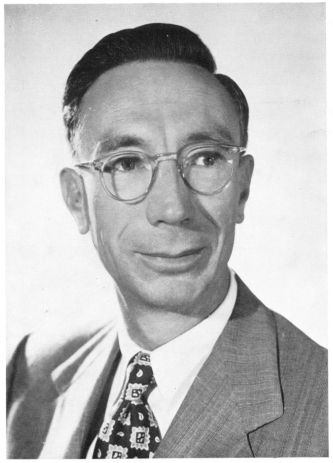
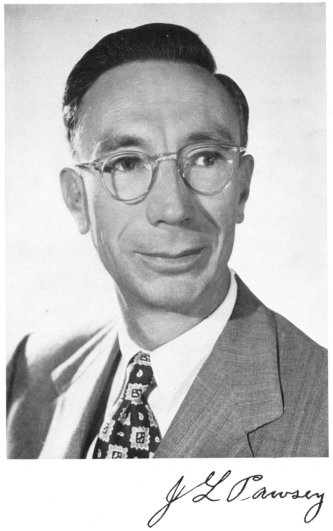
Pawsey Medal



- Pawsey's early unexpected death (brain tumor)
  - 30 Nov 1962
- request to Academy of Science for a medal
- Academy demurs – can't have a medal for every member that dies
  - A scientists legacy is their publications, discoveries and theories
  - A young Paul Wild (future CSIRO CEO) succeeds with a different approach
  - A medal for a new field of research started by Pawsey in Australia
- Hence my talk title:

70 years ago Australia started a new field of research Radio Astronomy



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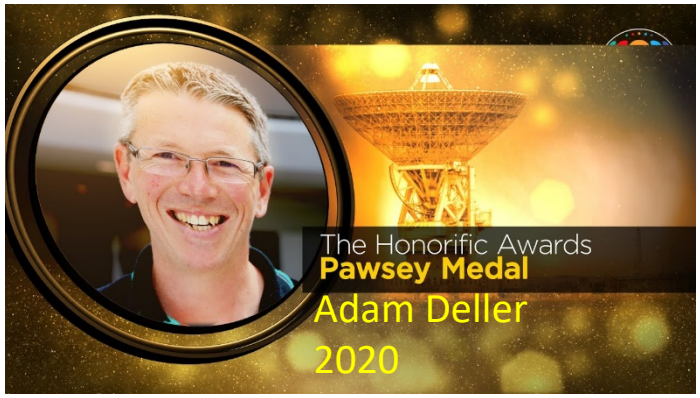

