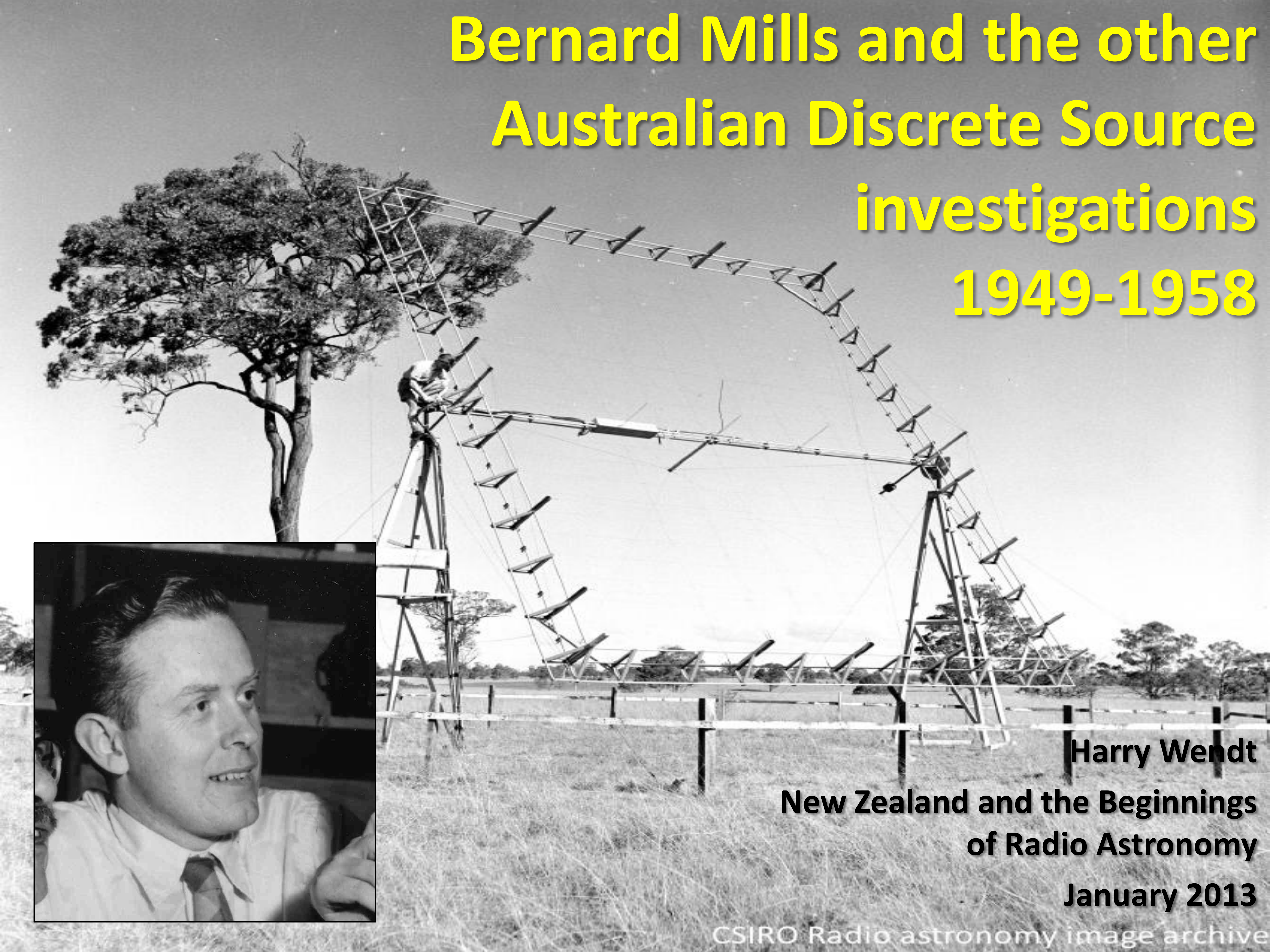
Bernard Mills and the other Australian Discrete Source investigations 1949-1958

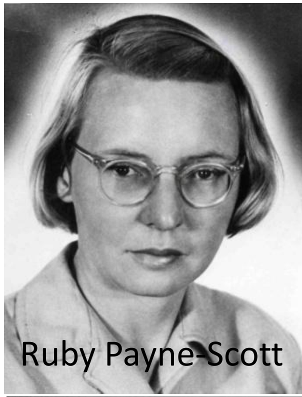


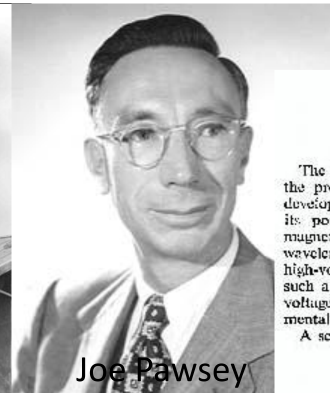
Harry Wendt

New Zealand and the Beginnings of Radio Astronomy

January 2013

Background on Bernard Mills





A MILLION-VOLT RESONANT-CAVITY X-RAY TUBE

621.386.1.027.89; 621.396.611.4 Paper No. 924 RADIO SECTION

B. Y. MILLS, B.Sc., M.E.

(Digest of a paper which will be published in Part III of the Proceedings.)

The idea of utilizing resonance in a high-frequency circuit for the production of high-voltage particles is not new, but the development of radar techniques during the war greatly increased its possibilities. The high power available from a pulsed magnetron, coupled with the small size of components at micro-wavelengths, permits of the construction of an extremely compact high-voltage source. The paper describes the construction of such a device intended for operation as an experimental high-voltage X-ray tube. Some of the technical problems and fundamental limitations of the method are discussed.

A schematic of the apparatus is shown in Fig. 1. Briefly it consists of a re-entrant copper cavity resonant in the region of 25 cm and fed by a 25-cm magnetron through a coaxial line and vacuum-tight choke joint. The cavity is continuously evacuated. The magnetron has an available power of about 600 kW with a pulse length of 5 microsec and a pulse repetition frequency of 200 c/s. Because of difficulties associated with coupling a self-excited oscillator to a high-Q resonant circuit, it has only been possible to dissipate some 300 kW in the cavity. Electrons are injected from a point-focused gun having a peak current capability of about 400 mA. They are accelerated across the gap between the re-entrant cones by the r.f. field and strike a thin gold target of the transmission type. The X-ray beam is confined by a lead shield surrounding the cavity to a narrow cone in the direction of the electron beam. The peak voltage of the electron beam is monitored by coupling a small amount of the cavity power into a calibrated thermistor bridge.

A mean beam current of 70 μA at a peak voltage of 1·1 MV has been obtained, whilst the highest recorded voltage is 1·25 MV with a very low beam current. An attractive feature is that the beam is focused at the target to a diameter of approximately half a millimetre, compared with a diameter of several millimetres usual in most commercial high-voltage equipment. A further advantage over conventional equipment is that it is not necessary to insulate for high voltages. The maximum voltage outside the actual cavity is a 30-kV pulsed supply to the magnetron.

An important possibility, although one which has not been explored, is that the tube could be used as a stroboscope to radiograph machinery undergoing a cyclical motion. The

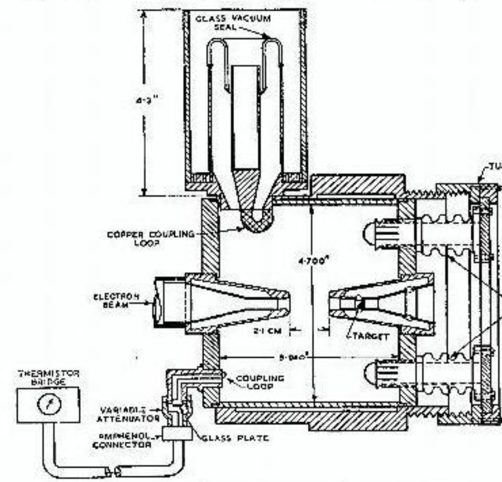


Fig. 1.—Assembly drawing of the cavity.

