Computers Go To War

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Computing Systems in WWII

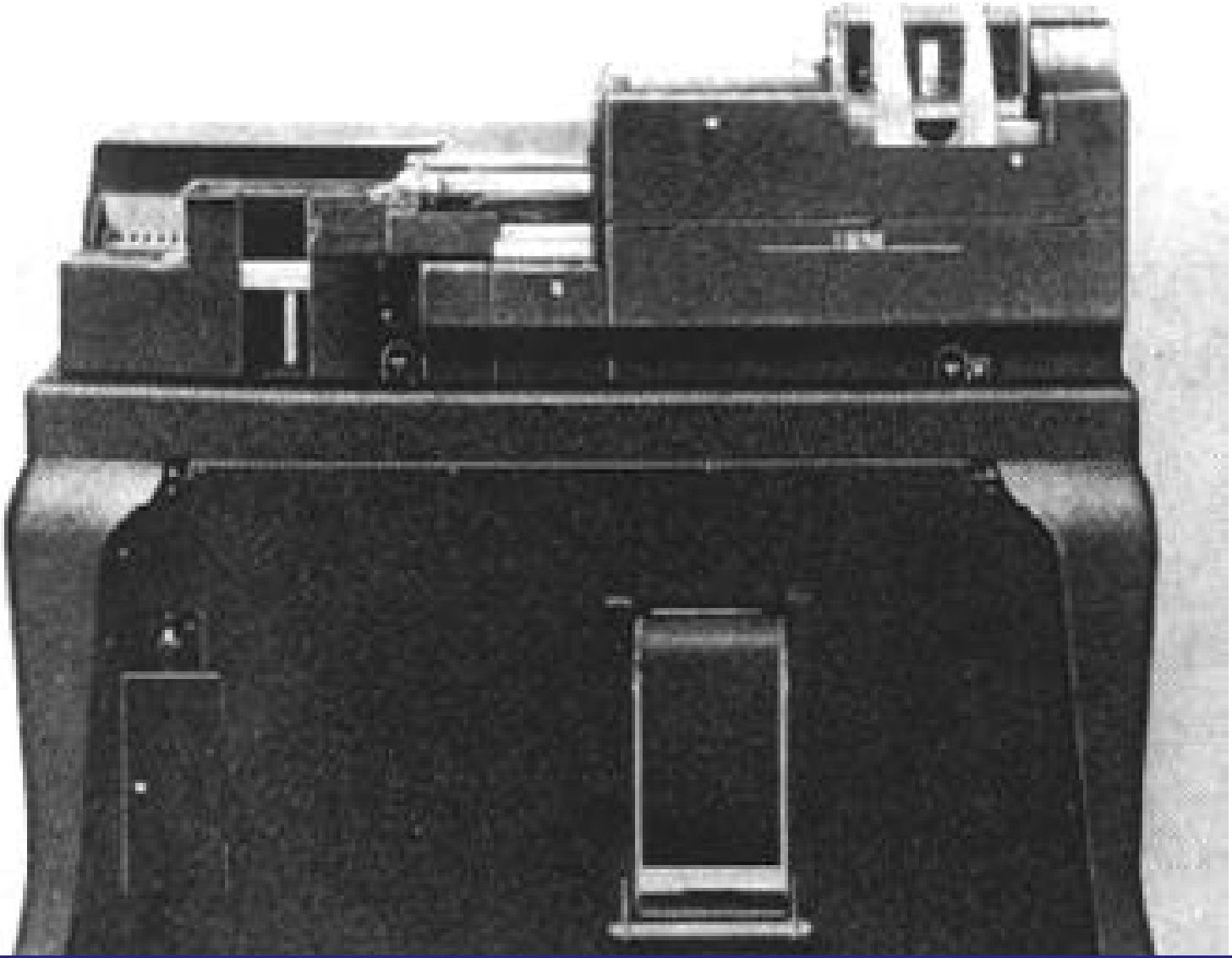
- Tabulating Machinery
- Harvard Mark I
- Differential Analyzers
- Konrad Zuse's Machines
- Bombe and Colossus
- ENIAC

Tabulating Machinery

- Herman Hollerith—put punched cards into common use
- Early card counters and sorters: 1900 census
- Adders/Difference Engine: 1932
- IBM 601 Relay Multiplying Punch: 1935
  - Used heavily on the Manhattan Project
- IBM 604 Tube Multiplying Punch: 1948

