

The Electronic Revolution

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And, the focus becomes an **electron**!

- Today, we live in an **electronic** world, where everything is electronic: our automobiles, our home appliances, even our *books, writing tablets, and tally sheets*.

Reference: Bunch and Hellemans, *The Timetables of TECHNOLOGY, A Chronology of the Most Important People and Events in the History of Technology*, Simon and Schuster, 1993.

Thomas A. Edison

- Thomas Alva Edison discovers the “**Edison effect**” in 1883, after introducing a metal plate into an **electric light bulb** in an attempt to keep the bulb from turning black. It doesn't work, but **Edison discovers that there is a current between the filament and a separate electrode, thus finding a basic principle of the operation of the vacuum tube.** Seeing no immediate application, he loses interest!

Science qua science!

- **William Crookes** [b. London, 1832] **1878**
describes his experiments on passing electric discharges through an evacuated glass tube to the Royal Society
- **Karl Ferdinand Braun** [b. Fulda, Germany] **1897**
develops a **cathode-ray tube** consisting of an evacuated electron tube in which electrons, aimed by electromagnetic fields, form an image on a fluorescent screen

First “valve”

- **John A. Fleming** [b. Lancaster, UK] **1904**
- files a **patent** for the first vacuum tube, also called a “**Flemming valve.**”
 - **diode** that acts as a **rectifier**, a device that makes current flow in a single direction instead of alternating back and forth; hence, it changes alternating current (AC) to direct current (DC)

The triode

- **Lee De Forest and R. Von Lieben 1907**
- invent the amplified vacuum tube (triode) based on a two-element vacuum tube invented by John Ambrose Fleming. The tube contains a **third element, a grid**, placed between the cathode and the anode which allows **modulation of the current** through the *valve* with very small voltage changes.

Put it all together, and....

- **William H. Eckles and F. W. Jordan** **1919**
publish a paper on *flip-flop circuits*; first used in **electronic counters**; later used in computers around 1940
- **C.E. Wynn-Williams (UK) develops** **1932**
the *thyatron*, an electronic tube used for **counting** electric pulses, and later develops a *binary counter* using thyratrons.



<http://www.compuudes.com/museumimages/vacuum.htm>

And then, applications....

- **John V. Atanasoff** builds a calculator **1939**
called the ABC using vacuum tubes
- **John Mauchly** writes “*The Use of High Speed Vacuum Tube Devices for Calculating*” **1942**
- **William Shockley** starts research, at **1942**
on **semiconductors** which results in the
development of the *transistor*
- The **Colossus**, a computer with 1,500 **1943**
valves is designed by *T.H. Flowers and M.H.A. Newman*
under the direction of *Alan Turing* (UK)

Impact of WWII

- Spurred **research and development** of electronic devices such as:
- **RA**dio **D**etecting **A**nd **R**anging, **RADAR**
- **S**ound **N**avigation **A**nd **R**anging, **SONAR**
- **Colossus** coding and deciphering machine
- Calculators at **Bell Laboratories & Harvard**
- Electronic projects at MIT and elsewhere
- Electronic computers such as the **ENIAC**
- **and many, many other devices and techniques!!!**

Science

- **Science, n**, 1. a branch of *knowledge* or study dealing with a body of *facts or truths* *systematically arranged* and showing the operation of *general laws*; 2. Systematic knowledge of the *physical or material world* gained through *observation and experimentation*.
- **Reference:** *Random House Webster's Unabridged Dictionary, Second Edition, 1998*

Technology

- **Technology**, n. 1. The branch of knowledge that deals with the *creation and use of technical means* and their *interrelation with life, society, and the environment*, drawing upon such objects as *industrial arts, engineering, applied science and pure science*; 3. A technological process, *invention, method*, or the like....
 - *The American College Dictionary (1970) “The branch of knowledge that deals with the industrial arts....”*

Science Vs Technology

- **1990s** “science and technology” seem to be interwoven; research and development include basic science, applied science and invention (homo farber, man the tool-maker)
- **1940s** -science and technology as separate activities, science as *pure*, technology as *commercial activity*, i.e., Eckert and Mauchly
- **1900s** science was an academic pursuit and technology was outside of science, the academy, and **academic manners and ethics!**

Show and Tell

- Vacuum tube
- Rack of tubes (various)