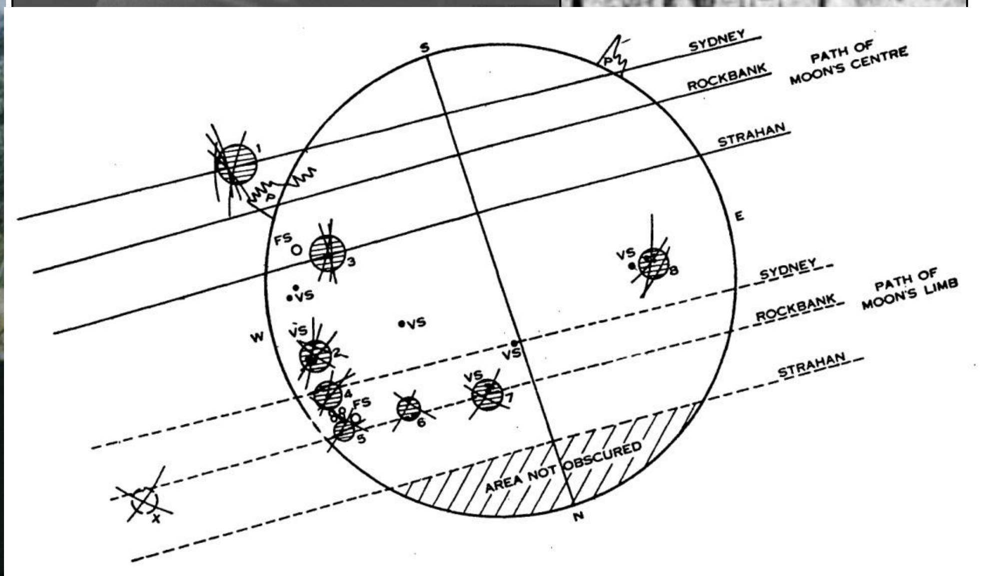
Mr. Mills is in the Division of Radiophysics, Commonwealth Scientific and Industrial Research Organization, Australia.

