

From the Stars, Back  
to Earth

# International Geophysical Year

- 1950 - Lloyd V. Berkner, Sydney Chapman – idea
- 1952 – initiation – ICSU – scientific cooperation
- Comité Spécial de l'Année Géophysique Internationale – manage operations
- 67 countries
- World Data Centres – est. archive/dissemination
- 1957 – why?
- Numerous areas of research – cosmic rays, gravity, oceanography
- Records – structure/function of Earth/surroundings
- 1st global map – earth's structure
- Bring together prior data
- Area of interest – ocean/continent formation - new tools – seismograph - study earth

# Continental Drift

- 1912 - Alfred Lothar Wegener (1880–1930)
- Enormous shift – analogous
- “...the Earth had been molten in its earliest days and that it had contracted as it cooled, allowing lighter continental material to rise above the denser basalt of the crust, forming one supercontinent...” (Ede and Cormack, 353)
- Broke up – parts – floated apart
- Popular, but rejected by Geologists
- 1929 - Arthur Holmes (1890–1965) – Thermal convection – mantle – little attention
- IGY – oceanographers- mapping ocean floors – new insights

# Continental Drift

- New information – IGY researchers
- 1965 – Transformational paper: “A New Class of Faults and Their Bearing on Continental Drift”
- Additional evidence? Space
- IGY Satellites - “gravitational anomalies”
- By-product – IGY research

# Science and Agriculture

- Notable application –global problems - green revolution
- Belief – science and tech – solve
- Science benefit humanity – similar?
- Norman Borlaug (1914–2009) - Nobel Prize
- Rockefeller Foundation's International Maize and Wheat Improvement Center – Mexico – wheat production
- Cross-breed – wheat varieties – success – 1963 – 95%
- Invitation – Indian Ministry of Agriculture - Mankombu Sambasivan Swaminathan – creation of hybrids
- 1968 – numerous countries -Borlaug's method
- Food security/stability

# Communication Satellites and Television

- Radio communication – problem – long-distance transmission
- Solution – communication satellites – possible?
- Postwar, Cold War, space race - television – science to commonplace
- No single inventor
- Electrical transmission of images - 1875
- Lee DeForest (1873–1961) – Audion Ampflier – 1906
- “...used to boost an electrical signal in a cathode ray tube or vacuum tube.”  
(Ede and Cormack, 374)
- Gave way – electrical devices

# Communication Satellites and Television

- 1927 - Philo Taylor Farnsworth (1906–71) - electronic picture tube
- 1923 - Vladimir Zworykin (1889–1982) – Iconoscope – “...a camera tube that combined lenses and used a photoelectric mosaic to capture the image.” (Ede and Cormack, 374)
- 1929 – prototype, 1933 – RCA
- 1935 – Broadcasts in Britain, France, Germany
- Local broadcasts – 1939, Britain – 20,000
- Postwar – enormous demand
- 1954 – colour broadcasting

# Communication Satellites and Television

- Communication satellites - space program – large objects – orbit
- 1960 – Echo – 1<sup>st</sup> passive
- 1962 - Telstar -first Transatlantic TV broadcast



# The Moon and the Microwave

- 1972 – moonwalk – science, modern society – intertwined
- Major science -teams/networks
- Enormous amounts of information
- 20,000 journals, subdisciplines of subdisciplines
- Growth – no longer elite/courtiers – occupation
- Scientists – not just research - scientific instruments, specialized knowledge – teaching

# International Council of Science

- 1900's – science – international
- International scientific unions - international cooperation
- Roots of new organizations – older – i.e. Royal Society – one discipline - forum – sharing information/meeting
- International unions – coordinated, undertook projects – IGY
- Notable – scientific communication open
- 1931 – ICSU –umbrella organization, 1998 –ICS, 2018 – ISC

# Women in Science

- 1970's – scientific careers - larger numbers
- Late 19<sup>th</sup> century – concerted effort – feminist movement
- Second wave feminism – protest – changes
- 1972- equal pay legislation
- Anti-nepotism legislation – unconstitutional
- Feminist philosophers of science – ideology of science
- Programs – scientific careers

# Science and Consumer Goods

- Expectation – science – not just high tech
- A lot of the time – research spinoffs – microwave oven
- By-product – magnetron tubes – radar detection – WW2
- 1946 – Percy Spencer – magnetron tubes – heated - popcorn, egg
- Patent – 1947 – “Radarange” – refrigerator, plumbing
- 1965 – countertop