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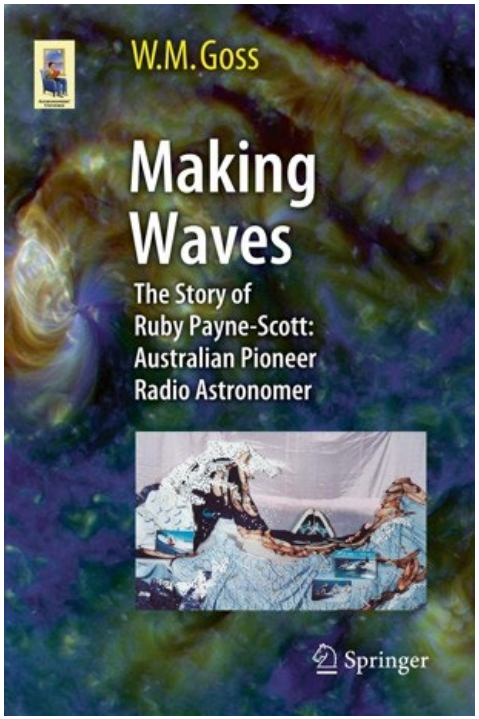
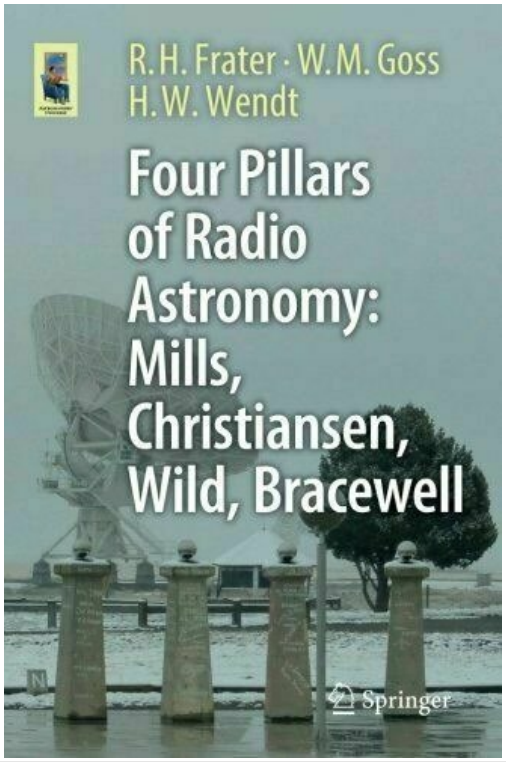
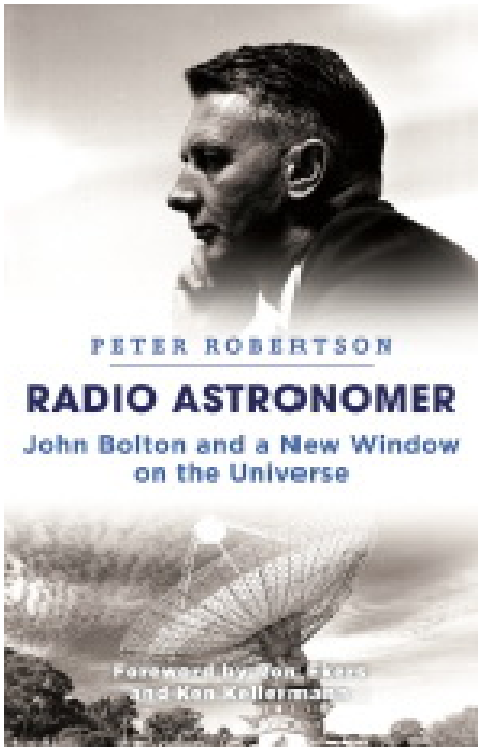
The people

- Joe Pawsey
  - ➢ Inspiring research leader







The Book

From the Sun to the Cosmos

- How a British colony embarks on basic research
- Opening a new field of research
- The history of Joe Pawsey & Australian radio astronomy
- Supported by CSIRO and AUI
- The authors
  - Miller Goss
    - *Making Waves*
    - *Four Pillars*
  - Claire Hooker
    - ***Irresistible Forces:***
      Australian Women in Science
  - Ron Ekers

Why did Australia get into Radio?

- No significant research activity in Australia before the early 1900s
- Vaste country – radio communications essential
  - 1896 Marconi (over hills and then around the globe)
  - 1905 first radio communications in Australia
  - 1908 Pawsey born in country Victoria
  - 1920 Radio Research Board formed to improve radio broadcasting
  - 1926 Pawsey Masters thesis on atmospherics
    - fading, skipping, static, …
    - similar to Jansky but much too low in frequency to see the galaxy

The Discovery of the Ionosphere

- Major failure of propagation theory
  - Surface diffractive theory 1902-1925 was wrong
    - All discrepant results were ignored, skipping was not explained