1948 Eclipse

Christiansen, Yabsley & Mills

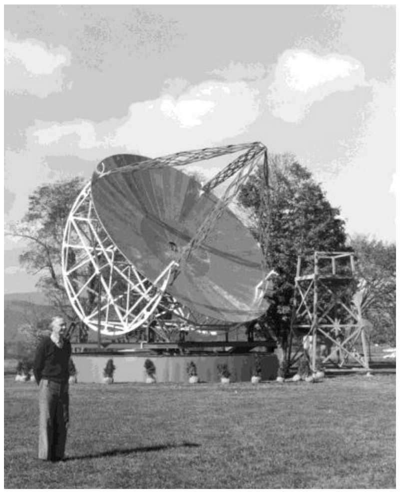

"Chris" Christiansen

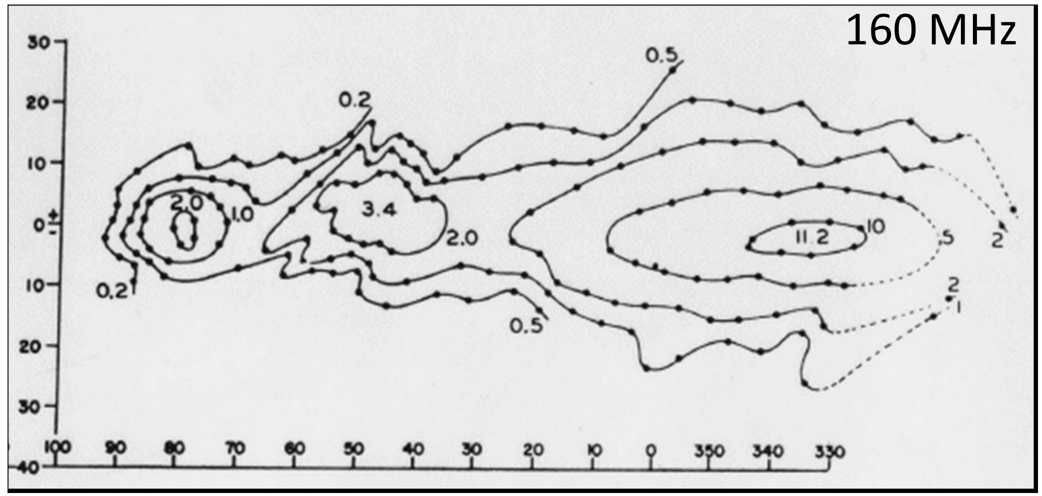

Don Yabsley



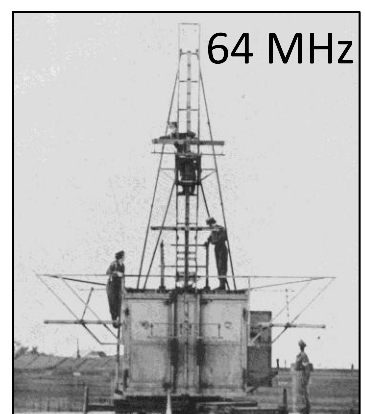
Background on Discrete Radio Sources

Reber 1944

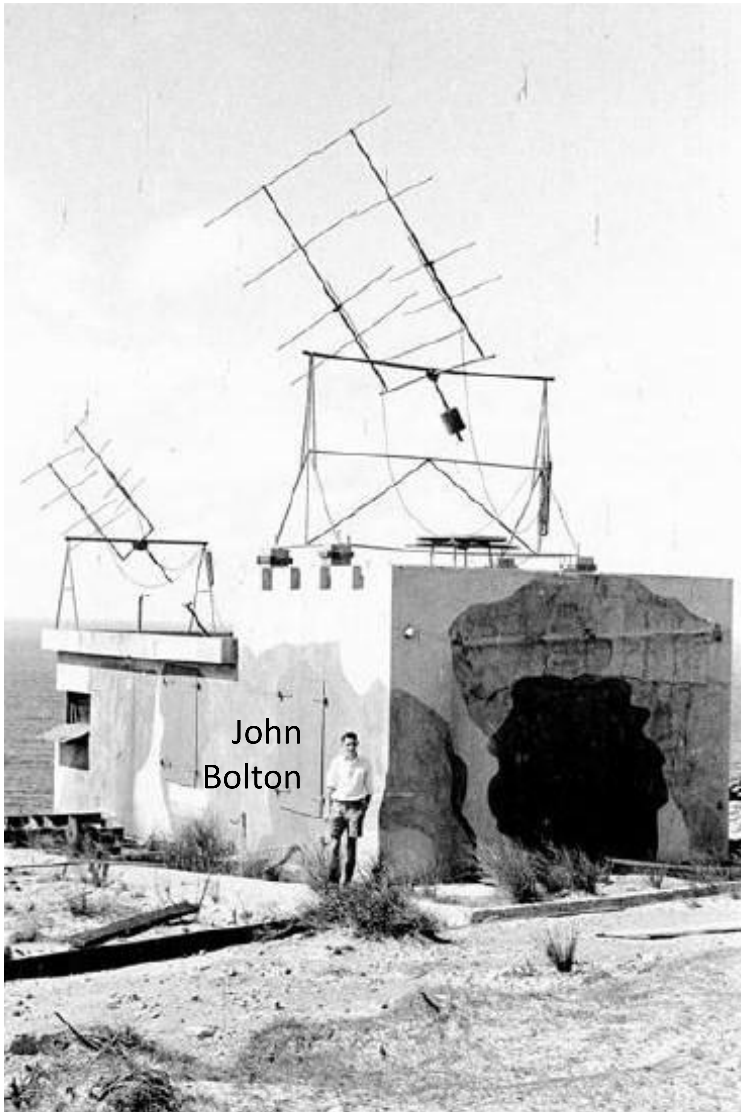


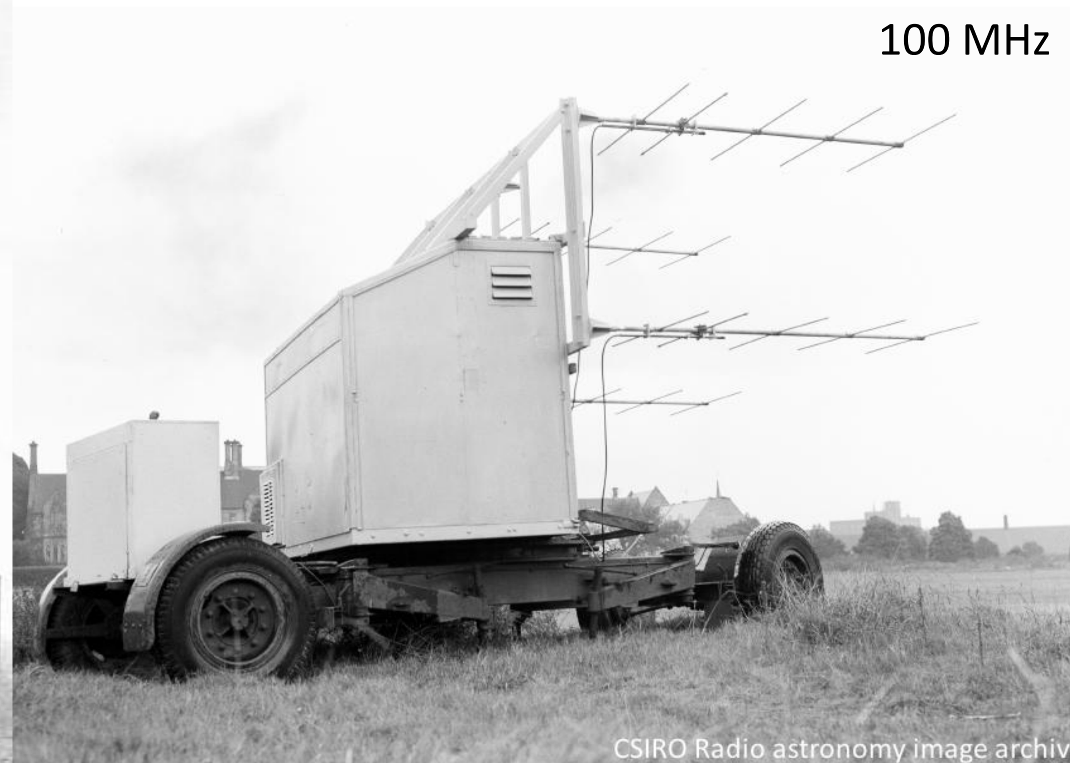


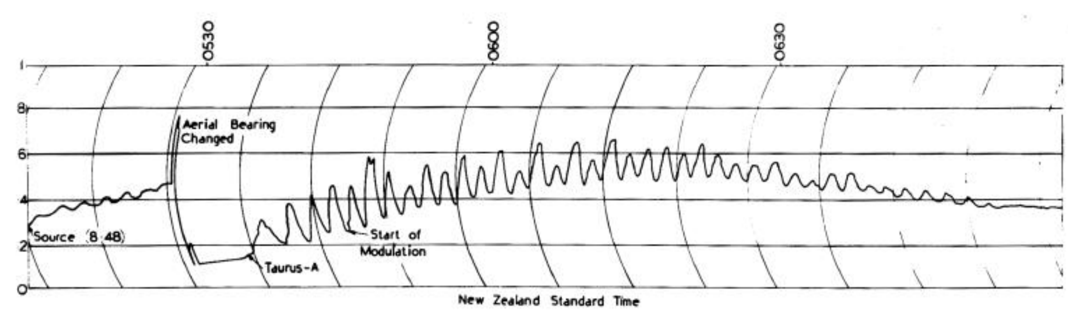
Hey, Parsons & Phillips 1946



