

11/7/2006 Announcements

- Class Offering in 20062
 - 1051-217, *Fundamentals of Astronomical Imaging Systems*
 - MWF, 11-11:50 + Lab
 - Dr. Joel Kastner
- Final Papers due THURSDAY, 11/9
- FINAL EXAM: 11/15/2006, W
 - 2:45PM – 4:45PM, 08-1300
 - You may hand in lab #5 with final exam (but NO later)

History of TV Technology Transmission, Reception, Recording



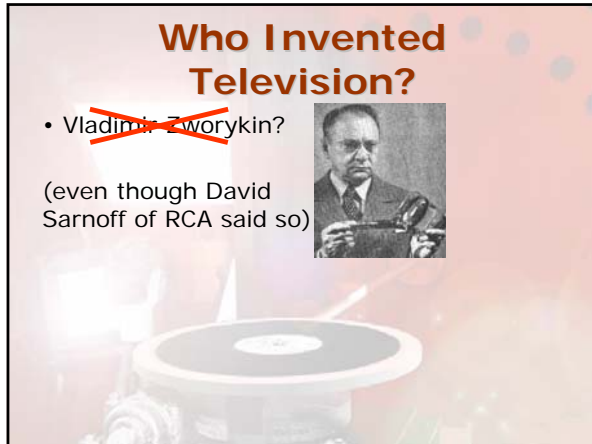
Who Invented Television?



Who Invented Television?

- ~~Vladimir Zworykin?~~

(even though David Sarnoff of RCA said so)

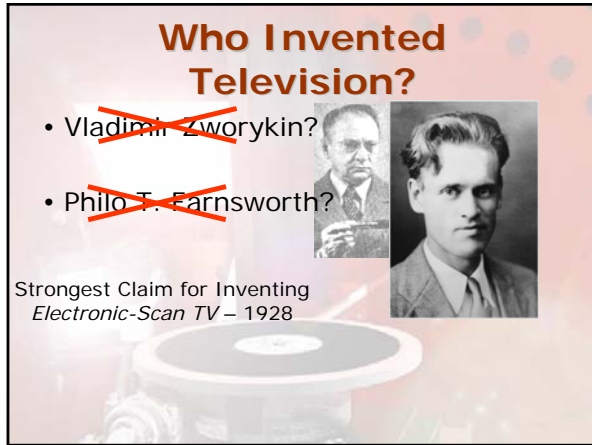


Who Invented Television?

- ~~Vladimir Zworykin?~~

- ~~Philo T. Farnsworth?~~

Strongest Claim for Inventing
Electronic-Scan TV – 1928



Sidebar: Patent Battles between Farnsworth and RCA

Subject of several recent books

1. **The Last Lone Inventor: A Tale of Genius, Deceit, and the Birth of Television**, Evan I. Schwartz, 2003
2. **The Boy Genius and the Mogul: The Untold Story of Television**, Daniel Stashower, 2002
3. **The Boy Who Invented Television: A Story of Inspiration, Persistence and Quiet Passion**, Paul Schatzkin, 2002



Who Invented Television?

• ~~Vladimir Zworykin?~~



• ~~Philo T. Farnsworth?~~

• ~~Charles Francis Jenkins?~~

Regular Schedule of Mechanically Scanned Broadcasts of silhouettes
1928 "Radiovisor"

(why silhouettes?)



Who Invented Television?

• ~~Vladimir Zworykin?~~



• ~~Philo T. Farnsworth?~~

• ~~Charles Francis Jenkins?~~

• ~~Rufus T. Firefly?~~

(Seemed to image with mirrors in
"Duck Soup" – 1933)

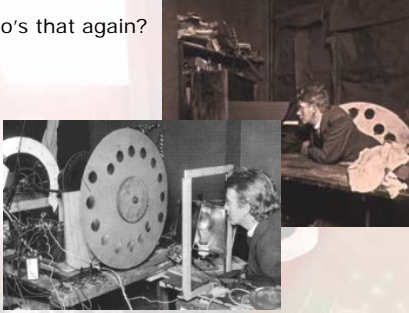


Case for John Logie Baird as Inventor of Television



John Logie (Low' gie) Baird

Who's that again?