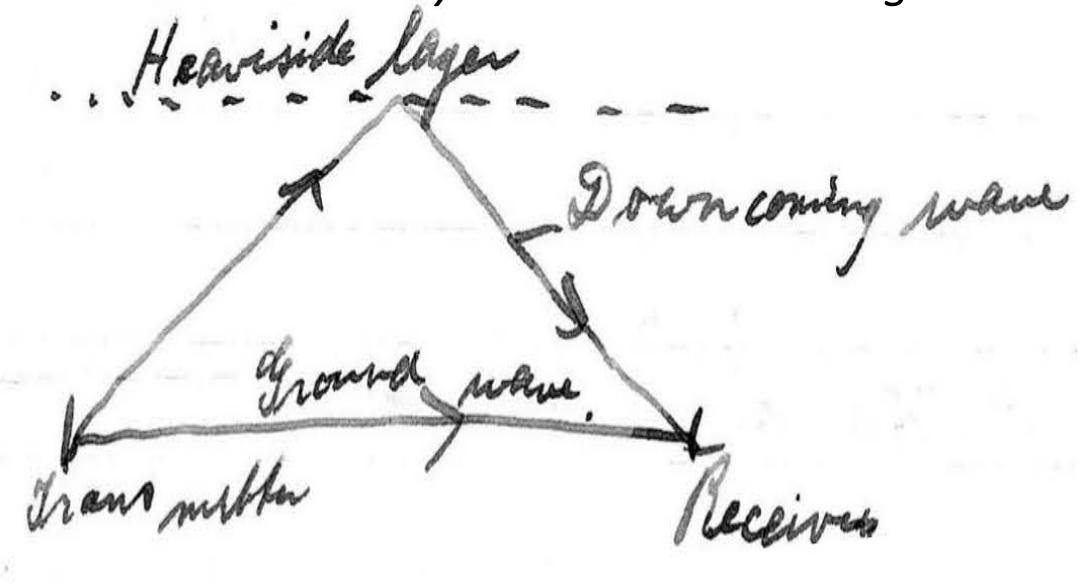
- Heaviside – amateur scientist
  - Invented coaxial cable
  - Simplified Maxwell's equations for practical use
  - Proposed a reflecting layer in the atmosphere in 1902 – not believed!

- 1924 Appleton (UK) detects the ionosphere using frequency scanning
  - BBC would retune their transmitters after the end of broadcasting
- 1925 Breit and Tuve (US) independently detect ionosphere using pulse echo
  - Military equipment so classified, along with their discovery of Radar
  - Considered of no practical value – research (including radar) stopped
  - BBC v US military

- The Ionosphere became a major research topic in the UK
  - Pawsey's PhD thesis with Ratcliffe

Pawsey explaining the ionosphere to his mother!

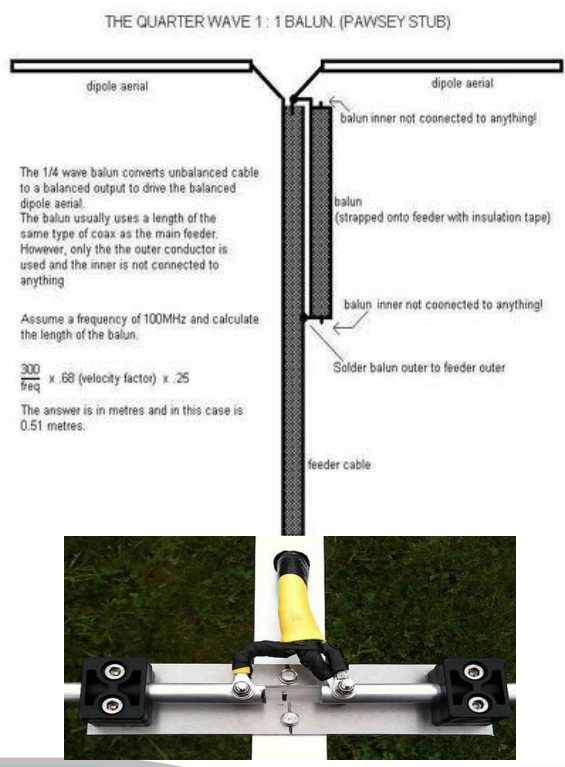
- Pawsey gets fellowship and starts PhD with Ratcliffe in Cambridge
- 26 May 1932: Pawsey writing to his mother
  - *The wave from a station goes to the receiver by two paths, one direct and one reflected from the Heaviside layer about 60 miles high*