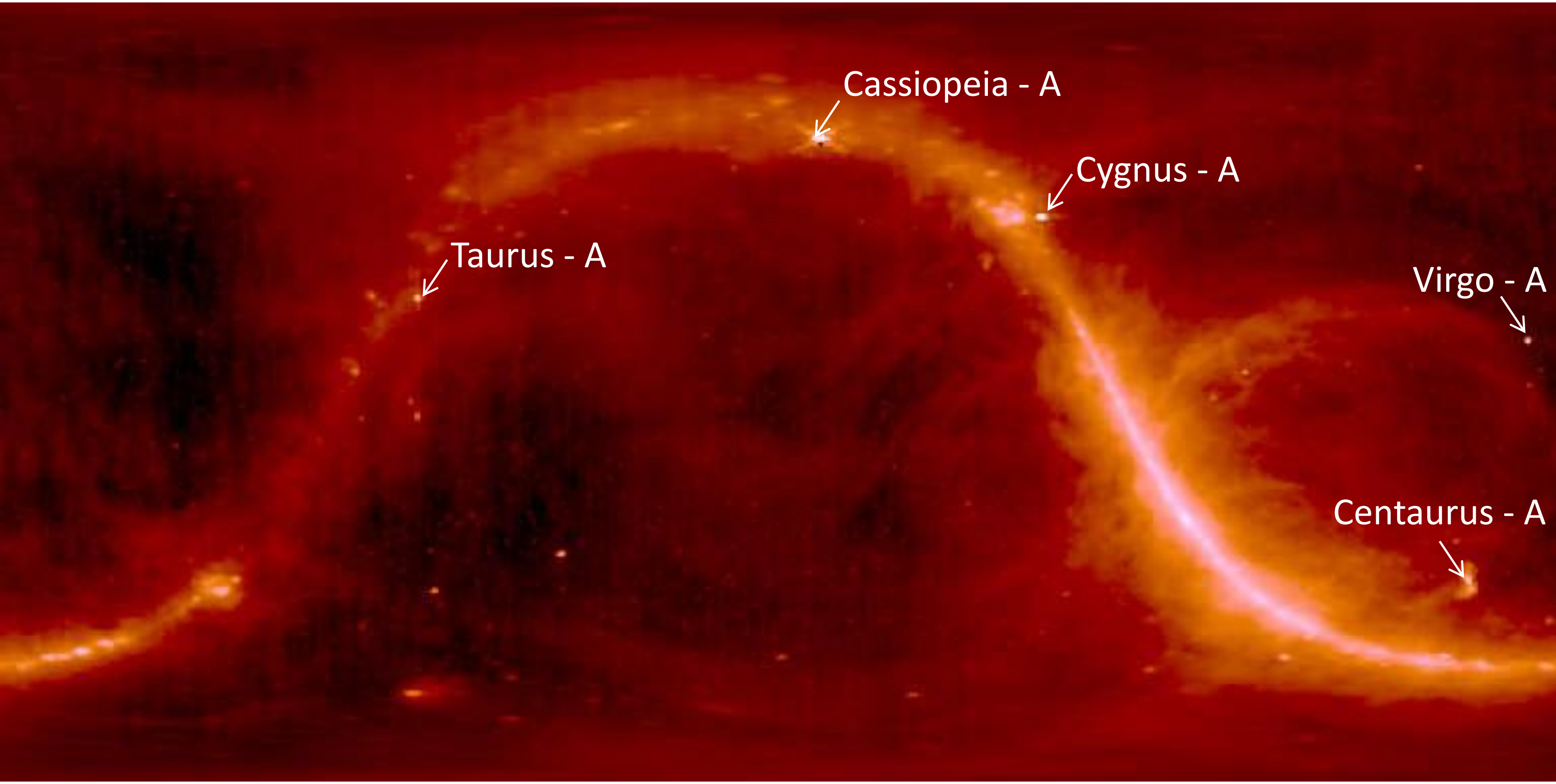
Australian Discrete Sources Research







408 MHz Sky

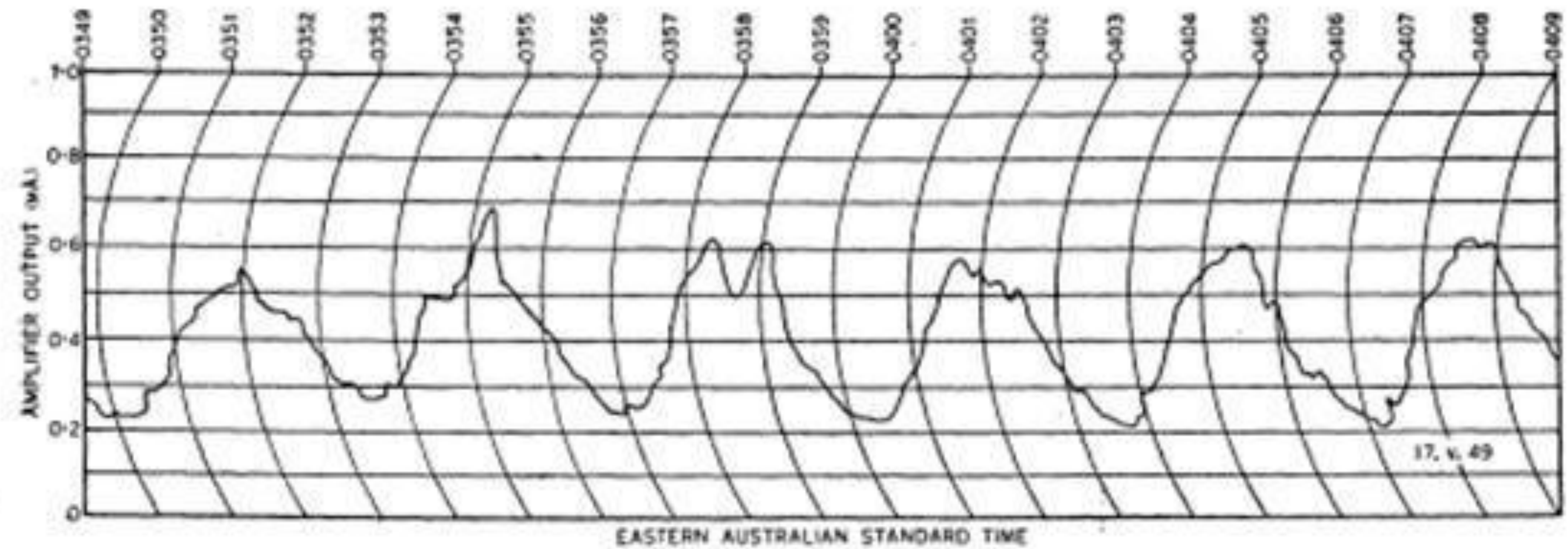


Potts Hill 1949

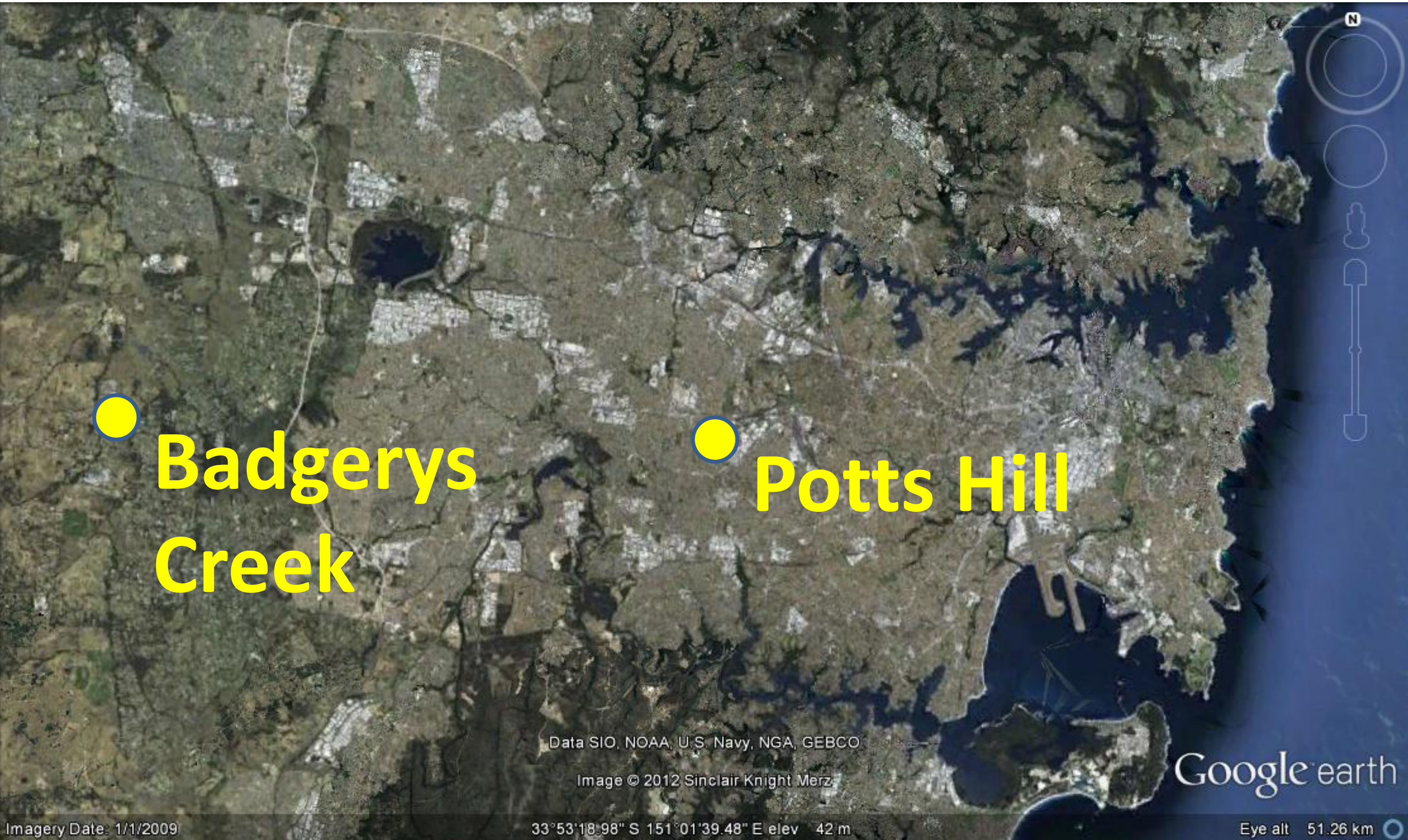
- 97 MHz Observations with Aidan Thomas
- Cygnus A position and tentative identification discounted
- Ionospheric scintillation confirmation

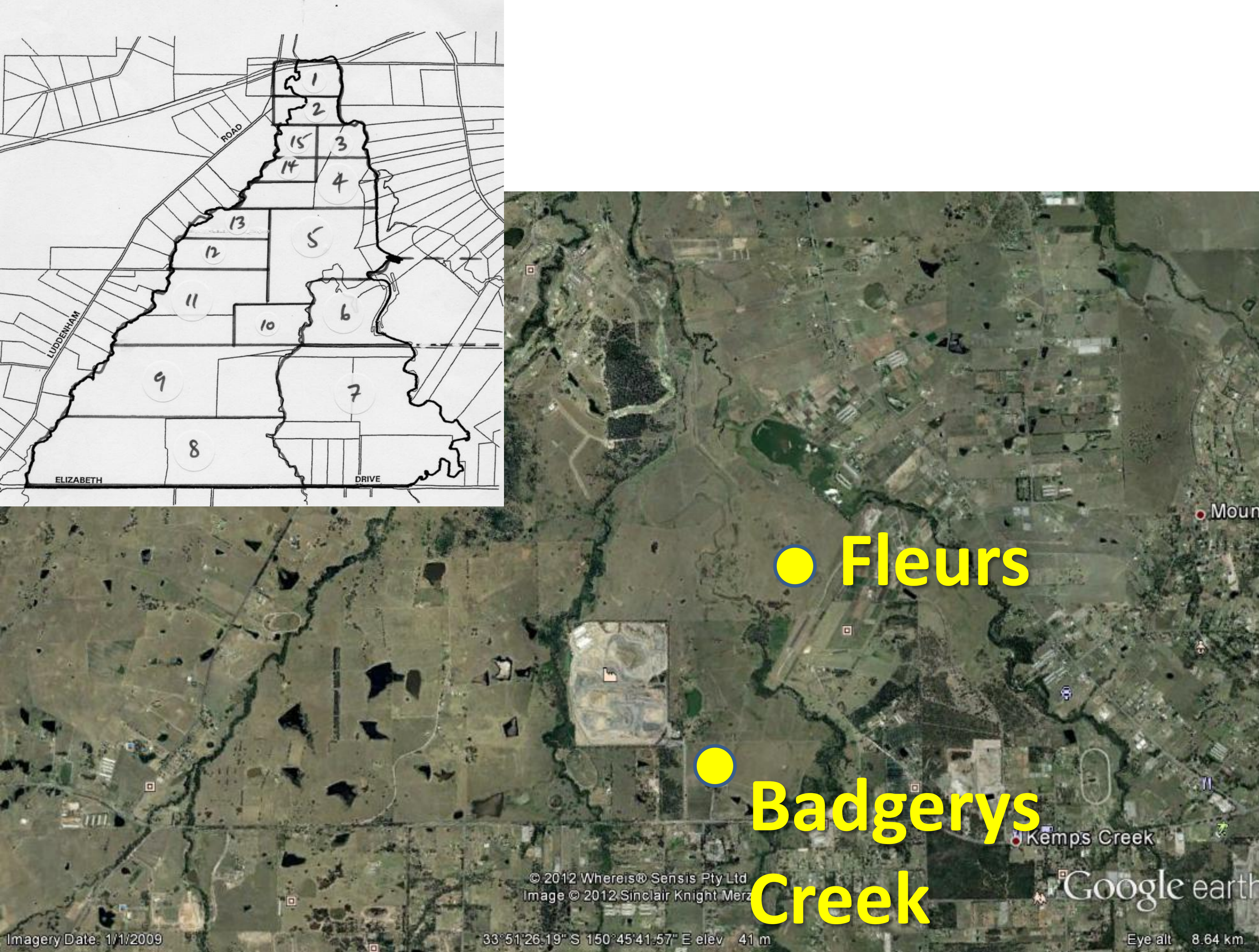
POTT'S HILL INTERFEROMETER SITE LOOKING NORTH-EAST