John Logie Baird

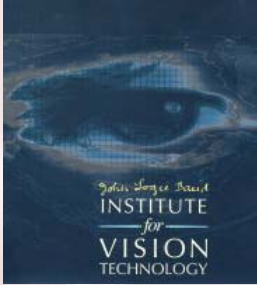


- Born 1888 near Glasgow, Scotland
- Some formal education
 - Royal Technical College, Glasgow (Now the University of Strathclyde)
- Often ill
 - Had "cold feet" (literally and figuratively)
 - Invented "Baird Undersock" to keep feet warm, used in World War I
- Invented "Baird's Speedy Cleaner" Soap
- Sold soap business in 1923, to devote time to goal of inventing TV
- Perhaps not most capable of experimenters
 - Burned his hands while trying to make a selenium photocell in 1903
 - "Close Encounter of 1200 Volt Kind" in 1924

Baird Claims to TV "Firsts"

- First to demonstrate television showing outlines (silhouettes). (1923).
- First to demonstrate television of moving objects and image tones. (1926)
- First to demonstrate infra-red television. (called "Noctovision" 1926).
- **First to record television signals (1926 - 1927)**
- First to send TV by land line, London-Glasgow, 400 miles (1927)
- **First to demonstrate transatlantic television (1928)** (reenacted 2003)
- First to demonstrate full-color television using 3 primary colors (1928)
- First to demonstrate stereoscopic television in 3 dimensions (1928)
- First to demonstrate large-screen theater television (1930)
- First outside television broadcast of live street scenes (1931)
- **First outside television broadcast of sporting event** ("Epson Derby" 1931)
- "Telechrome": **Electronic color television system** with two electron guns scanning 600 - 650 lines on white mica sheet coated with orange and blue-green phosphors on the two sides
- Developed all-electronic, high-definition, 3-D (stereoscopic) color TV
- And the list goes on....

Sidebar: John Logie Baird Institute for Vision Technology



- Honors his achievements
- at his alma mater: University of Strathclyde in Glasgow
- Colleges of Engineering and Science
 - Mandate is much like RIT's Carlson Center for Imaging Science
- Examples of Activities
 1. Advanced Image Processing
 2. Nonlinear Image Processing
 3. Video Coding
 4. Volumetric Imaging
 5. Spectroscopic Image Analysis & Luminescence
 6. Ultrasonic Image Gathering and Visualization
 7. Flexible Mirror Technology
 7. "Innovative Telepresence"

<http://www.lvt.strath.ac.uk/>

Time Line (1)

- 1830s: study of electromagnetism by Joseph Henry and Michael Faraday
- 1860s: Abbe Giovanna Caselli's *pantélégraphe* transmitted still-frame image over telegraph wires
- 1870s: discovery that selenium is *photoconductor*
 - has high resistance to electric current in the dark
 - low resistance to current if illuminated
- 1884: Nipkow invents mechanical scanning disk
- 1907-08: Campbell Swinton, Boris Rosing independently suggest use of *cathode ray tubes* (CRTs) to display images

Time Line (2)

- 1923: Zworykin patents *iconoscope* camera tube
- 1924: Baird (UK), Jenkins (USA) independently demonstrate transmission of mechanically scanned images over wires
- 1926: Baird transmits 30-line images at 5 frames per second
- 1926: WGY experimental TV station W2XAD licensed in Schenectady
 - video at $v = 7.9$ MHz, audio at 755 kHz
- 1927: Farnsworth patents complete electronic video system

Time Line (3)

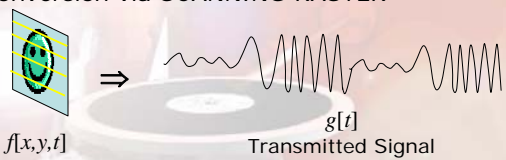
- 1928 (1/13): Alexanderson (GE, Schenectady) demonstrates home reception (1.5" screen, 48 lines, 16 fps)
- 1928 (5/11): first scheduled TV programming (experimental)
 - W2XAD in Schenectady, 24 lines
 - TThF, 1:30PM –3:30 PM
- 1928 (7/2): first broadcasts designed for public reception
 - W3XK, Charles Francis Jenkins, Washington DC
- 1928 (July): Experimental TV Stations in USA
 - W2XBU, Beacon NY (Harold E. Smith)
 - W2XBV, New York (RCA)
 - W2XBW, Bound Brook NJ (RCA)
 - W2XAV, East Pittsburgh (Westinghouse)
 - W3XK, Washington, DC (Jenkins)
 - W4XA White Haven TN (near Memphis)
 - W6XC Los Angeles

