The Final Frontier: The Space Program of the 1960s

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Post WW 2

- WW2 turned US into industrial powerhouse
- Science funded by govt worked (Manhattan Project)
- Satisfy pent up demand for consumer products
- Many spinoffs into postwar economy driven by Cold War:
  - Commercial airliners
  - Digital computers
  - Solid state electronics – cheap, compact, lightweight
  - Pop rivet – British aviation industry
  - WD-40 – Atlas missile program

Cold War Environment

- Space race during Cold War with Soviet Union was abetted by news media:
  - Driven by resulting public hysteria
  - Driven by media
- Major driver of early stages of space with feedback between media and public
- Media – Space flight possible – Colliers, Disney, von Braun

Civilian Context – 1

- 1955 – White House announced Vanguard to be launched during upcoming IGY
- Soviets announced they would too (mocked by US)
- IGY: July 1, 1957 – December 31, 1958
  - Approved 1952
  - IGY Director Joseph Kaplan (UCLA)
  - S Fred Singer (Univ MD) -- Farside
  - James van Allen (Iowa) -- Radiation

Civilian Context – 2

- Army Jupiter/Explorer proposal rejected
- Vanguard derived from Viking, Aerobee
- Sputnik 1 launched October 4, 1957
- US media went berserk
- Major driver of early stages of space race with feedback between media and public

Military Human Aerospace

- Rocket plane programs: X-1, X-2, X-15
- Biodynamics
- The USAF “preastronauts”
  - Lt Col John Paul Stapp
  - Capt David G Simons – August 19, 1957 Man High
  - Capt Joe Kittinger Excelsior

Extreme Experimental Accelerations

- **10 Dec 1954 Holloman AFB**
  - **USAF Lt Col John Paul Stapp**
  - **44½ yr old Biophysicist**
  - **Sonic Wind II Rocket Sled**
  - **Peak Speed 286 m/sec (937 ft/sec)**
  - **Max -46.2G_x During Braking**
- **1958: USAF Capt Eli Beeding +82.6G_x Holloman AFB**

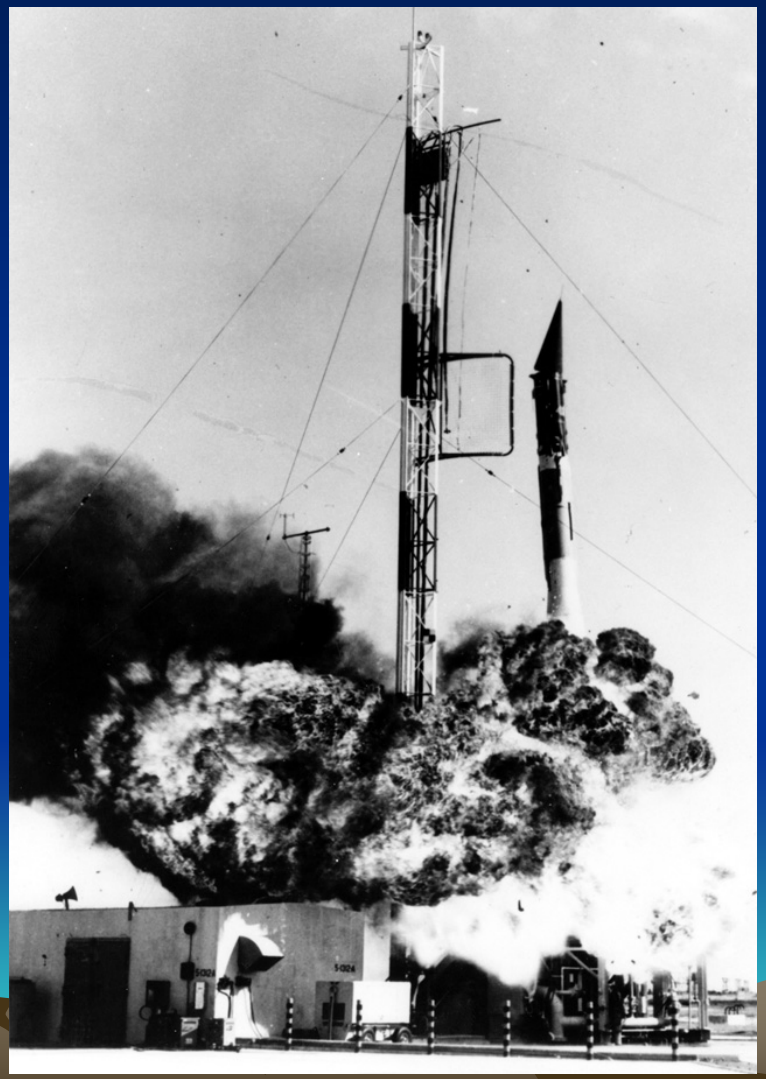
John Paul Stapp

Experimental (Crash Dummy)