Cygnus-A 97 MHz



Field Station Locations





ROAD
LUDDENHAM
ELIZABETH
DRIVE
1
2
3
4
5
6
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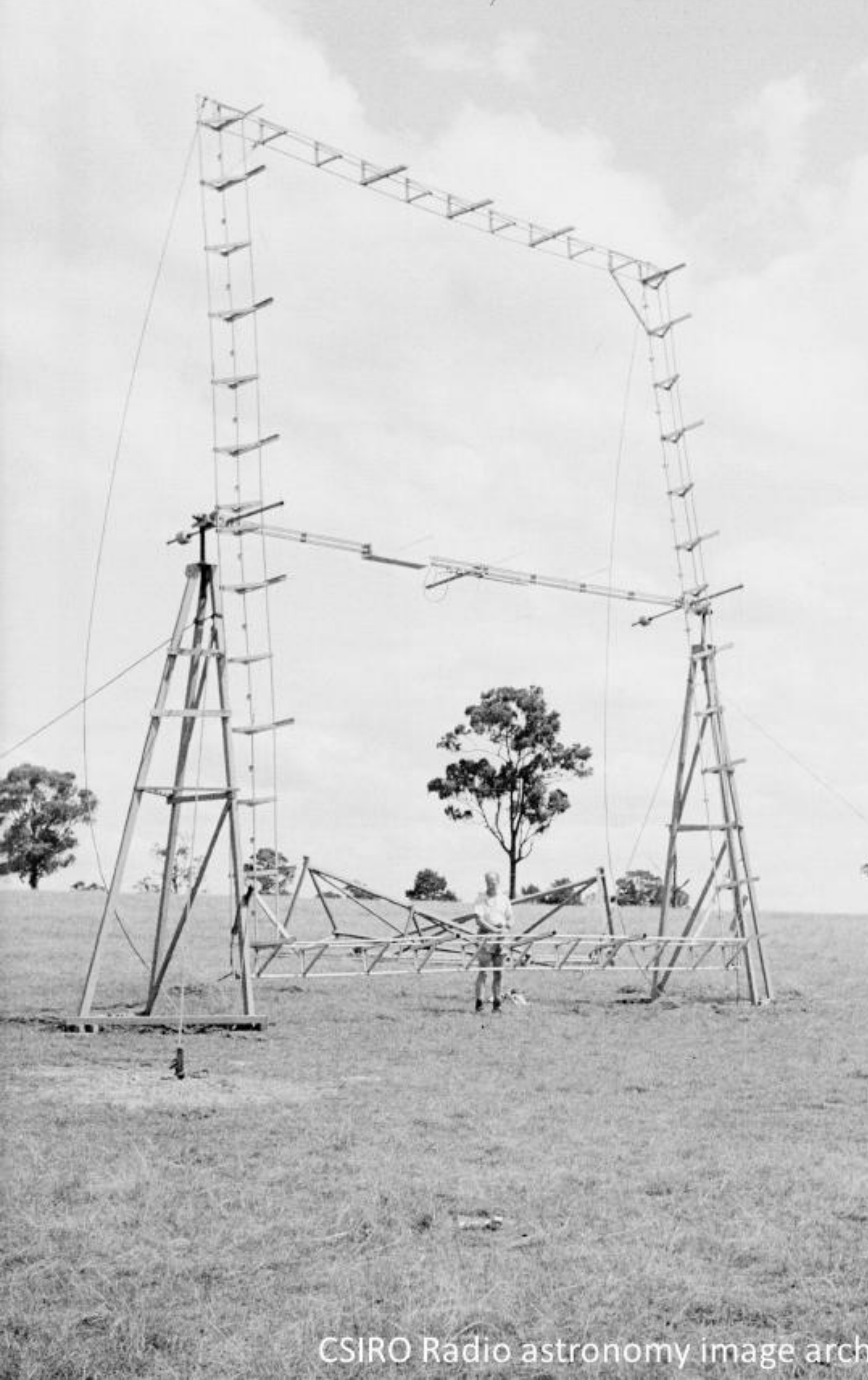
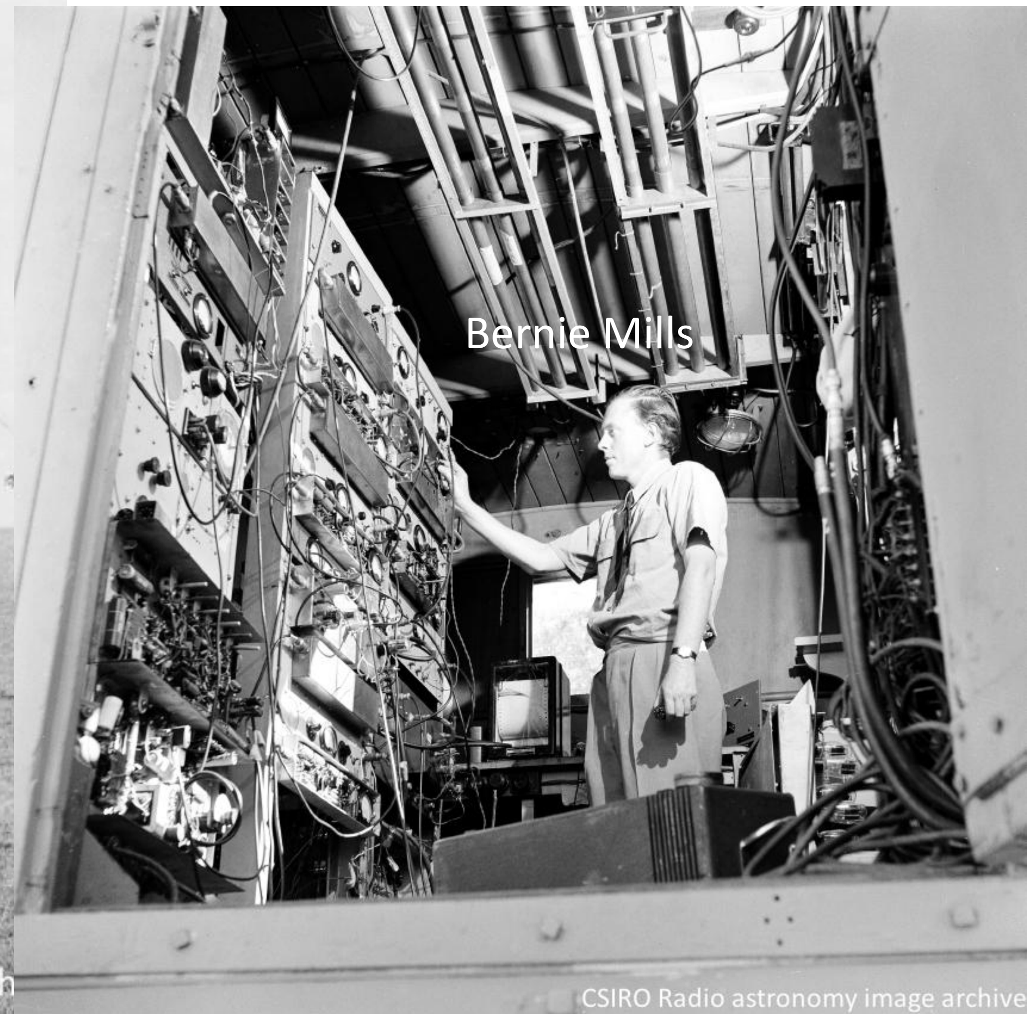
8
9
10
11
12
13
14
15
Fleurs
Badgerys Creek
Mount
Kemps Creek
© 2012 Whereis® Sensis Pty Ltd
Image © 2012 Sinclair Knight Merz
Google earth
Imagery Date: 1/1/2009
33°51'26.19" S 150°45'41.57" E elev 41 m
Eye alt 8.64 km

Badgerys Creek

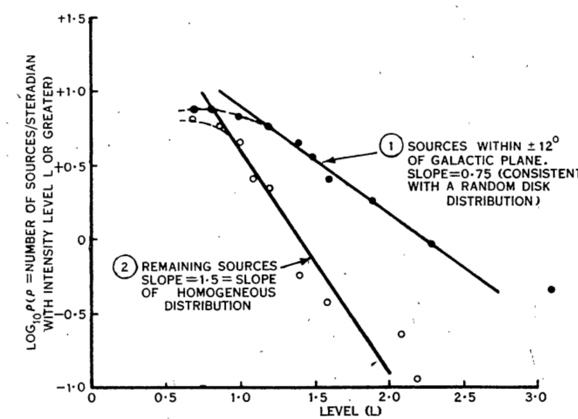
- 101 MHz Observations supported by Arthur Watkinson