Early Hollerith System

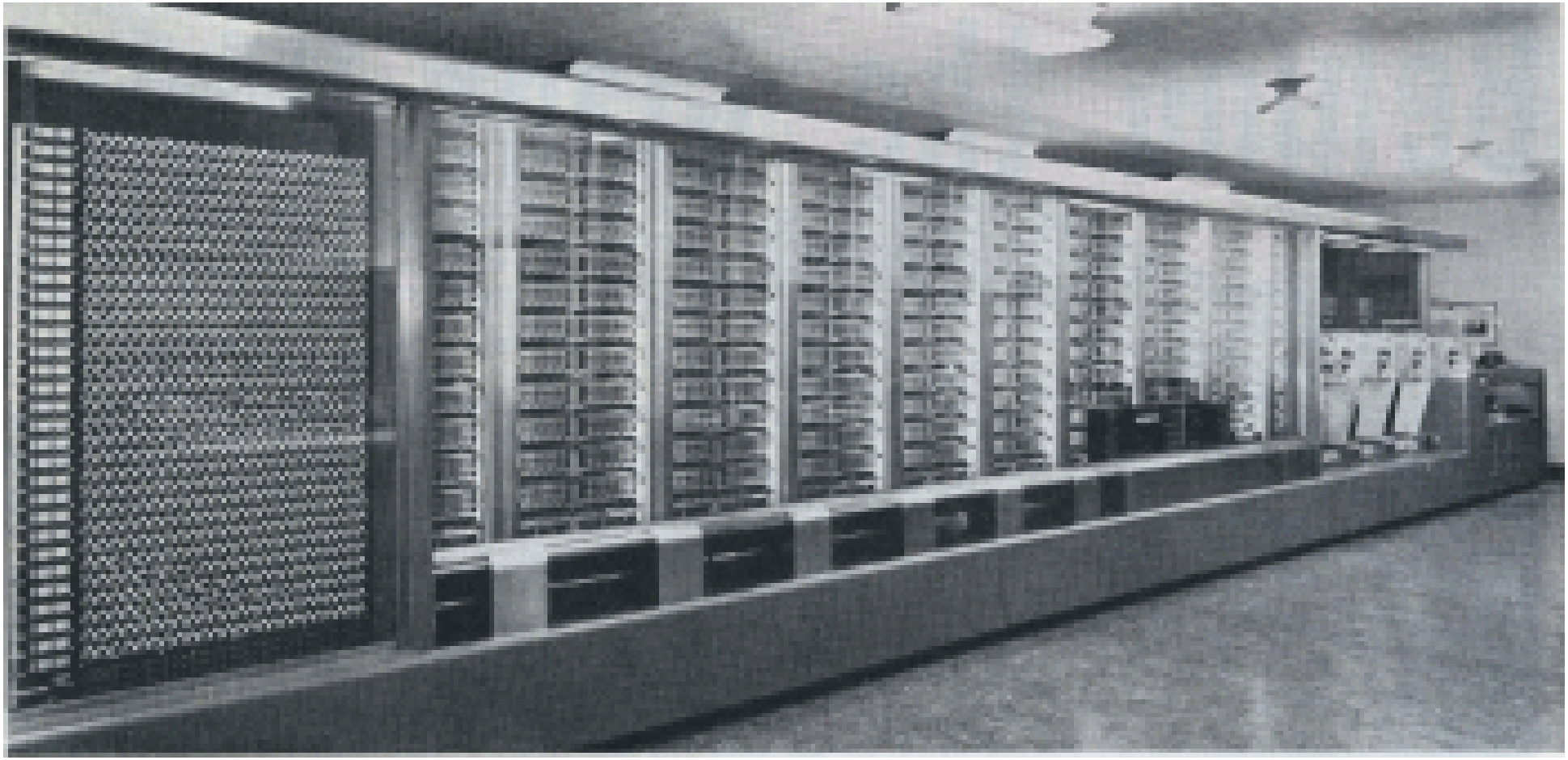
IBM Multiplying Punch



Harvard Mark I

- Howard Aiken with IBM: 1939–1944
- Grace Murray Hopper, assistant to Aiken
- Somewhat inspired by Babbage
- 51' long, 8' high, 500 miles of wire
- Toothed wheels
- Controlled by paper tape
- Used by the Navy for artillery calculations

