Joan Clarke Murray (mathematician, cryptanalyst, and numismatist)

(June 24, 1917 – September 4, 1996)

In 2014 my husband and I watched the movie "The Imitation Game" starring Benedict Cumberbatch and Keira Knightley. The movie was about the cryptanalysts who worked at Bletchley Park, a secret British government agency called Government Code and Cipher School (GC&CS) during World War II. The movie was based on the 1983 biography *Alan Turing: The Enigma* written by Andrew Hodges, a British mathematician, author, and emeritus senior research fellow at Wadham College, Oxford. The book and the movie were mostly about the accomplishments of Alan Turing, the head of the Hut 8 cryptanalysts who were assigned to break the German Enigma naval codes. About 30 minutes into the movie, I got very upset. Who is Joan Clarke (Keira Knightley's character) and why have we not heard about her before? She was obviously working with Alan Turing and was even briefly his fiancée. I googled her when I got home. Wow! She not only became deputy head of "Hut 8" when Alan Turing left, she was also the longest serving member of this group of cryptanalysts. I began to think of how history has treated these women scientists and in March 2015 I did a poster presentation about them during the Women's History Month Celebration at Lawrence Livermore National Laboratory. You can also say that this blog was a direct response to the movie and a result of my frustration/anger when I realized that important women scientists like Joan Clarke and Ellen Richards were overlooked and almost forgotten in history. This blog hopes to spotlight these women's accomplishments!

Her science journey began when Joan Elisabeth Lowther Clarke was born on June 24, 1917, in West Norwood, London, England. She was the youngest child of Dorothy Fulford Clarke and the Rev. William Kemp Lowther Clark, an Anglican priest. Her grandfather was Archbishop Henry Lowther Clarke of Melbourne, Australia. Even at a young age her mathematical abilities were evident! She came from an academic family and a family that could afford to send her to private schools. She attended Dulwich High School for Girls in South London and in 1936 won a scholarship to attend Newnham College at the University of Cambridge, the same alma mater as Rosalind Franklin. In 1939, she received a double first degree in Mathematics but was denied a full degree as the University of Cambridge only gave full degrees to men. Her double first degree means that she received first-class honors in at least two of the annual "Tripos" exams – a rare achievement. In 1948 women at Cambridge would finally be allowed to get a full degree. So, just like Rosalind Franklin, she worked very hard in college only to graduate with less than a full degree. Her mathematical abilities were first discovered by Gordon Welchman who was her professor in undergraduate Geometry. Gordon Welchman had studied mathematics at Trinity College, Cambridge and was a Research Fellow at Sidney Sussex College. In September 1939 Welchman was recruited to work for the Government Code and Cipher School (GC&CS) at Bletchley Park located in the small town of Bletchley. The town of Bletchley is in the north of Buckinghamshire and located halfway between London and Birmingham. It was a railway town, sitting on a busy junction. The other industry in town was brick manufacturing.

BLETCHLEY PARK

Bletchley Park is located on the other side of the railway track from the main streets of Bletchley. It has fifty-five acres of ground and a nineteenth-century mansion. It used to be the property of Sir Herbert Leon and his wife Fanny. In 1937 it was sold to the government. The decision was made to move the GC&CS office to the countryside

because they were afraid the central London location could be at high risk from potential German bomber raids. Soon the number of employees working at Bletchley Park grew so large that the employees could not all fit in the mansion. They started building wooden huts, insulated with asbestos. Hut 1 was originally intended to house the Park's wireless station. When the local residents of the town inquired about the presence of so many visitors, they were told it was a shooting party.

In late 1939, Welchman sent a letter to Joan inviting her to join him at Bletchley Park. He offered Joan an interesting job in government. He told her that one does not need a mathematics degree to do the job, but it was a big help. Joan responded that she would prefer to continue her studies at Cambridge until the following summer to complete Part III of the Mathematical Tripos. She would then follow Welchman to Bletchley Park. A week after Italy declared war on France and Britain in June 1940, Joan Clarke arrived at Bletchley Park ready to help Britain win the war.