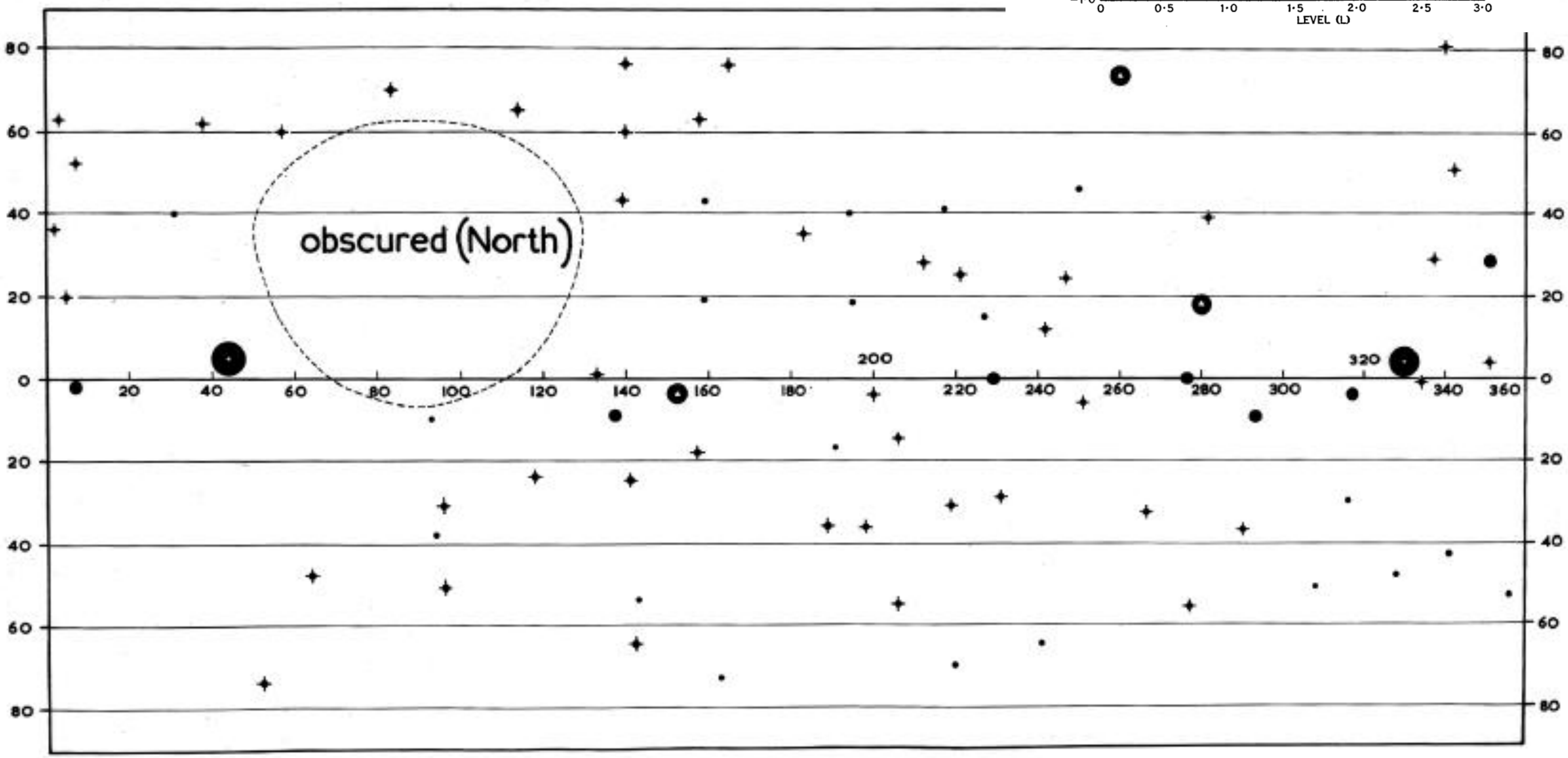


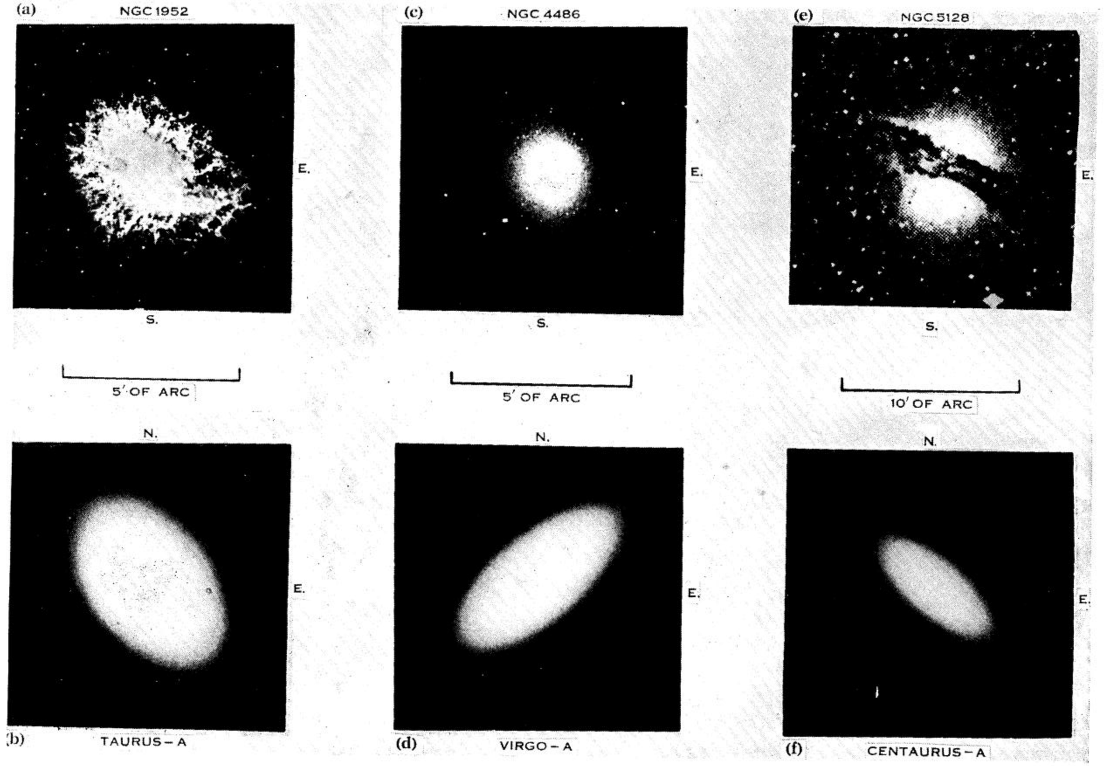


Discrete Source Survey 1952

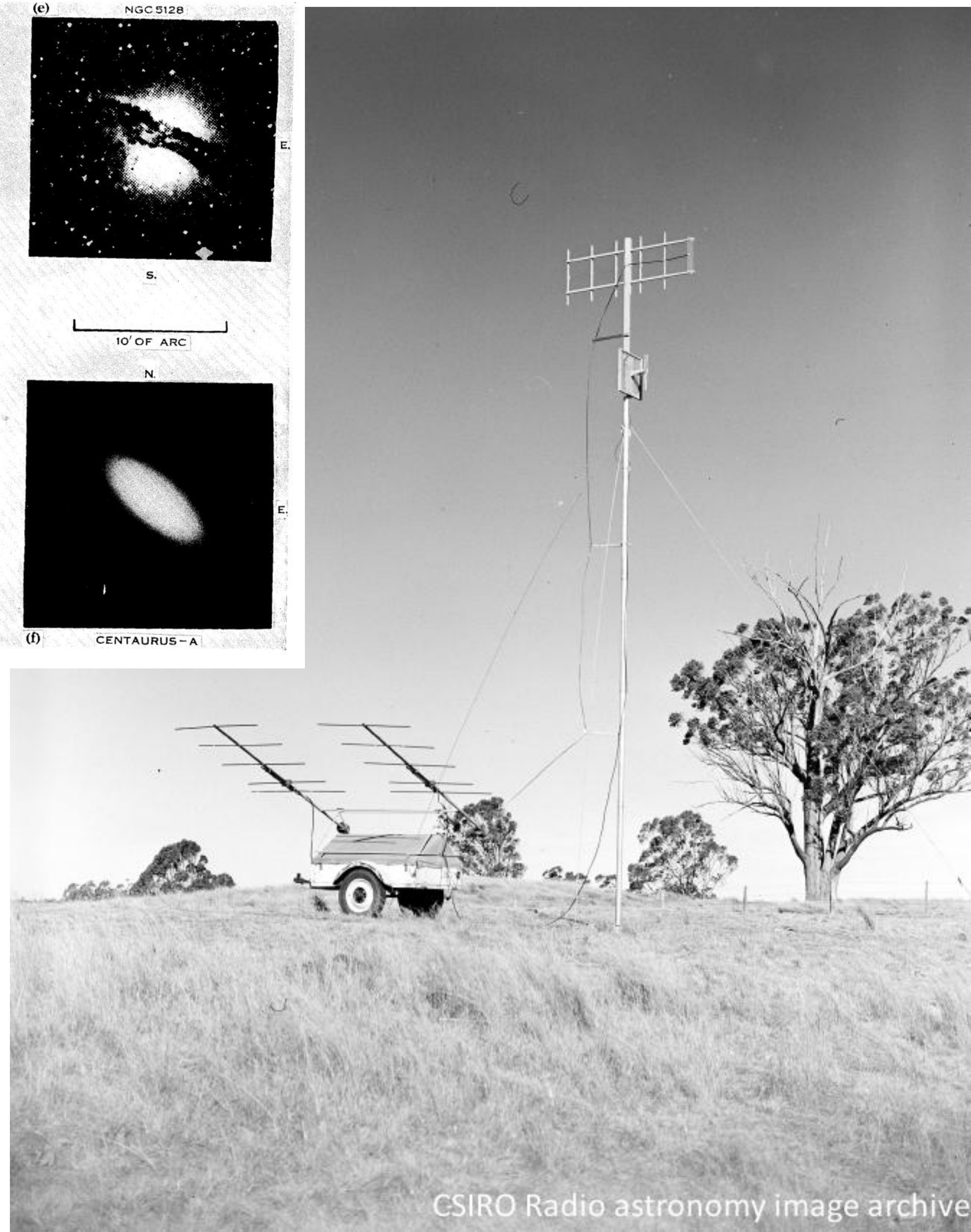
- Confirmed Bolton, Stanley & Slee Discrete Source Identifications
- 77 Discrete sources, two main population classes