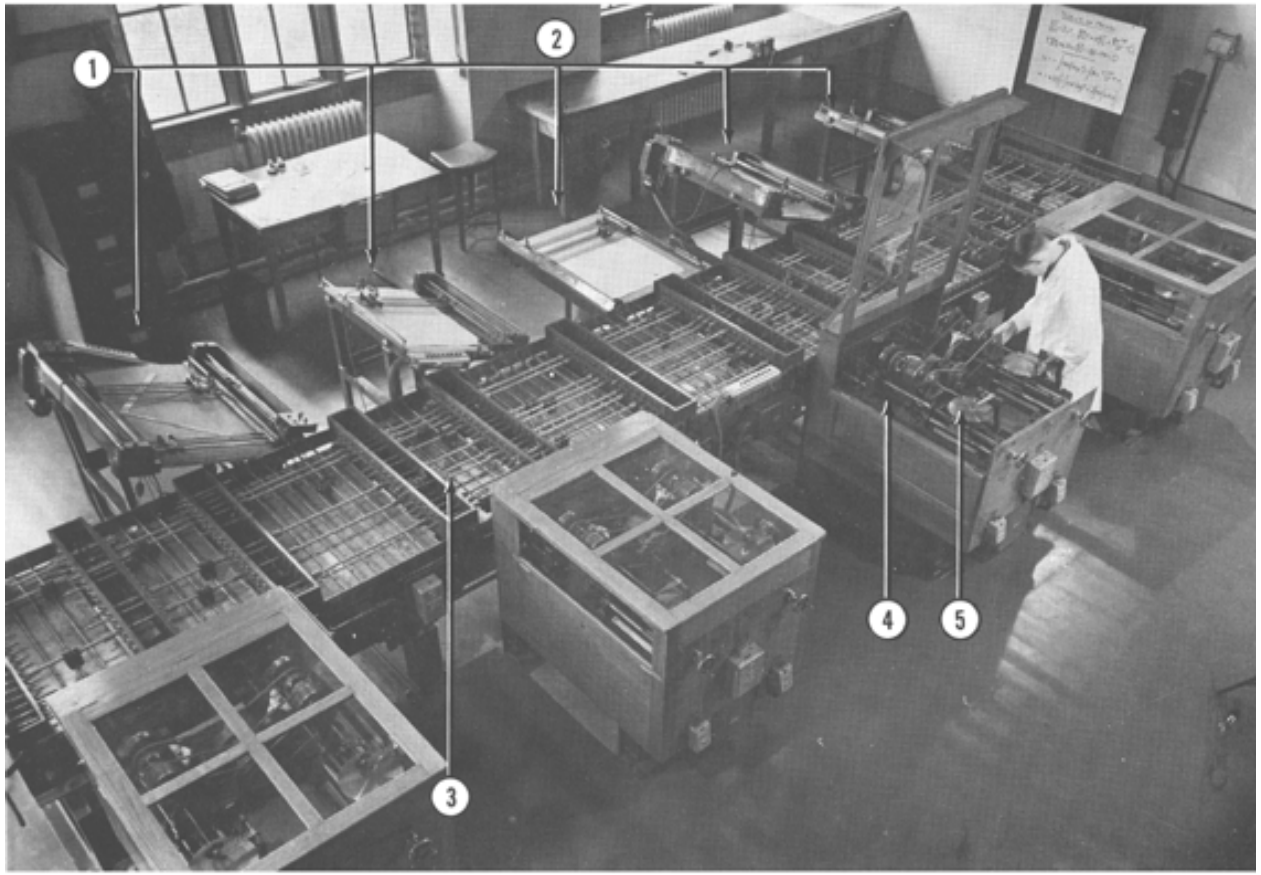
Harvard Mark I



Differential Analyzers

- Mechanical Analog Computer
- Vannevar Bush at MIT
- Solves differential equations
- Used for ballistic tables
- Special set of tables for V2

