the production of a "generally accessible COBOL certifier as well as translator programs to convert non-standard COBOL languages into the standardized version." It was not until 1986 that an eighty year old Grace retired again involuntarily from the Navy. This was an end to a forty-three year Naval career. (Dickason, "Remembering")

"Never forgetting her father's example, she took on the established system and won." She was a true pioneer. She not only helped show the way for computing but also women's issues. Grace received the first Computer Sciences "man of the year" award from the Data Processing Management

Association in 1969, a major step for women. (Dickason, “Remembering”) Grace also was honored with the Distinguished Service Medal and had over forty honorary degrees from various colleges and universities. (Lee) She even had a US navy Destroyer named after her, USS Hopper. (Information Executive) Not to mention, she was the first woman to earn a doctorate from Yale University. (Information Executive) Rear Admiral Grace Murray Hopper died January 1, 1992 and was buried at Arlington National Cemetery with full military honors. She was “Amazing Grace,” one of her many nicknames.

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