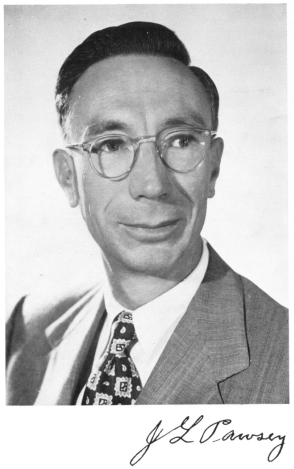


From the Hastings Pawsey collection

1933 to 1945

- 1933 Jansky detects radio emission from the Galaxy
  - ➢ No one (except Reber) pays any attention
- 1934 Pawsey joins EMI in London – beginning of Commercial TV
  - ➢ Invents the Pawsey stub
- 1939 Pawsey returns to Australia to work on RADAR in CSIR
- CSIR gets transformed – many stories
- The CSIR(O) division of Radiophysics is continued after the end of WW II
  - ➢ one project is to investigate cosmic noise
  - ➢ Solar radiation had been detected during war





First radio astronomy in Australia

- First Solar Noise Observations at Collaroy Sydney, October 1945
- Discovery of the Million Degree Solar Corona
- 75th anniversary Oct 2020

J L Pawsey

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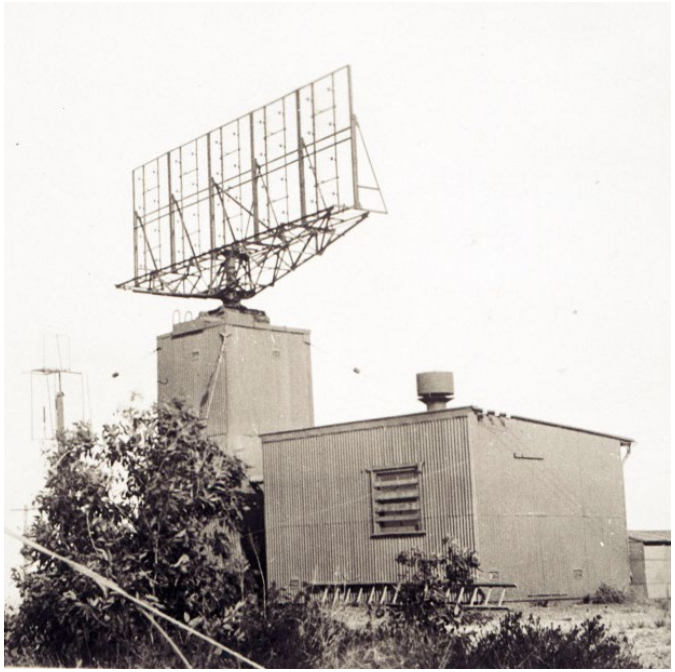