Extreme Parachute Jumps

- 1960 USAF Capt Joe Kittinger 31,330 meters
- 1962 USSR Col Pyotr Dolgov 28,640 meters (fatal)
- USA Nicholas Piantanida (3 attempts -- 3rd fatal)
- October 14, 2012 Felix Baumgartner 39,045 m
- October 24, 2014 Alan Eustace 41,419 m

To Make Matters Worse – December 6, 1957



Civilian Context – 3

- Army Jupiter/Explorer proposal revisited
- January 31, 1958 Explorer 1 launched
- US media & public demanded catch up
- NASA created from NACA July 1958
  - Mercury Program
  - Gemini program
  - Apollo Program

Civilian Context – 4

- April 12, 1961 Yuri Gagarin orbits
- February 20, 1962 John Glenn orbits
- September 12, 1962 Pres Kennedy speech
- March 18,1965 Alexi Leonov spacewalk
- June 3, 1965 Ed White spacewalk
- January 27, 1967 Apollo 1 fire
- October 11, 1968 Apollo 7 flight

The Lead Changes

- The hare passes the tortoise: Apollo 8 launches
- Christmas Eve broadcast from lunar orbit

The Big Picture - 1

- Creation of National Science Foundation by Eisenhower administration
- Emphasis on study of science and math
- Associated production of scientists, mathematicians, and engineers became national priority

The Big Picture - 2

- Infusion of scientists, mathematicians, and engineers into US society created virtual explosion of technical knowledge
- Much of this knowledge and technology resulted directly or indirectly from space program
- Link knowledge explosion to our current standard of living

Integration into Society

- Space technology integrated into essentially all aspects of economy and society at large
- Synergism between military and civilian space technology and infrastructure
- Military space much larger than NASA
- Most of public unaware of this history

Illustration – GPS – 1

- Modern GPS technology benefits all
- Evolved from military space
- Few people know that GPS timing signals stamp electronic bank transactions and synchronize computer networks

Illustration – GPS – 2

- GPS used for variety of other applications:
  - Navigation – land, air, sea
  - Monitoring land shifts – geology and geophysics
  - Wildlife biology and conservation, ecology
  - Military – major benefits for warfighters

The Bigger Picture – 2

The Bigger Picture – 3

- Satellite-based communications
- Real-time world-wide communications (eg car satellite radios, On-Star, etc)
- Essential for Earth-sensing studies
  - Fire and pollution monitoring
  - Modern agriculture
  - Weather prediction better than Grandpa Joe's joint pain
- Telemedicine – pioneered by space program