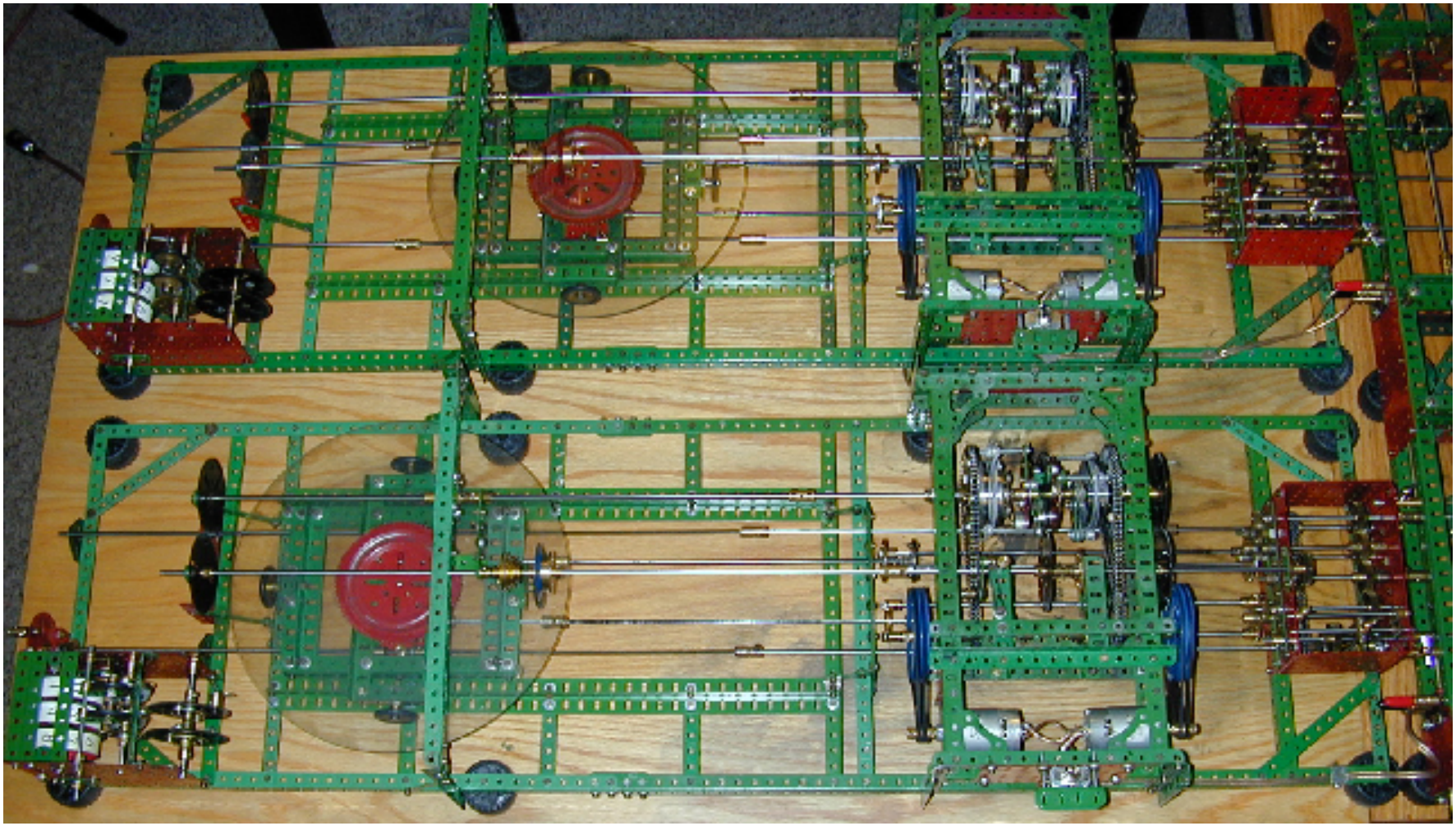
Vannevar Bush and Differential Analyzer



1 Input table
2 Output table
3 Shafts and gears used for interconnection
4 Torque amplifier
5 Integrator disk

Wheel and Disk Integrator

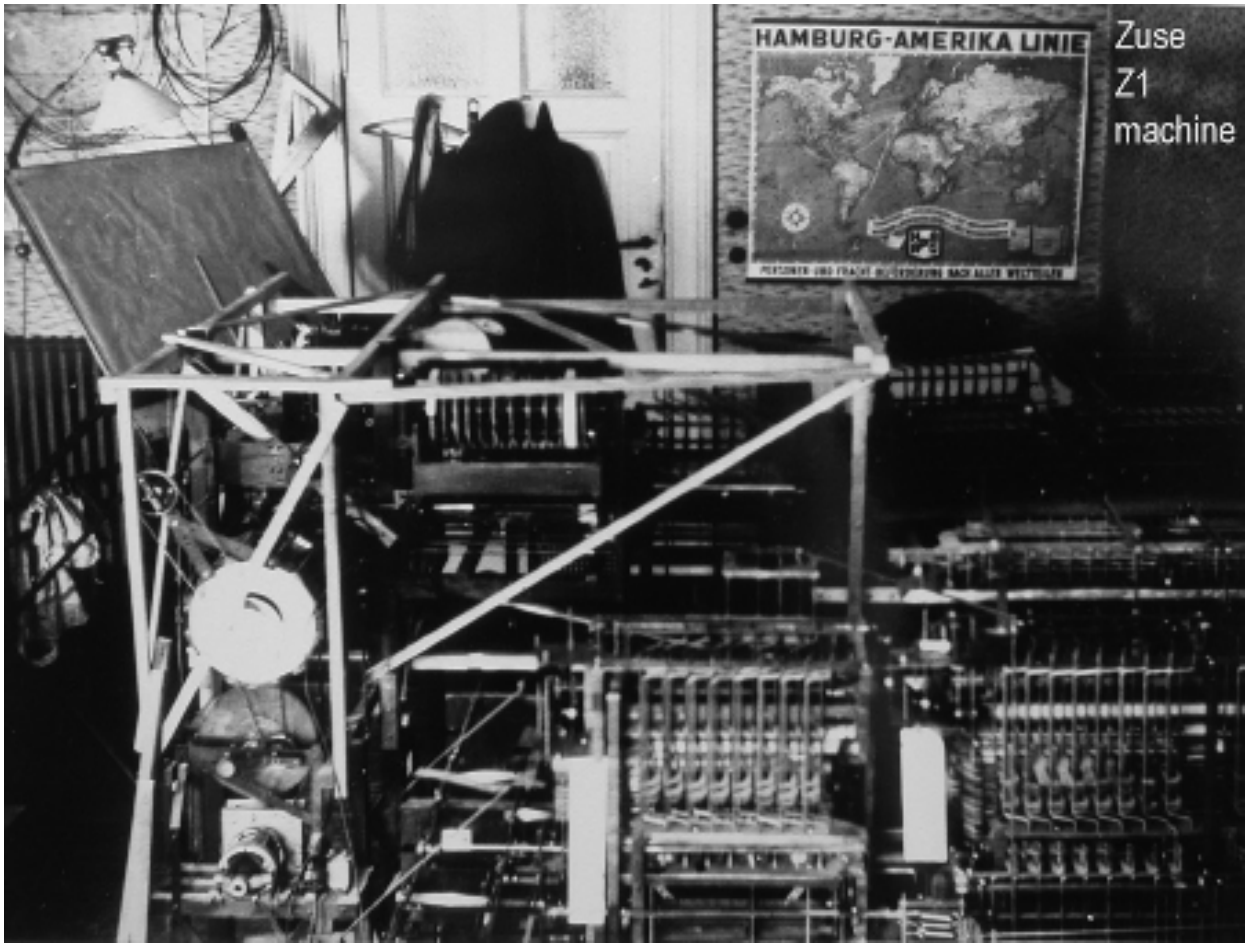