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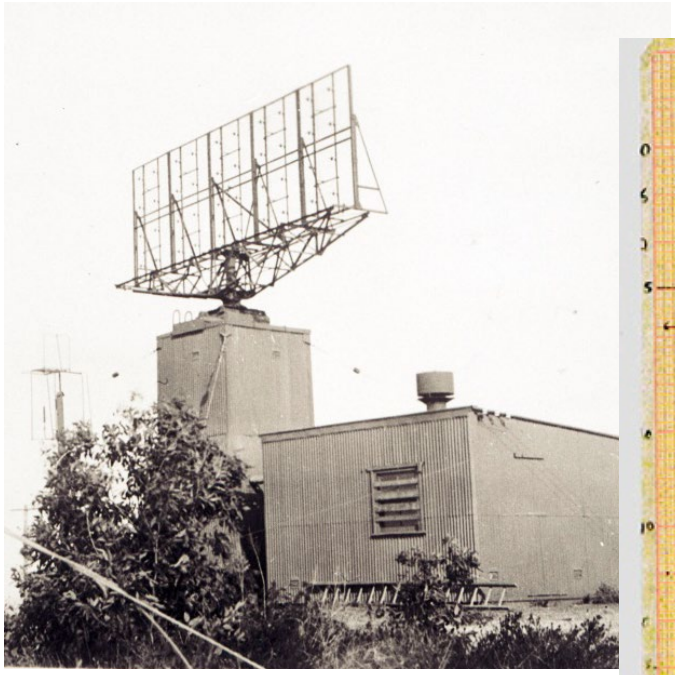
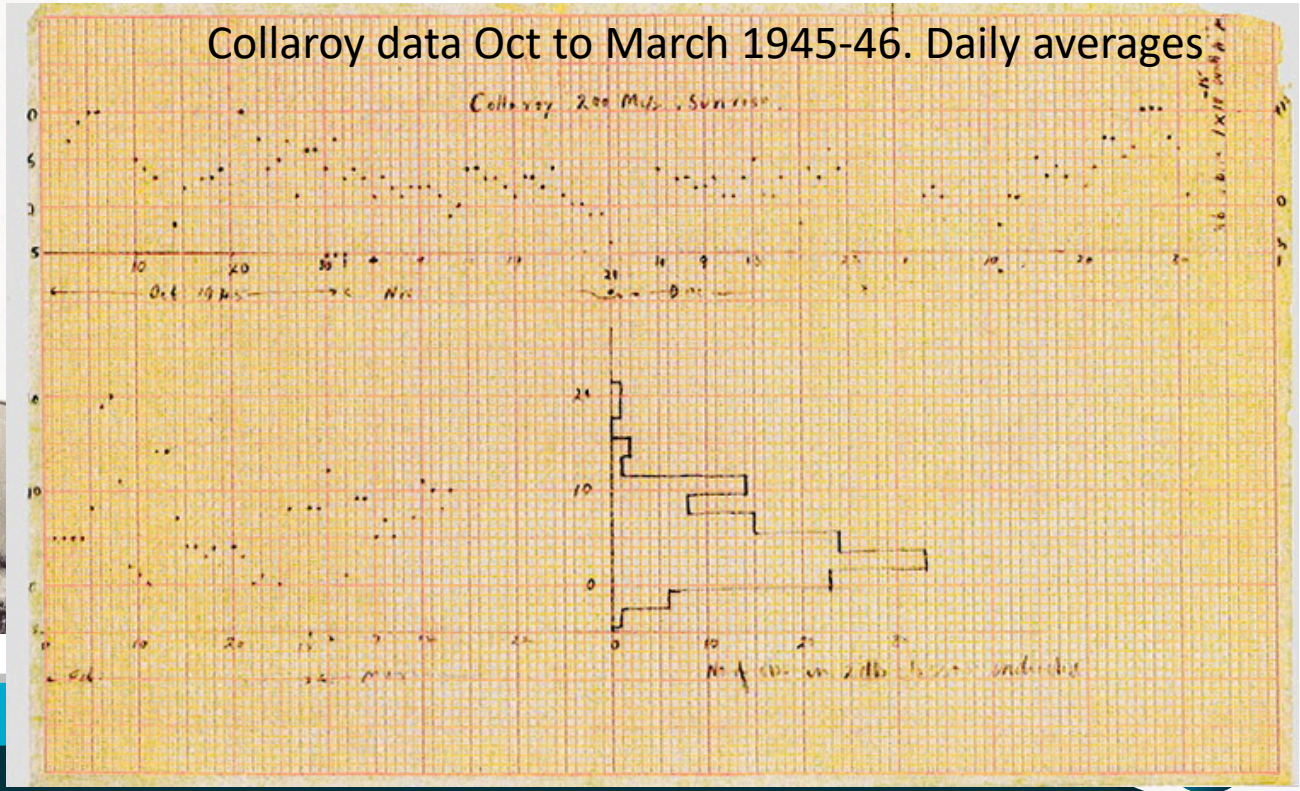
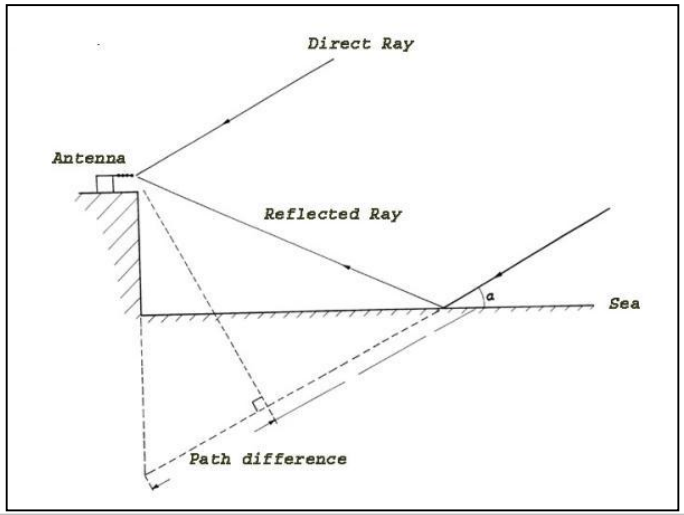