Time Line (4)

- 1930: Scheduled TV transmissions by BBC (Baird 30-line system)
- 1937: BBC begins "high-definition" electronic TV transmissions (405 lines)
- 1939: RCA begins experimental TV transmissions from Empire State Building; DuMont manufactures electronic TV sets
- 1941: FCC issues NTSC B&W Video Standard
- 1943: Zworykin invents Image *Orthicon*, improved camera tube with more sensitivity
- 1946: Peter Goldmark (CBS) demonstrates hybrid color television system (electronic + mechanical)
- 1953: FCC issues NTSC color video standard, adopts RCA electronic system

Process of Television

- Convert time-varying planar distribution (2D) of light to a 1D time-varying electronic signal
- Transmit to Receiver, where 2D signal is reconstructed
- Conversion via SCANNING RASTER



Two Scanning Methods

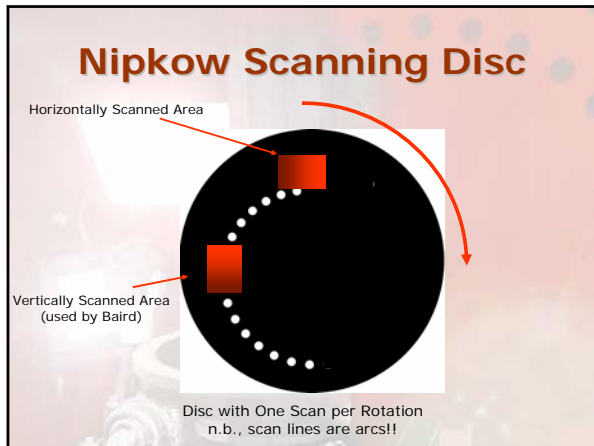
1. Mechanical Scanning: First Used, Best Resolution
 - Charles Francis Jenkins
 - John Logie Baird
2. Electronic Scanning: fastest, easiest to control
 - Philo T. Farnsworth (independent, later at Philco)
 - Vladimir Zworykin (RCA)

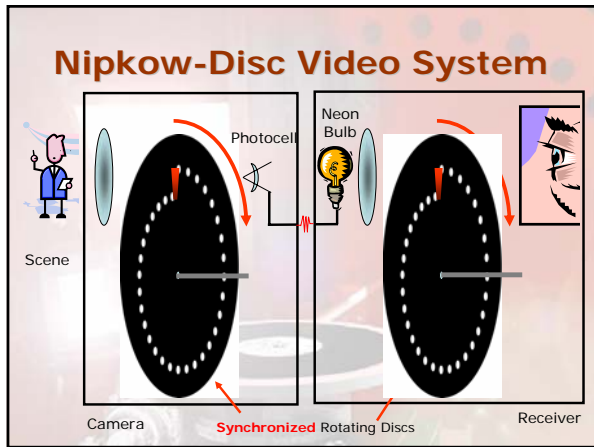
Mechanical Scanning in Early TV

Nipkow Scanning Disc



- Invented in 1883 (or 1884?) by Paul G. Nipkow (1860-1940)





