Colossus - The First Programmable, Electrical Computer

In 1938 the UK government purchased Bletchley Park off of property developer Captain Hubert Faulkner, and housed The Government Code and Cypher School here as the threat of war was building[1]. As August 1939 came around, codebreakers began to arrive at Bletchley Park to begin work on decoding Axis communications. One of the ciphers that Axis powers were using was the Lorenz cipher, which was mainly used by the German Army[2]. This lead to research telephone engineer Thomas H. Flowers to design and build Colossus, the first electronic programmable computer[6s].

In 1943 the first prototype, Colossus Mark 1 was operational, and fully working by February 1944. The build took Flowers and his team ten months to complete, and surprisingly worked straight away once disassembled and then moved from Flower's workshop to Bletchley Park[2]. By June 1944 the successor to the Mark 1 was operational, whos processing power was vastly superior, going from 5,000 characters per second in the Mark 1 to 25,000 characters per second in the Mark 2[6]. This was achieved by using shift registers. This allowed the machine to use five processors simultaneously to work on the same program[3]. Data would have had to have been read from six lines of punched tape simultaneously with a photoelectric reader, and passed into each of the five processors (with the sixth for any differences between the lines)[3]. Shift registers meant that only one line of punched tape had to be read at a time, thereby making five sequential characters available simultaneously to the processors[3][6].

Both versions of the Colossus operated in a similar way using at least 1500 electric vacuum tubes for Boolean calculations[4]. Tunny, the machine used by the Germans for encrypting messages, replicated a Vernam cipher using the XOR operator. This makes it extremely difficult to decrypt messages without knowing the correct gear and cam positions that were used when encrypting[4][5]. Programming Colossus was conducted via plugboards[6] allowing flexibility, and more vitally, allowing changes to be made to how the electronic components behave so that they can replicate the key-generating gears of the Tunny machine. Colossus worked by using the photoelectric reader to convert holes in punched tape to electronic pulses. The tape also contained holes for sprockets in the machine, so that processor timing was correct (essentially acting like a clock pulse in a modern computer)[7]. The gear settings from a Tunny machine were stored electronically on rings of thyratron valves, which work by essentially trapping a current or a value[7], and were changes by the plugboards. The message is then decrypted by adding (Boolean XOR) a thyratron ring value with the corresponding message character to get the plain text message[4][7].

Although simple by todays standards, Colossus was revolutionary for its time, and pathed the way for machines after it. A couple years later in 1945 the ENIAC was created, which followed many of the same principles and design choices of Colossus, but with more vacuum tubes and therefore greater processing power[6]. Debatably Colossus and its creators were held back by the lack of high-speed storage technologies[6], as with this Colossus would have been comparable in principle to computers of today. Despite this, there is no denying that Colossus was indeed the first electric programmable computer.

Bibliography

[1] BPSIC, 2013. *History of Bletchley Park.* [Online]
Available at: http://www.bpsic.com/history-of-bletchley-park
[Accessed 15 10 2017].

[2] Copeland, J. B., 2006. In: *Colossus: The secrets of Bletchley Park's code-breaking computers.* Oxford: Oxford University Press, pp. 1, 2, 75.

[3] Flowers, T. H., 1983. The Design of Colossus. *Annals of the History of Computing,* 5(3), p. 246.

[4] Copeland, J. B., 2004. Colossus: its Otigins and Originators. *Annals of the History of Computing,* 26(4), pp. 38-45.

[5] Rosenberg, B., 2004. *Vernam Cipher, a perfect cipher.* [Online]
Available at: http://www.cs.miami.edu/home/burt/learning/Csc609.051/notes/02.html
[Accessed 18 10 2017].

[6] Randell, B., 1980. The Colossus. *A History of Computing in the Twentieth Century,* pp. 17-27.

[7] Brown-Cohen, J., Souza, K. & Stepanchuk, A., 2008. *Colossus Machine.* [Online]
Available at: https://cs.stanford.edu/people/eroberts/courses/soco/projects/2008-09/colossus/colossus.html
[Accessed 18 10 2017].