Radio emission from sun spots
Dover Heights 1946

- Fringe visibility to measure radio source size
- Fringe phase used to collocate radio burst with sunspot



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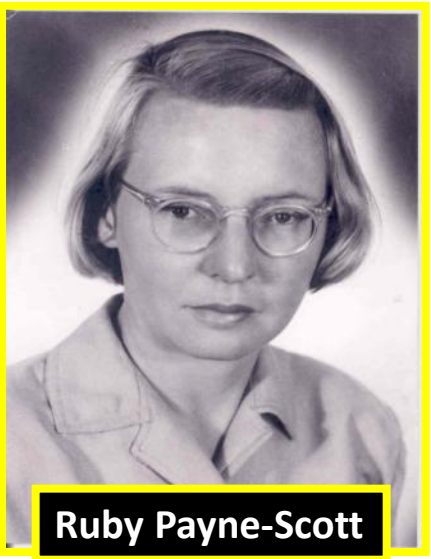
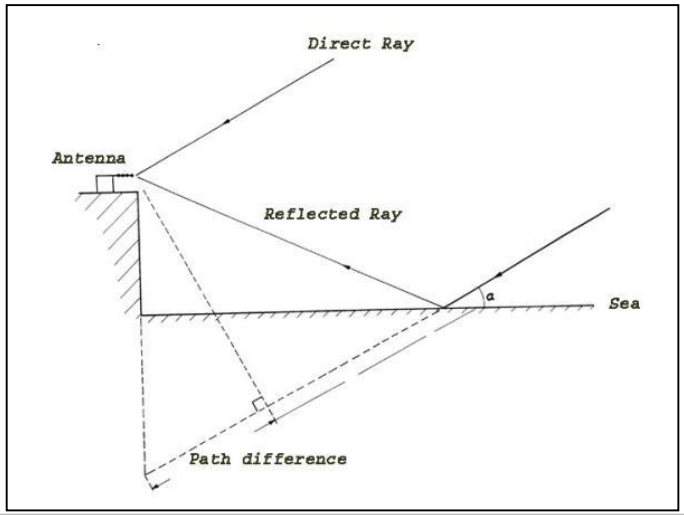
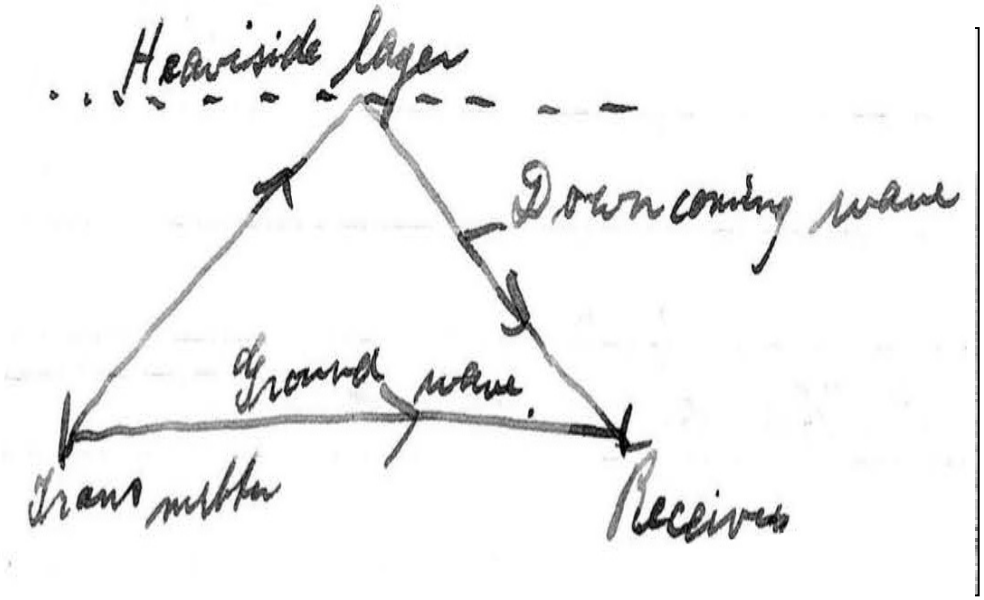