Meccano Differential Analyzer



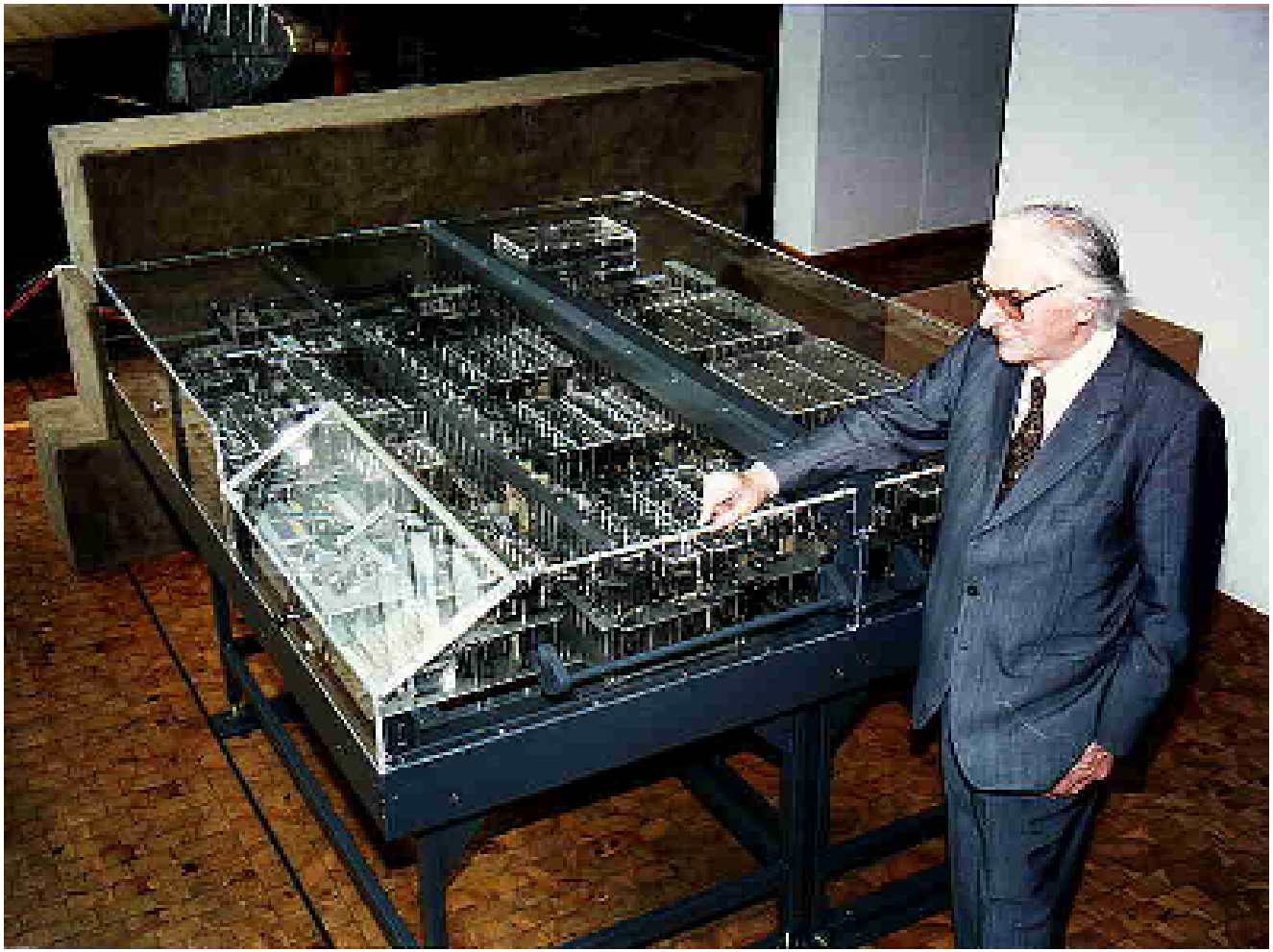
Z1

- Konrad Zuse
- Mechanical
- Binary
- Floating point
- Controlled by “paper tape” (35mm movie film)
- Built in his parents’ living room
- Completed in 1938