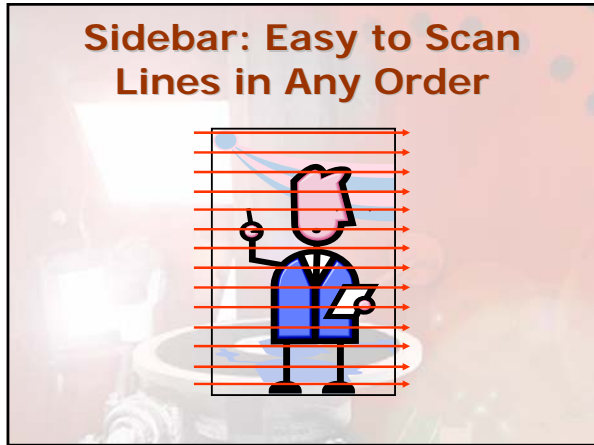
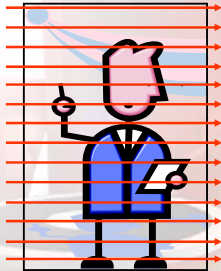
- ### Advantages of Mechanical Scanning
- Receivers could be (and were!) made by amateurs with motors and household "junk"
 - Baird's Original System included:
 - Cardboard discs from hat box
 - Disc of tinplate cut out with scissors
 - Lenses from bicycle lamps
 - Sealing wax
 - Darning needles (for spindles)
 - Powered by small motor from electric fan
- <http://www.1066.net/baird/>

Advantages of Mechanical Scanning

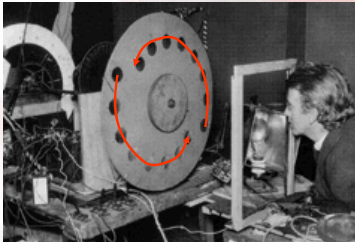
- Can give very high spatial resolution
 - Used today (though not with Nipkow discs)
 - all modern weather satellites
 - camera in Mars Pathfinder
 - ...



Sidebar: Easy to Scan Lines in Any Order



"Improved" Nipkow Disc in Early Baird Scanning System

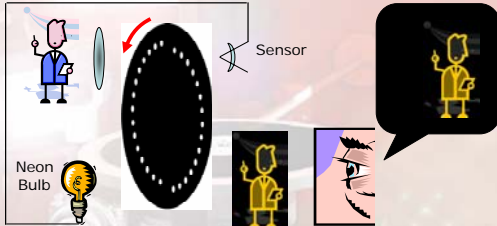


- Nipkow disc with Two Sets of Lenses
- 8 Lines per Scan, 2 Scans per Rotation
 - Lenses \Rightarrow Better Light Gathering



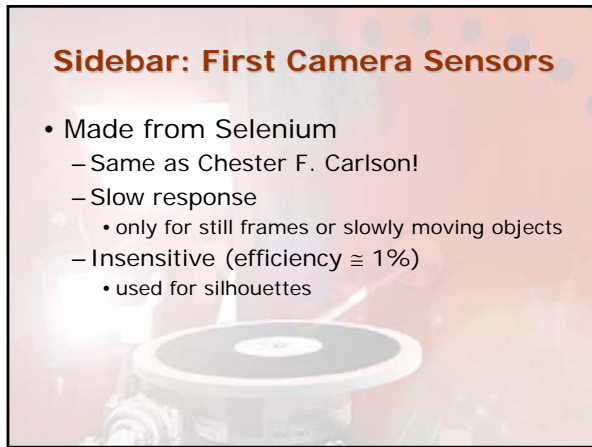
Advantages of Double-Spiral Nipkow Disc

- Use in experiments as both camera and receiver
 - “automatic” synchronization
- Better dynamic balance (especially with lenses)

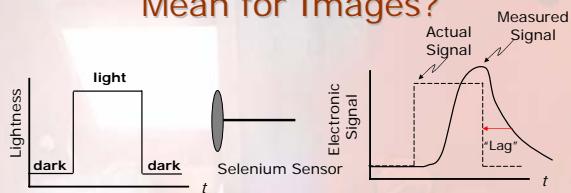


Sidebar: First Camera Sensors

- Made from Selenium
 - Same as Chester F. Carlson!
 - Slow response
 - only for still frames or slowly moving objects
 - Insensitive (efficiency \cong 1%)
 - used for silhouettes



What Does “Slow Response” Mean for Images?



Slow Response of Sensor Produces “Smeared” Image
“Lag” Blurs Sharp Corners

Two Classes of Cameras using Mechanical Scanning

1. "Flying-spot scanning"
 - flood scene with illumination
 - Put **LOTS** of LIGHT on subject
 - read reflected light from each spot

2. "Flying-spot illumination"
 - spot of light scanned across scene
 - NOT MUCH LIGHT on subject
 - many sensors measure light reflected from illuminated spot at each time