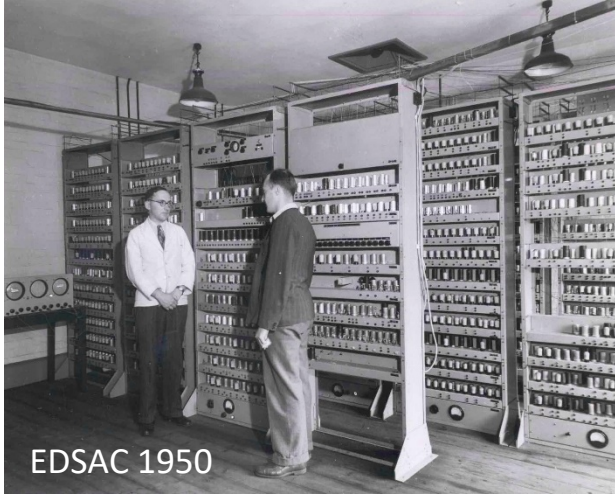
McCready, Pawsey & Payne-Scott 1947

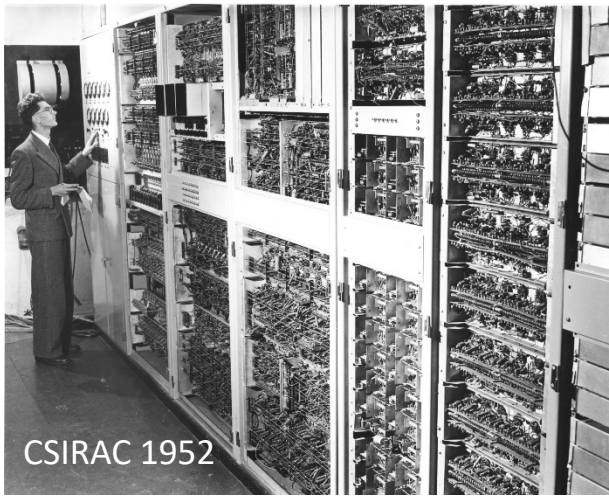
- Proc Roy Soc, Aug 1947 - received July 1946!

- They note that its possible in principal to determine the actual distribution by Fourier synthesis using the phase and amplitude at a range of height or wavelength.
- They consider using wavelength as a suitable variable as unwise since the solar bursts are likely to have frequency dependent structure.
- They note that getting a range of cliff height is clumsy and suggest a different interference method would be more practical.

Aperture Synthesis

- Developed in Sydney and Cambridge
- Australia published the first description of aperture synthesis (1947)
- Christiansen made the first aperture synthesis image (1955)
- But Ryle and the Cambridge group went on to exploit the new technology to make major advances in radio astronomy
  - Ryle Nobel prize (1974) - why Cambridge?
  - Ryle used the EDSAC computer
  - Australia had CSIRAC, a comparable computer, but didn't use it for radio astronomy!


EDSAC 1950


CSIRAC 1952

- Pawsey Centre

From “Cosmic Noise” to “Radio Astronomy”

- Radio bursts – sunspot correlation
  - Engaged solar astronomers at Mt Stromlo
  - Radio included in IAU solar commission (Woolley)
- Bolton identifies 3 radio sources
  - Crab nebula – super novae remnant
  - NGC5128 and M87 – external galaxies
- 1948
  - Pawsey uses the term “radio astronomy”
  - URSI adds Radio Astronomy Commission, Martyn (Aus) is chair
- 1950
  - IAU Commission 40 formed Woolley (Aus) as first chair,
  - replaced by Pawsey in 1952

From “Cosmic Noise” to “Radio Astronomy”