# Science and Consumer Goods

- Electronics
- Thomas Edison (1847–1931), Nikola Tesla (1856–1943)
- Electrification – industry/homes
- Workers – engineer/scientist/technician
- Basic principles, and also: “what can I make this do?” (Ede and Cormack, 384)
- Two discoveries – altered scientific practice:
- Computing
- Solid-state transistor

# Computing

- Charles Babbage – Difference Engine, Analytical Engine
- “...designed to calculate and print mathematical tables using polynomial functions, all without the necessity of human intervention.” (Ede and Cormack, 385)
- Punch cards, general purpose
- “The idea of a calculator whose functions could be changed, or programmed, to suit the circumstances was a crucial step toward the creation of computers.” (Ede and Cormack, 385)
- Augusta Ada Byron, Countess of Lovelace (1815–52) – explanation – description of programming
- 1979 – programming language – Ada

# Computing

- Significant - introduction – vacuum tubes (high-speed switching), WW2, technical demands
- Colossus – electronic code breaker
- 1946 - ENIAC (Electronic Numerical Integrator and Computer)
- Complexity – long range artillery
- Not used – WW2 – numerous other functions
- Notable – computer industry

# Computing Theory

- : John von Neumann (1903–57), Alan Turing (1912–54)
- Manhattan Project, Ordnance Corps – ENIAC
- Project Ultra
- Contact with computing devices
- 1937: “On Computable Numbers with an Application to the Entscheidungsproblem”
- “...a machine that could carry out calculations based on a finite table of operations and reading or deleting a series of instructions on a paper tape.” (Ede and Cormack, 388)
- Turing Machine
- Ideas – modern computers



# Computing Theory

- 1950 - Computing Machinery and Intelligence
- “Turing Test”
- 1945 - “First Draft of a Report on the EDVAC”
- “...general purpose, stored program computer.” (Ede and Cormack, 389)
- Ideas to equipment
- Consultant – IBM – commercial computers
- 1953 – IBM 701 – 19 sold – aerospace/government
- Nuclear weapons

“Turning computing machines from gigantic monsters full of temperamental vacuum tubes that had to be tended by a phalanx of technicians into something more manageable and affordable required the introduction of a new technology.” (Ede and Cormack, 389)

# Solid State Transistor

- Began – solution to problem – electronic communication
- 1936- Bell Labs - – William Shockley – solid state device – failures
- Project - John Bardeen (1908–91), Walter Brattain (1902–87)
- “Taking a small piece of germanium, some gold foil, and a paper clip as a spring, they were able to amplify an electrical signal almost 100 times its original strength.” (Ede and Cormack, 390)
- 1937 – breakthrough demonstration
- “point contacts”
- Shockley - “junctions”
- At first, limited usage

# Solid State Transistor

- 1952 – first product – hearing aid
- 1954 - First mass market – junction transistors – portable radio
- Late 1950's - Jack Kilby, Robert Noyce – integrated circuit
- 1964 – Comcor Company – 1<sup>st</sup> entirely transistorized –ci 5000
- 1971 – Ted Hoff – Intel Corp. - microprocessor
- Explosion - electronic technology
- Toys, elevators, cars
- Computers in science – transformational

# Contraception

- Originally, barrier methods, timing of ovulation
- 1951: Carl Djerassi (1923–2015) – University of Mexico
- “...showed that ovulation could be controlled by administering the hormone progestin orally.” (Ede and Cormack, 392)
- 1956 – clinical trials, 1960 - approval
- 1961 - Jack Lippes – Lippesloop – IUD

# Ecology and the Environment

- Carl Sagan – Cosmos, Steven Hawking, A Brief History of Time
- 1970's, 1980's – interest – Earth
- Ecological movement
- Study of ecology – late
- 1962 – Rachel Carson (1907–64) - Silent Spring - public audience
- Environmental pollution- pesticide use
- Support – 1969 - National Environmental Policy Act, 1970- EPA, Earth Day
- 1972 - DDT – banned

# The Human Genome Project

- By 1977 – theoretical elements –mapping
- 1988 – began
- 2001- “working draft”
- 2003- mapping completed
- Legacy – techniques, technology
- Cost to sequence base - \$10
- Tech R & D – 10 cents

# Activity: Hubble Telescope

- Go to: <https://science.nasa.gov/missions/hubble/nasas-hubble-watches-jupiters-great-red-spot-behave-like-a-stress-ball/>
- Answer the following questions:
  - 1.) What is GRS an acronym for, and what is it?
  - 2.) What does recent data pertaining to the GRS show?
  - 3.) How long has the Hubble Space Telescope been in operation for?
  - 4.) What agencies and organizations support the Hubble Space Telescope project?