ENIGMA

At Bletchley Park, Joan was first assigned with the "Girls" to do clerical work. Then she was assigned to help a group of cryptanalysts[1] crack Enigma naval codes at Hut 8. The Enigma was a type of enciphering machine used by the German armed forces to send messages securely. Each hut in Bletchley Park is assigned a different Enigma communication. One hut was assigned the army codes, one hut the Air Force codes, and Hut 8 was assigned the naval codes.

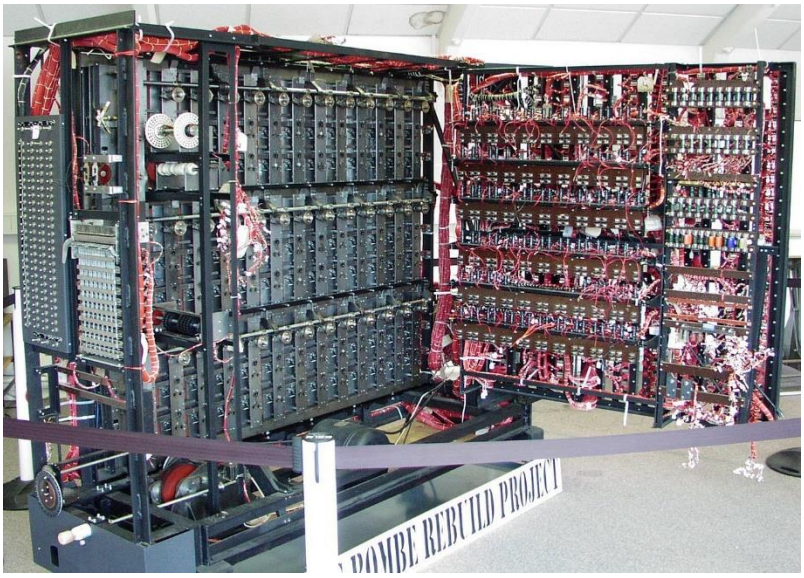
[1] A cryptanalyst is a professional codebreaker who analyzes and decodes secret coding systems and encrypted messages.

The Enigma machine was invented by Dr. Arthur Scherbius in the 1920s. He hoped to sell it to commercial companies, e.g. banks. With Enigma, the operator would type in a message, and then scramble it. The scrambling was done by three, four or five notched wheels or rotors which displayed different letters of the alphabet. To decode the message, the receiver needed another Enigma machine and the exact settings of the rotors. In 1926, the German Navy adopted the Enigma with a few modifications.

At Hut 8, Joan met the head of the cryptanalysts- Alan Turing, an old friend of her brother Martin! Turing used to live in the same dorm as Martin when Martin was attending Kings College. When Joan arrived at Cambridge, Martin introduced Joan to Turing since both were interested in mathematics. Turing remembered Joan's ability in mathematics. Soon Joan and Turing were spending their time together. Turing arranged their days off so they would be on the same day. They would go to the cinema, play tennis or chess, and go on picnics together.

THE BOMBE

Turing and Welchman invented the British Bombe to help them crack the Enigma naval codes. This was patterned from a device called "bomba" designed in Poland by cryptologist Marian Rejewski. He had broken German Enigma messages using this device. The British bombe, like the Polish bomba, was designed to discover the daily settings of the Enigma machines in the German armed forces:



specifically, the set of rotors in use and their positions in the machine; the rotor core start positions for the message which is the message key and one of the wirings of the plugboard.