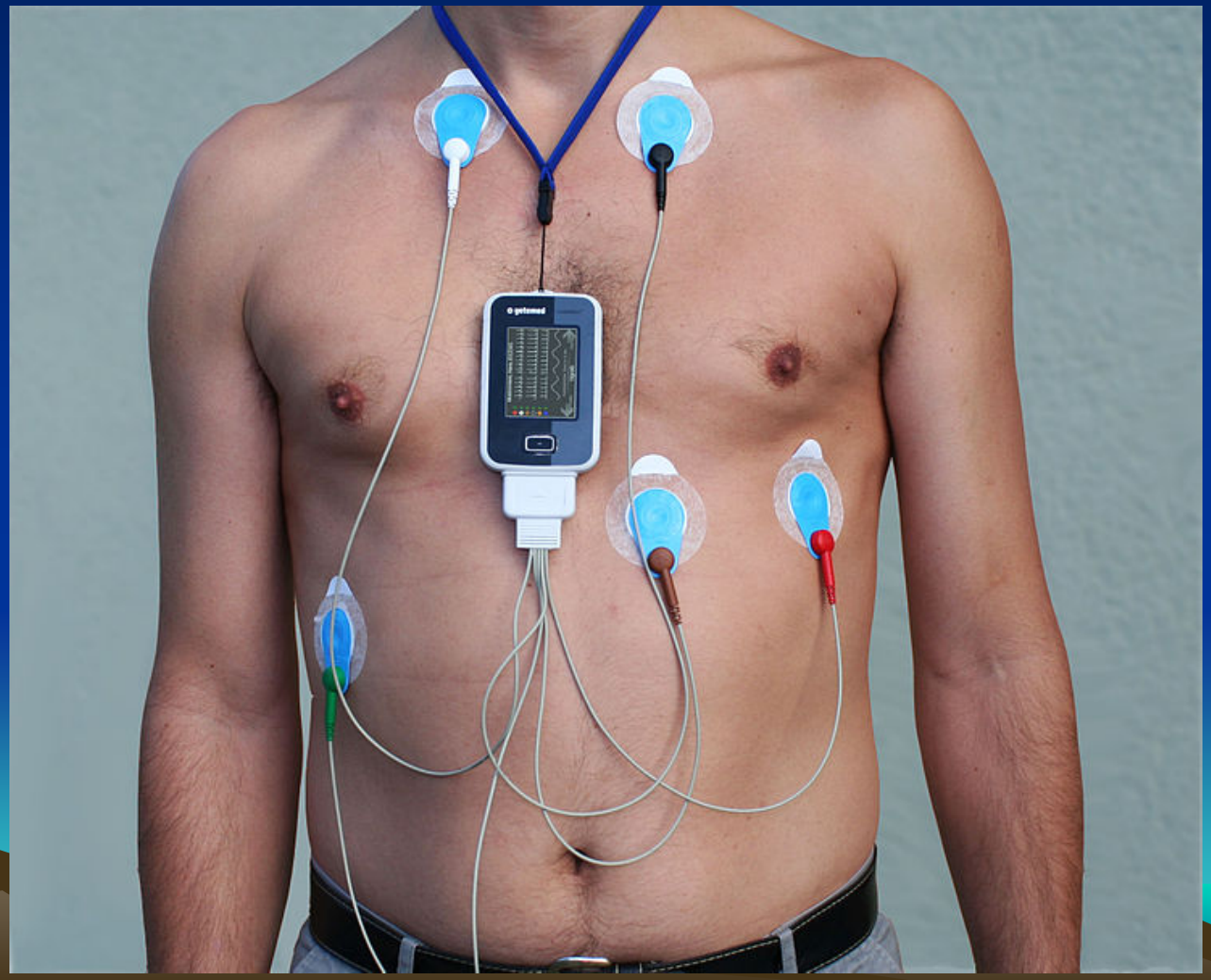
Modern Medical Technology – 1

- Physiological monitoring developed and produced as adjuncts for early human high performance aviation and space flight by aerospace electronics firms led to modern medical facilities:
  - Emergency rooms
  - Intensive care units – eg Max Weil's shock ward
  - Operating rooms
  - Cardiac telemetry
- Adopted rapidly into clinical practice

Modern Medical Technology – 2

- Holter monitors
  - Norman Holter (1914-1983)
  - Born and died in Helena, MT
  - UCLA trained physicist turned biophysicist
  - Worked as administrator at UCSD
  - Prototype weighed 85 lbs in 1949
  - Reduced to practicality by Del Mar Avionics (near SD) after Deke Slayton's AF

Modern Medical Technology – 3



Modern Medical Technology – 4

- Physiological monitors developed by Spacelabs Healthcare (Issaquah, WA)
- Now in Snoqualmie, WA

Modern Medical Technology – 5

- NASA contracted Spacelabs to solve tough clinical challenge of wireless monitoring of Gemini astronauts' vital signs
- Evolved into other physiological monitoring and anesthesia systems
- Acquired Del Mar Holter and others

Modern Medical Technology – 6

- DEXA machines for diagnosing osteoporosis and monitoring treatment
  - Prototypes developed at University of Wisconsin Medical School and SSEC – 1960s
  - NASA and AEC funding for precise bone mass measurement – bone loss in microgravity
  - J R Cameron, J M Jurist, J A Sorenson, R B Mazess: New methods of skeletal status evaluation in space flight, *Aerospace Medicine*, 40:1119 (Oct. 69)
  - LUNAR Radiation Madison, WI now GELunar

Modern Medical Technology – 7