Z1



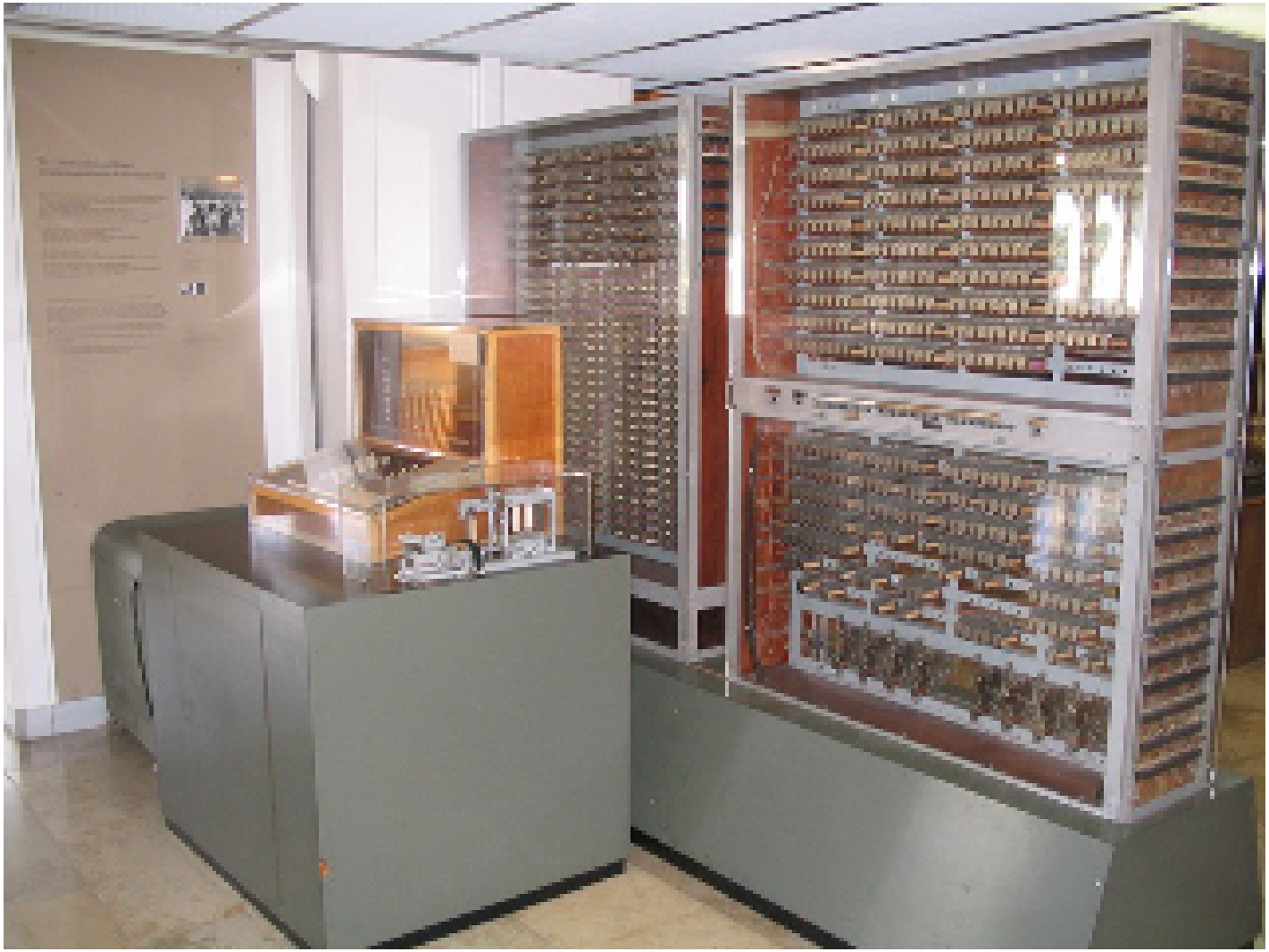
Rebuilt Z1



Z2–4

- Z2 operational 1939
  - Same mechanical memory as Z1
  - Relay logic
- Z3 operational 1941
  - Relay logic
  - Relay memory
- Z4 not completed during the war
  - Back to mechanical memory
  - Relay logic