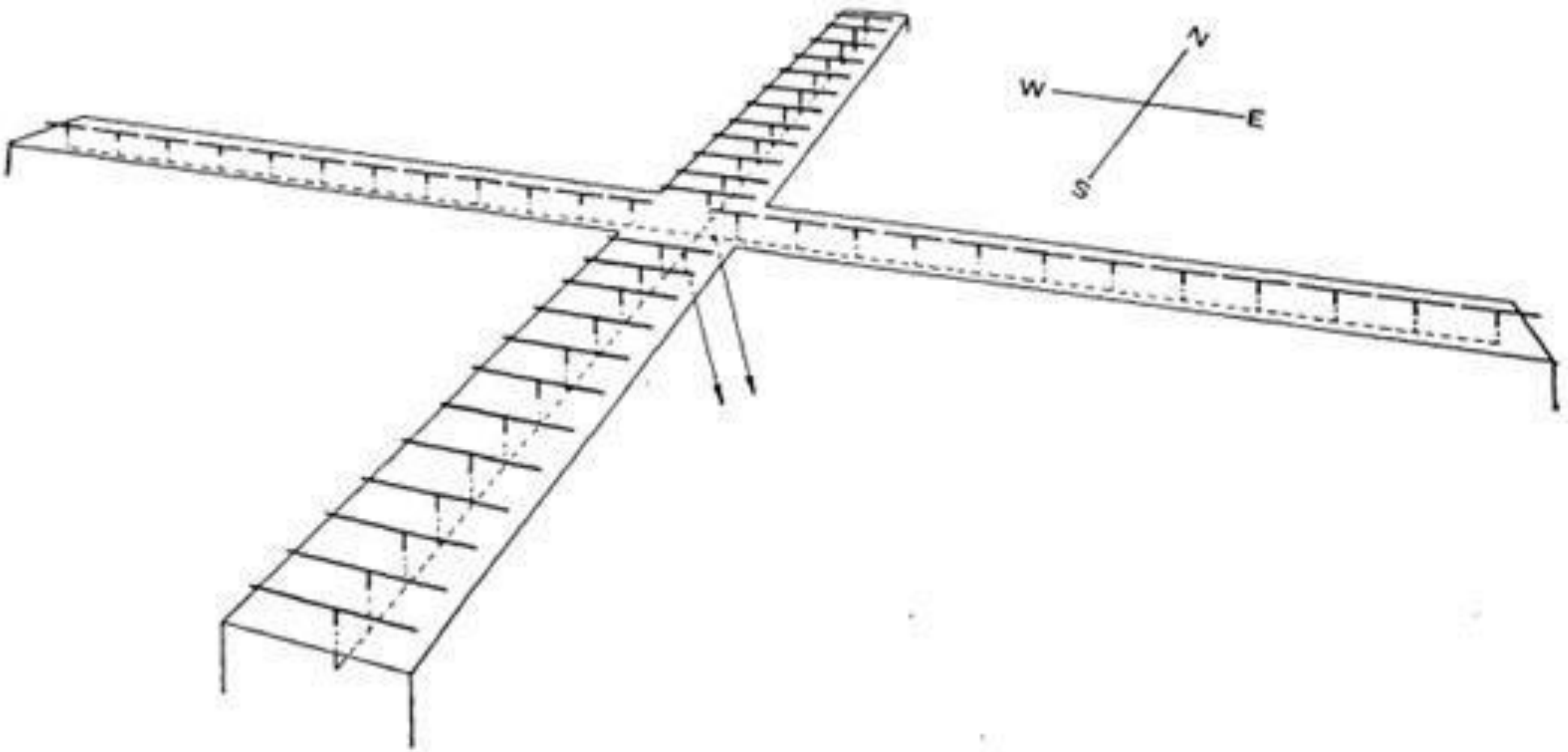




- Radio-Link Interferometer
- Radio Brightness Distributions
- Preliminary results at URSI 1952