Although the Bombe helped with the mechanics of decryption, it was not the solution. Code-breaking still depended on the skill of the codebreakers. With the help of captured Enigma material, Turing developed a technique called Banburismus. With successful use of this technique, they could read the Enigma messages of the German naval forces. Joan excelled in Banburismus. She is one of the best in Hut 8. We will never know the extent of work done by Joan and the other cryptanalysts at Hut 8 since everything was classified and everything related to Enigma was destroyed after the war. It has been estimated that the work done by Bletchley Park cryptanalysts shortened the war by two years and saved over 14 million lives. The importance of the work Joan did at Hut 8 was evident when she was appointed Member of the Order of the British Empire (MBE)[2] in 1946

In 1941, Alan Turing proposed to Joan Clarke. She accepted the proposal even though Turing confessed that he had homosexual tendencies. Joan was unfazed by this revelation and had already suspected that Turing may be homosexual. It bothered her a bit but since they enjoyed each other's company and were able to talk to each other as intellectual equals, she accepted his proposal. He introduced her to his parents, and she invited him to go with her when she visited her parents in West Dulwich. Every one of their co-workers thought it was a good match although no one had suspected that Turing was homosexual. After a few months of the engagement, Turing broke it off, believing that it would never work. They remained good friends even after the war. For details you can watch this interview with Joan Clarke: https://www.youtube.com/watch?v=MB2e9R7bXCk. In the video Joan explained what happened with the engagement to Turing.

GCHQ EASTCOTE

After the war, Turing worked at the National Physical Laboratory (NPL) while Joan joined the GC&CS office in Eastcote. GC&CS Eastcote's name was changed to Government Communications Headquarters (GCHQ). Joan and her colleagues were tasked with reading Soviet intelligence traffic. The first major project of GCHQ was to identify active Soviet agents and "sleepers" operating in government departments. Joan worked at Section H with Hugh Alexander as Section chief; Hugh had been one of the cryptanalysts at Hut 8. The cryptanalysts used the enormous computer power given to them by the Americans. They found out that the Soviet Union had spies and informers placed in the most secret American and British organizations.

[2] . The Most Excellent Order of the British Empire is a British order of chivalry rewarding contributions to the arts and sciences, work with charitable and welfare organizations, and public service outside the civil service.

With so many government agencies compromised, the decrypted documents were restricted to the cryptanalysts, and a few select members of the United States National Security Agency (NSA) and GCHQ. With help from the agents of MI5 and MI6 and their American counterparts, the cryptanalysts were able to ascertain the identity of five famous spies called the Cambridge Five. *Homer* was identified as Donald Maclean, *Madchen or Hicks* was Guy Burgess, *Sonny or Stanley* was Kim Philby and later *Johnson or Yan* as Anthony Blunt and *Liszt*, their former colleague at Bletchley Park John Cairncross. Together the Cambridge Five spy ring divulged British secrets to the Soviets during World War II and in the early stages of the Cold War.

At GCHQ Eastcote, Joan met a retired Lieutenant Colonel from the Army, John Kenneth Ronald Murray, known by his nickname Jock. Murray was a new recruit to GCHQ Eastcote as a fluent Russian speaker. He and Joan got engaged in the spring of 1952 and were married on July 26, 1952 at Chichester Cathedral. After the wedding they bought a house in Crail in Fife, Scotland. It was an interesting choice for a home to settle in since neither had any relatives in the area. Crail was a small fishing community on the Firth of Forth with a sheltered harbor. It was a wealthy community with its own golf course. A downside was that Jock had poor health and Crail did not have a hospital.

We don't know for sure why Joan and Jock moved there, but there were Cold War activities in the area. Just outside Crail was a naval airfield. About 5 miles from the airfield was a wartime radar station which was rebuilt as part of the ROTOR early warning system. Also, the Joint Services School for Linguists (JSSL) planned to consolidate its operations at the airfield. And maybe there was more. We could speculate on a secret spy school, or maybe an ultra -secret GCHQ listening and analysis center. Whatever it was, their mission ended after 10 years. In 1962 they went back to work at Bletchley Park in England. Joan continued working at Blectchley Park until she retired in June 1982.

While in Scotland, Joan heard of the death of Alan Turing on June 7, 1954. One chapter of her life had closed after the death of Turing.