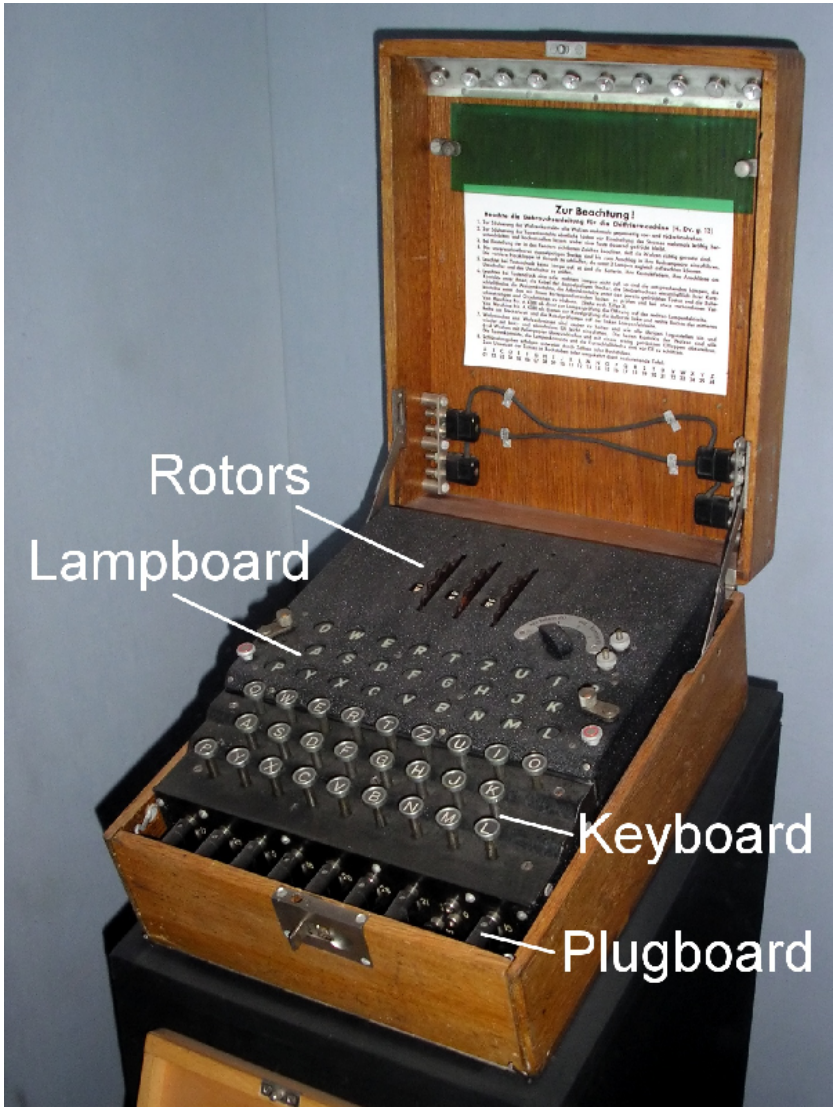
Z3



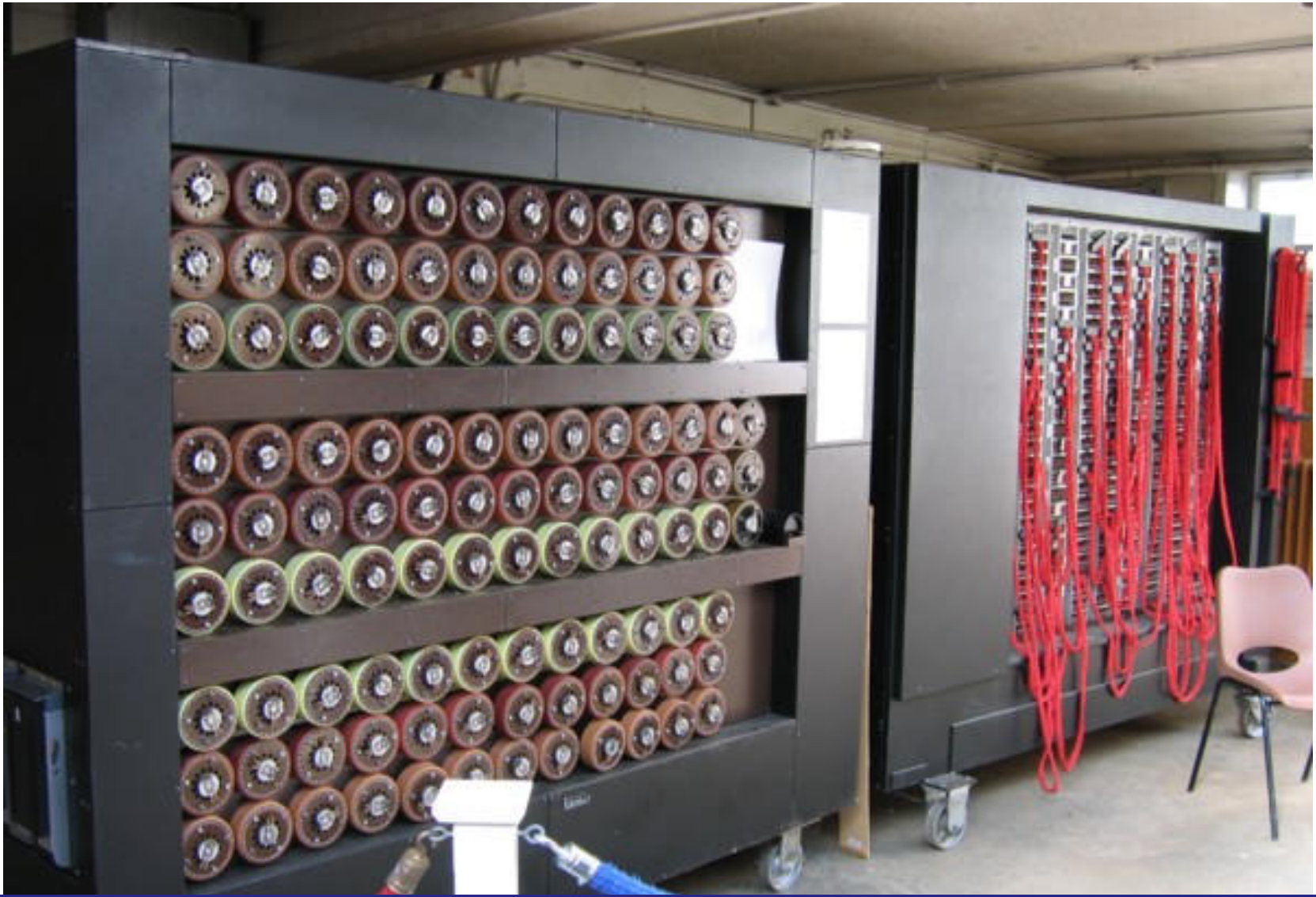
Bombe

- Massively parallel
- Brute force Enigma simulation
- Automatically checked for non-solutions