URSI GA Sydney 1952

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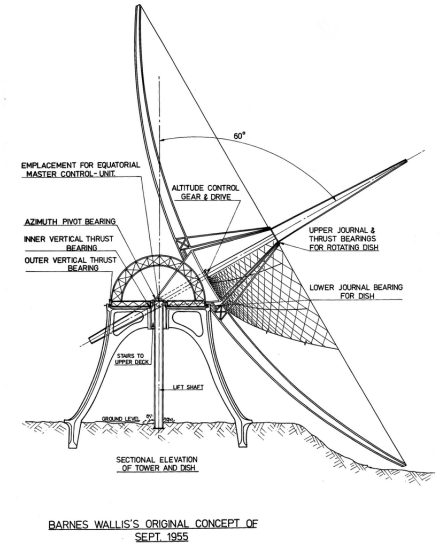
Radio Stars or Radio Galaxies

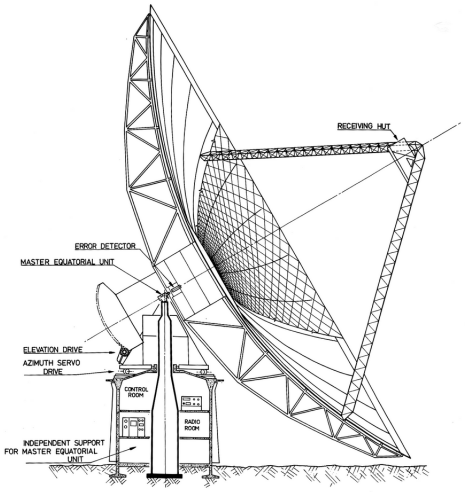
- New field - many mistakes - what can we learn?
- Occam doesn't deliver
  - Detect a new source of cosmic radiation
  - Assume one mechanism: the sun, the discrete sources and the galaxies are all the same
  - The radio star model, all radio sources of radio emission are like the sun
  - Led astronomers astray for 5 years
- Serendipity plays a major role
- Progress was driven by the observations but needed a theory
  - Synchrotron emission was the answer Ginzburg (1953)
- Distant Radio Galaxies meant cosmology
  - Demise of the Steady State Theory!

Parkes Telescope

- Conceived 1954
  - A bigger dish than Jodrell Bank
- Bowen - Pawsey – Bolton
  - The interplay of strong characters

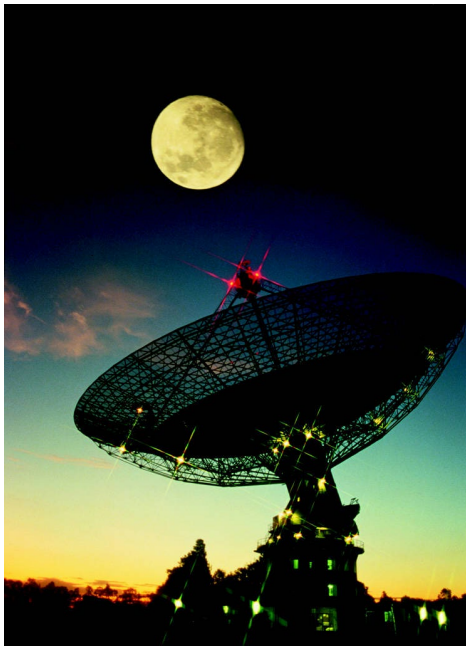


BARNES WALLIS'S ORIGINAL CONCEPT OF SEPT. 1955



THE PARKES RADIO TELESCOPE 1961

- Opened 1961 - first results
  - Faraday rotation
  - 3C273 occultation – quasars
  - Population of flat spectrum sources
  - Magellanic stream



"Promising Fields of Radio Astronomy"
Joe Pawsey, NRAO Director 1962

- HII regions in absorption at low frequencies
  - 20MHz observations
- Magnetic fields in inter-stellar space
  - linear polarization ☑
  - Zeeman splitting ☑
    - Made possible by the Weinreb digital correlator
- Counting radio sources
  - resolve the violent disagreements ☑
- High angular resolution of solar flares ☑
  - Paul Wild's solar heliograph

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- Quasars, CMB, Masers, Pulsars

But look what was missed in the next 10 years!