When Jock Murray retired from the Army in 1948, he became interested in medals and medal ribbons. When he got married and moved to Scotland with Joan, he sold his collection through the London auction house of Glendining & Co. On their return to England, he resumed his interest in coins and became a member of the Cheltenham Numismatic Society[3]. In 1965 Joan also got interested in numismatics and joined the British Numismatic Society. When Jock health deteriorated Joan stopped her numismatic studies and took care of her husband. He died in November 1986. In the same year, Joan was awarded the John Sanford Saltus Gold Medal, an honor given by the British

[3] A numismatist is a person who studies, collects, or specializes in numismatics, or the study of coins, currency, and other related objects.

Numismatic Society every three years based on the votes of its members and for scholarly contributions to British numismatics. Joan had contributed to an important study on Scottish coins of the sixteenth and seventeenth centuries. The work was something like code breaking, since previous scholars had been unable to solve the puzzle of the coins' chronological sequence. Specifically, she established the sequence of the complex series of gold unicorn and heavy groat coins that were in circulation in Scotland during the reigns of James III and James IV.

After her husband's death, Joan moved to Headington, Oxfordshire where she continued her research into coinage. In the 1980s she helped Sir Harry Hinsley with the appendix to volume 3, part 2 of *British Intelligence in the Second World War.* She also helped historians who were studying the code-breaking activities at Bletchley Park during World War II. Joan died in her home in Headington, Oxfordshire, England on September 4, 1996, at the age of 79 years. She had been planning to visit her sister-in-law. When she did not arrive, her sister-in-law contacted the police in Headington. The Police found her in her bedroom where she apparently died of a heart attack. Joan's funeral was held at Holy Trinity in Headington Quarry on September 23,1996. Memories of Joan came from both her fellow numismatics and her cryptanalyst colleagues. Though her cryptanalyst colleagues were not able to say much about the work they did at Bletchley Park, Shaun Wylie commented that she had an acute intelligence and held her own with her male colleagues at Hut 8. "She was also known as one of the really good cryptanalysts at GCHQ. She served her country well, in a noble cause."

HER LEGACY

Joan Clarke will forever be known as the only woman member of the Hut 8 cryptanalysts. She had an essential role in breaking the German Enigma naval codes and in discovering the identities of the members of the Cambridge Five spy ring. She will also be known for her expertise in numismatics. On July 27, 2019 an Oxfordshire Blue Plaque was unveiled at her house in Headington. In May 2024, a blue plaque in Joan Clarke's memory was unveiled by the English Heritage at 193 Rosendale Road, West Dulwich, London, Joan's childhood home.

HER SCIENCE JOURNEY

1917 - Joan Elisabeth Lowther Clarke was born on June 24, 1917, in West Norwood, London, England.

1932 - Attended Dulwich High School for Girls

1936 - Received a scholarship at Newnham College, Cambridge

1939 - Received Double First Degree in Mathematics from Newnham College

- Was invited by Gordon Welchman to work at Bletchley Park

1940 - Started working at Bletchley Park. Initially placed with the "Girls" to do clerical work.

- Transferred to Hut 8 to work with cryptanalysts under Alan Turing

1944 - Became Deputy head of Hut 8

1944 - Exposed the identity of Cambridge Five

1946 - Received MBE award

1947 - Met Lieutenant-Colonel John Kenneth Ronald Murray at GCHQ Eastcote where she transferred after the war

1952- Married Lieutenant-Colonel John Kenneth Ronald Murray and moved to Scotland

1962 - Moved back to England

1965 - Joined the British Numismatic Society

1982 - Retired from Bletchley Park

1986 - Received the John Sanford Saltus Gold Medal,

1986 - Husband Jock Murray passed away

1996 - Died in her home in Headington, Oxford

2019 - An Oxfordshire Blue plaque was unveiled on her house in Headington

2024 - English Heritage unveiled a blue plaque in Joan Clarke's memory at her childhood home

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The photographs and some of the information were taken from the following websites:

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