Enigma



Bombe



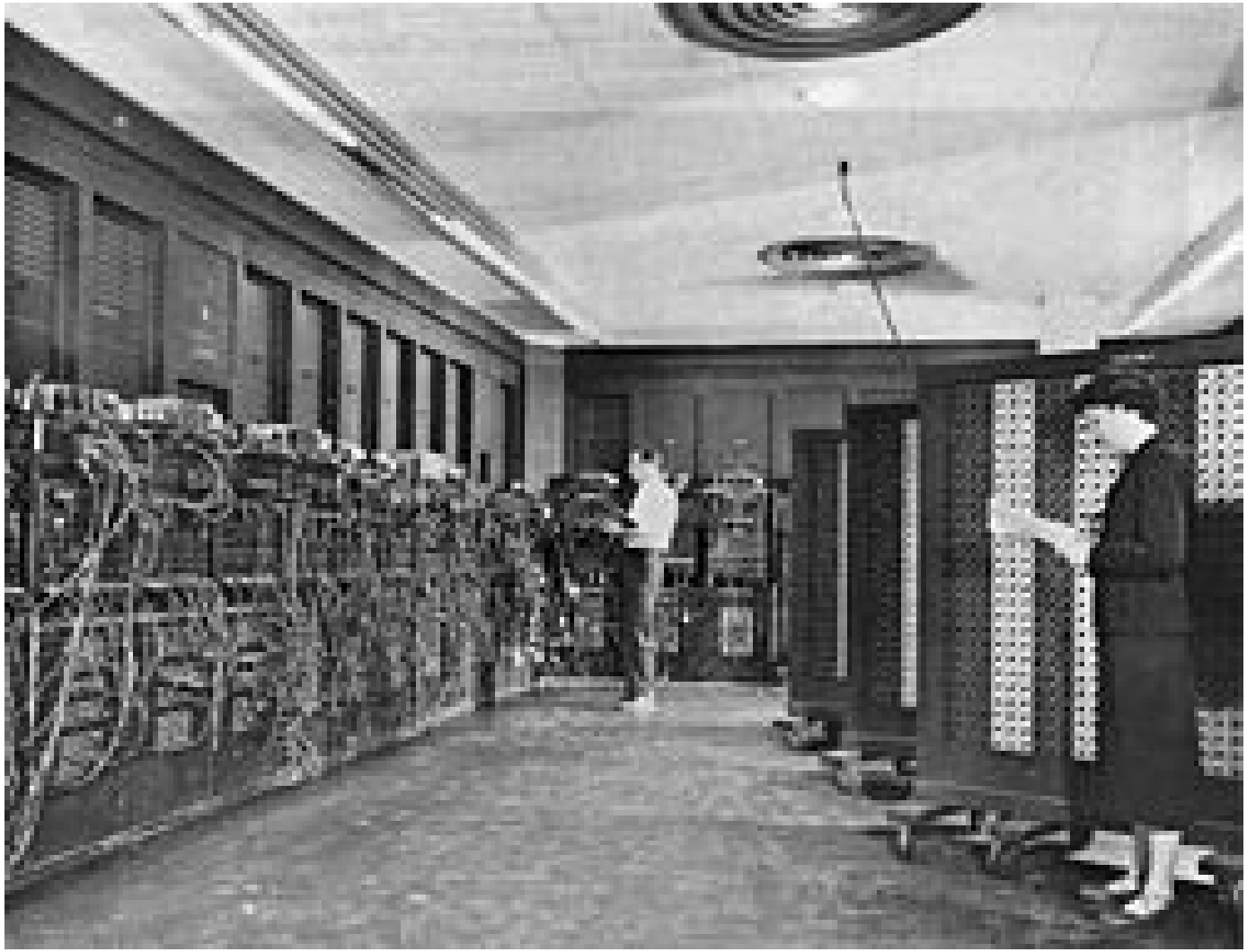
Colossus

- Used to break Lorenz cipher
- Big Boolean algebra engine
- Message on paper tape loop
- Tape processed at 5000 character per second
- Used vacuum tubes

Lorenz Cipher Machine

Colossus

ENIAC

- Electronic Numerical Integrator and Computer
- J Presper Eckert and John Mauchly
- 18,000 vacuum tubes
- Not binary—decade counters
- Completed 1946

ENIAC