

# Colossus

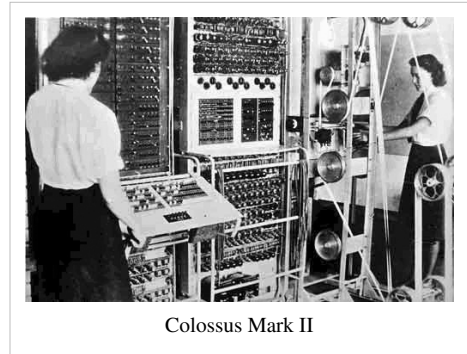
**Colossi** waren frühe Computer, die in England während des Zweiten Weltkriegs speziell zur Dechiffrierung von geheimen Nachrichten des deutschen Militärs gebaut wurden. Mit ihrer Hilfe wurde ab 1943 in Bletchley Park die Entzifferung der deutschen Lorenz-Schlüsselmaschine möglich.

## Motivation

Die Verschlüsselungsmethode – Erzeugung von Pseudozufallszahlen und exklusive Veroderung – wurde durch einen schwerwiegenden Fehler der Deutschen bereits beim 1. Erprobungsversuch erkannt: Eine etwa 4000 Zeichen lange Nachricht wurde mit leicht unterschiedlichem Text, jedoch mit derselben Pseudozahlenfolge zweimal übertragen, was eigentlich streng verboten war.

Die Deutschen verwendeten einen täglich wechselnden Schlüssel, der unterschiedliche Zahlenfolgen erzeugte. Jede Nachricht musste daher getrennt entziffert werden. Eine manuelle Dechiffrierung einer Nachricht nahm mehrere Monate in Anspruch. Die enthaltene Information ist dann in der Regel wertlos. Max Newman erkannte, dass die Entzifferung mit Maschinenhilfe wesentlich beschleunigt werden kann.

Der Entwurf der Maschine stammte von Max Newman, einem in Bletchley-Park beschäftigten Mathematiker, aufbauend auf den Ideen zu einer universellen Maschine von Alan Turing. Gebaut wurde die Maschine von Tommy Flowers im Forschungszentrum der britischen Post in Dollis Hill.



Colossus Mark II

## Aufbau und Leistungsfähigkeit

Colossus bestand zunächst (1943) aus 1.500 Röhren, später aus 2.500. Bei einer Leistungsaufnahme von 4500 W konnten von der Maschine erstaunliche 5.000 Zeichen (à 5 Bit) pro Sekunde verarbeitet werden. Der Speicher bestand aus 5 Zeichen von je 5 Bit in Schieberegistern. Die Zeichen wurden photoelektrisch von einem Lochstreifen gelesen, die Lochreihe in der Streifenmitte erzeugte den Takt, bei 5.000 Zeichen/sek also 200  $\mu$ s. Innerhalb eines Taktes konnten etwa 100 Boolean-Operationen auf jeder der fünf Lochreihen und anschließend auf einer Zeichenmatrix parallel durchgeführt werden. Die Treffer wurden dann gezählt.

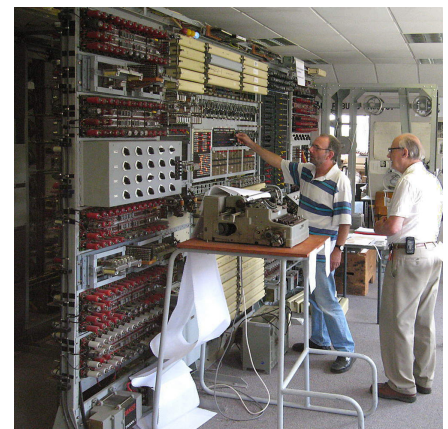
Zwischen 1943 und 1946 wurden insgesamt zehn Geräte gebaut. Colossus erlaubte die Entzifferung einer Nachricht innerhalb weniger Stunden.

## Erster speicherprogrammierbarer Computer

Die Colossus gilt zwar als der erste speicherprogrammierbare Computer, war jedoch fest an eine bestimmte Aufgabe angepasst und nicht im heutigen Sinn frei programmierbar. Das Gerät wurde unter strengen Geheimhaltungsrichtlinien gebaut, so dass keinerlei Aufzeichnungen oder Handbücher darüber existieren. Alle britischen Colossus wurden 1946 aus Geheimhaltungsgründen demontiert und vernichtet, jedoch überlebte eine US-Variante.

## Nachbau durch Tony Sale

Erst 1970 wurde die Existenz von Colossus öffentlich bekannt. Ab 1990 baute Tony Sale, Ingenieur und ehemaliger Mitarbeiter des Nachrichtendienstes MI5 den Colossus für das Computermuseum in Bletchley Park nach. Am 6. Juni 1996 hatte er seinen ersten erfolgreichen Lauf. Zur offiziellen Einweihung des Gerätes am 16. November 2007 sandten deutsche Funkamateure einen mit einer original *Lorenz* verschlüsselten Text. Colossus „knackte“ die Nachricht in drei Stunden und 35 Minuten, sie enthielt eine Einladung zu einer Ausstellung mit historischen Computern im Heinz Nixdorf MuseumsForum, Paderborn. Die Entzifferung verzögerte sich um rund 45 Minuten, da eine der 2400 Röhren des Rechners geplatzt war.<sup>[1]</sup> Im parallel zur Übertragung veranstalteten Wettbewerb gelang es einem Funkamateur, das Signal mit der Antenne seines Clubs aufzufangen, akustisch zu bearbeiten und es mit einem Laptop unter FreeBSD schließlich in 46 Sekunden zu entziffern. Der Nachbau des Colossus ist im Museum von Bletchley Park zu sehen.



Tony Sale 2006 bei einer Entzifferung mit der fertiggestellten Maschine.

## Colossus – der Film

1970 entstand der Science-Fiction-Thriller „Colossus: The Forbin Project“ nach einem Roman von Dennis Feltham Jones. Er bezieht sich zwar nicht ausdrücklich auf seinen älteren Namensvetter, dennoch sind Parallelen erkennbar: Ein gigantischer Supercomputer, eingebettet in das Innere eines Berges, soll helfen, den Weltfrieden zu sichern. Professor Forbin (dargestellt von Eric Braeden), der geniale Entwickler des Computergiganten, welcher sogar einen Nuklearkrieg überstehen soll, rechnet nicht mit dem gefährvollen Potential seiner Kreation.

## Vergleich mit anderen frühen Computern

### *Eigenschaften der ersten Computer*

Computer	Land	Inbetriebnahme	Gleitkomma-arithmetik	Binär	Elektronisch	Programmierbar	Turingmächtig
Zuse Z3	Deutschland	Mai 1941	Ja	Ja	Nein	Ja, durch Lochstreifen	Ja
Atanasoff-Berry-Computer	USA	Sommer 1941	Nein	Ja	Ja	Nein	Nein
Colossus	UK	1943	Nein	Ja	Ja	Teilweise, durch Neuverkabelung	Nein
Mark I	USA	1944	Nein	Nein	Nein	Ja, durch Lochstreifen	Ja
Zuse Z4	Deutschland	März 1945	Ja	Ja	Nein	Ja, durch Lochstreifen	Ja

ENIAC	USA	1946	Nein	Nein	Ja	Teilweise, durch Neuverkabelung	Ja
		1948	Nein	Nein	Ja	Ja, durch eine Matrix aus Widerständen	Ja

## Literatur

- Bengt Beckmann, K. O. Widmann: *Arne Beurling und Hitlers Geheimschreiber. Schwedische Entzifferungserfolge im 2. Weltkrieg*. Springer, Berlin u. a. 2006, ISBN 3-540-23720-8.
- B. Jack Copeland: *Colossus. The Secrets of Bletchley Park's Codebreaking Computers*. Oxford University Press. Oxford u. a. 2006, ISBN 0-19-284055-X.
- Paul Gannon: *Colossus. Bletchley Park's Greatest Secret*. Atlantic Books, London 2006, ISBN 1-84354-330-3.

## Weblinks

- Der wiedererbaute Colossus <sup>[2]</sup>
- Offizielle Seite von Bletchley Park <sup>[3]</sup>
- Code-Knacker, Süddeutsche Zeitung, 18. November 2007 <sup>[4]</sup>
- Neue Zürcher Zeitung, (2. März 2007) <sup>[5]</sup>: Colossus, der erste elektronische Computer, ist in Bletchley Park als Nachbau zu besichtigen.
- *Colossus: The Forbin Project* <sup>[6]</sup> in der Internet Movie Database (englisch)

## Quellen

- [1] *Der Code-Knacker - Briten rekonstruieren Computer aus dem Zweiten Weltkrieg*, Süddeutsche Zeitung, Nr.265, S. 24, 17./18. November 2007
- [2] <http://www.codesandciphers.org.uk/lorenz/rebuild.htm>
- [3] <http://www.bletchleypark.org.uk/>
- [4] <http://www.sueddeutsche.de/digital/verschlueselung-code-knacker-1.333646>
- [5] [http://www.nzz.ch/nachrichten/panorama/articleeyv3k\\_1.120963.html](http://www.nzz.ch/nachrichten/panorama/articleeyv3k_1.120963.html)
- [6] <http://www.imdb.com/title/tt0064177/>
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