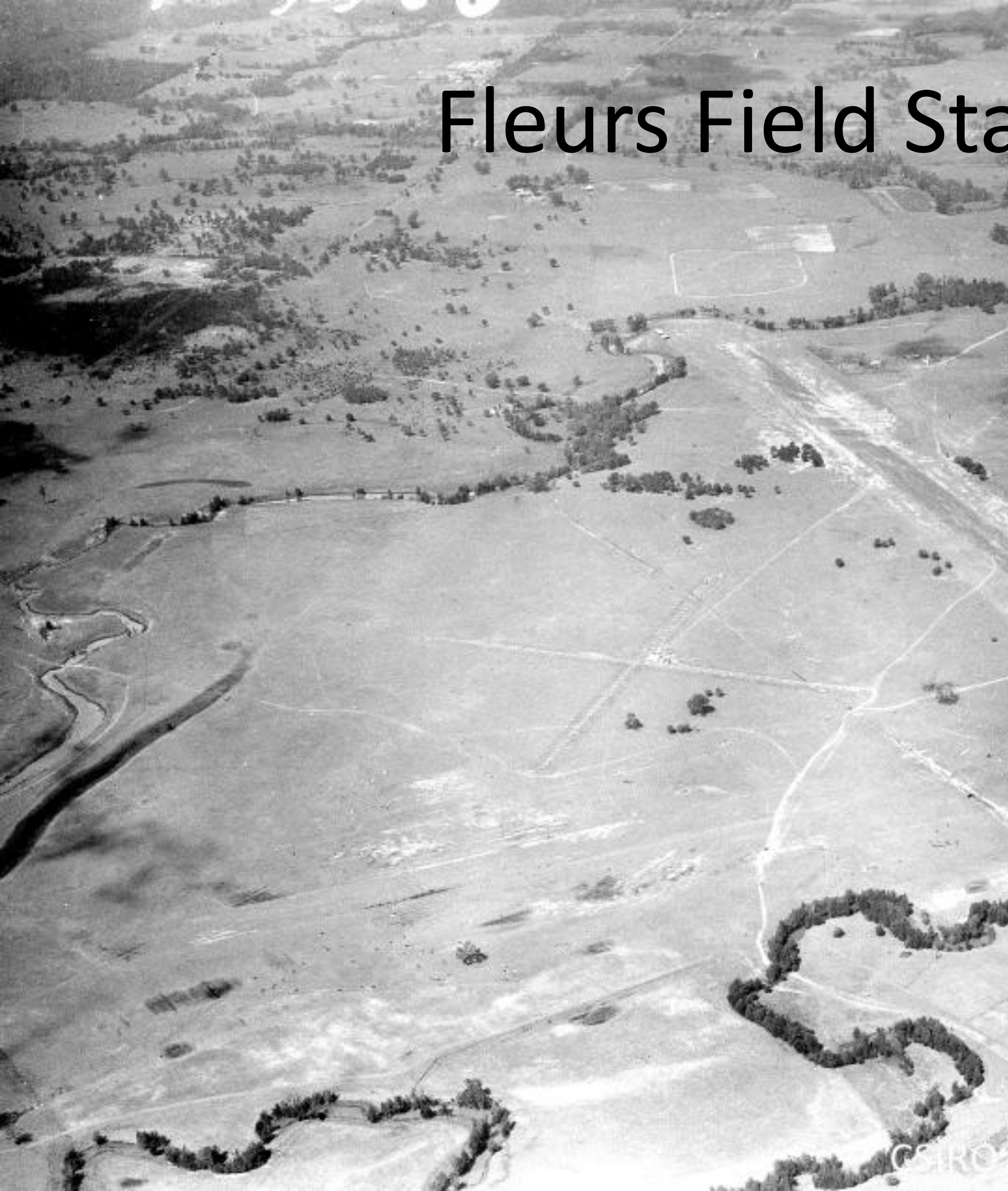


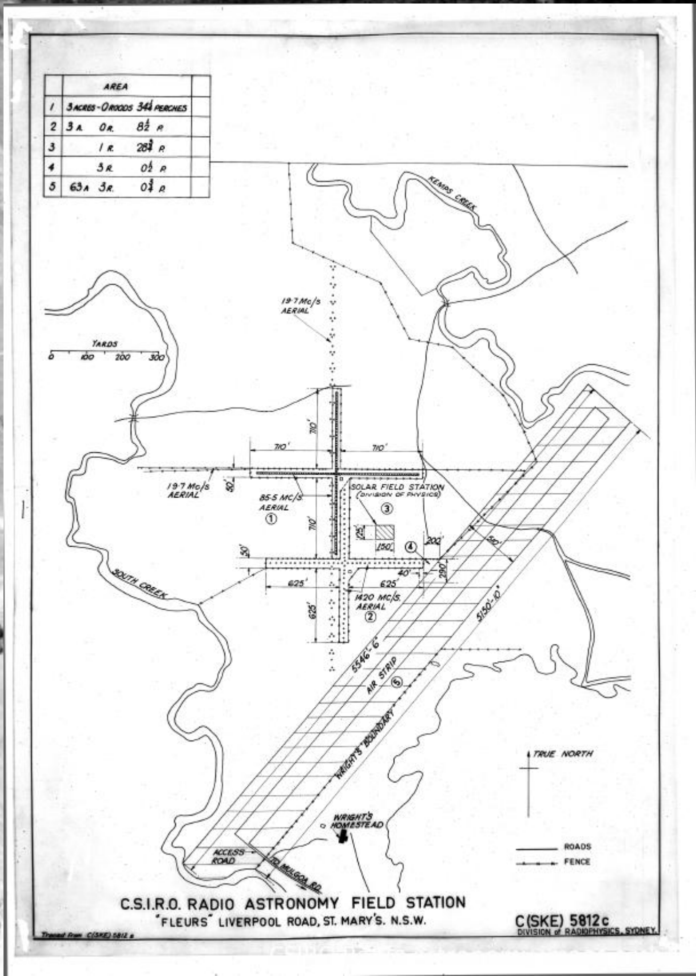
The Idea for a Cross

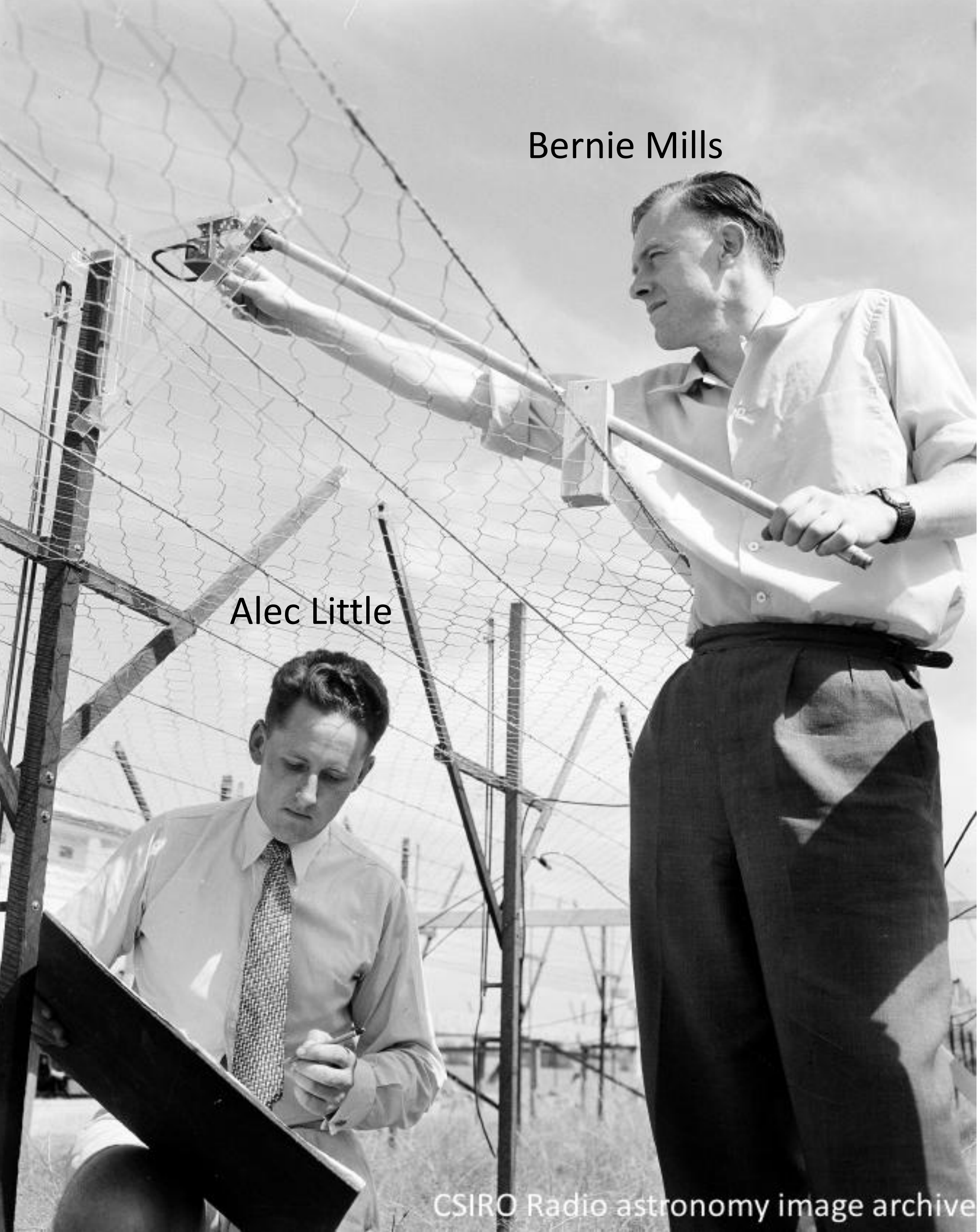


Prototype at Potts Hill 1953

Fleurs Field Station



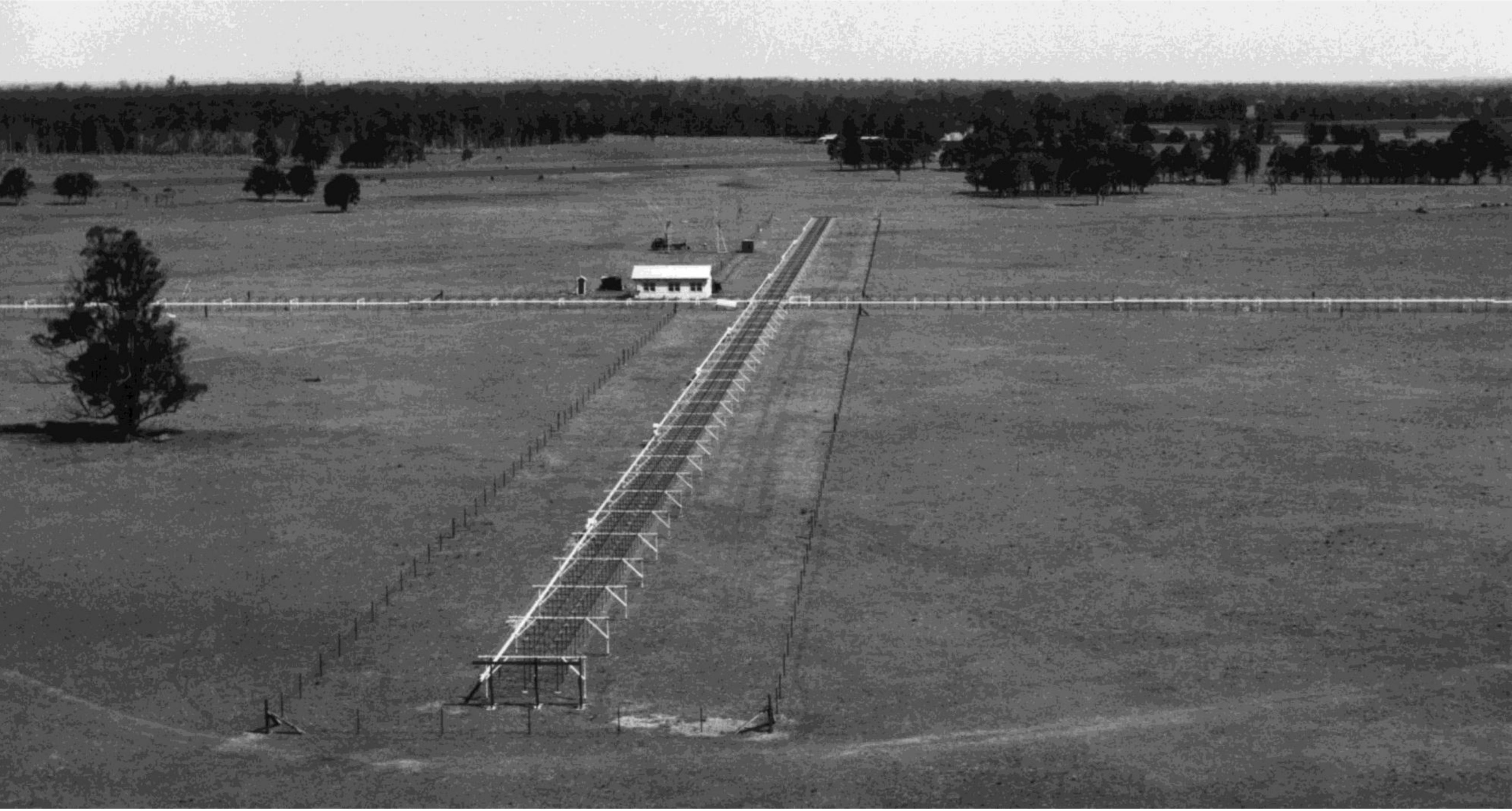




Mills Cross at Fleurs

- Joined by Alec Little
- Constructed 1953-45
- 85.5 MHz Observations
  48 arcmin beamwidth

Mills Cross at Fleurs



Southern Sky Survey - MSH

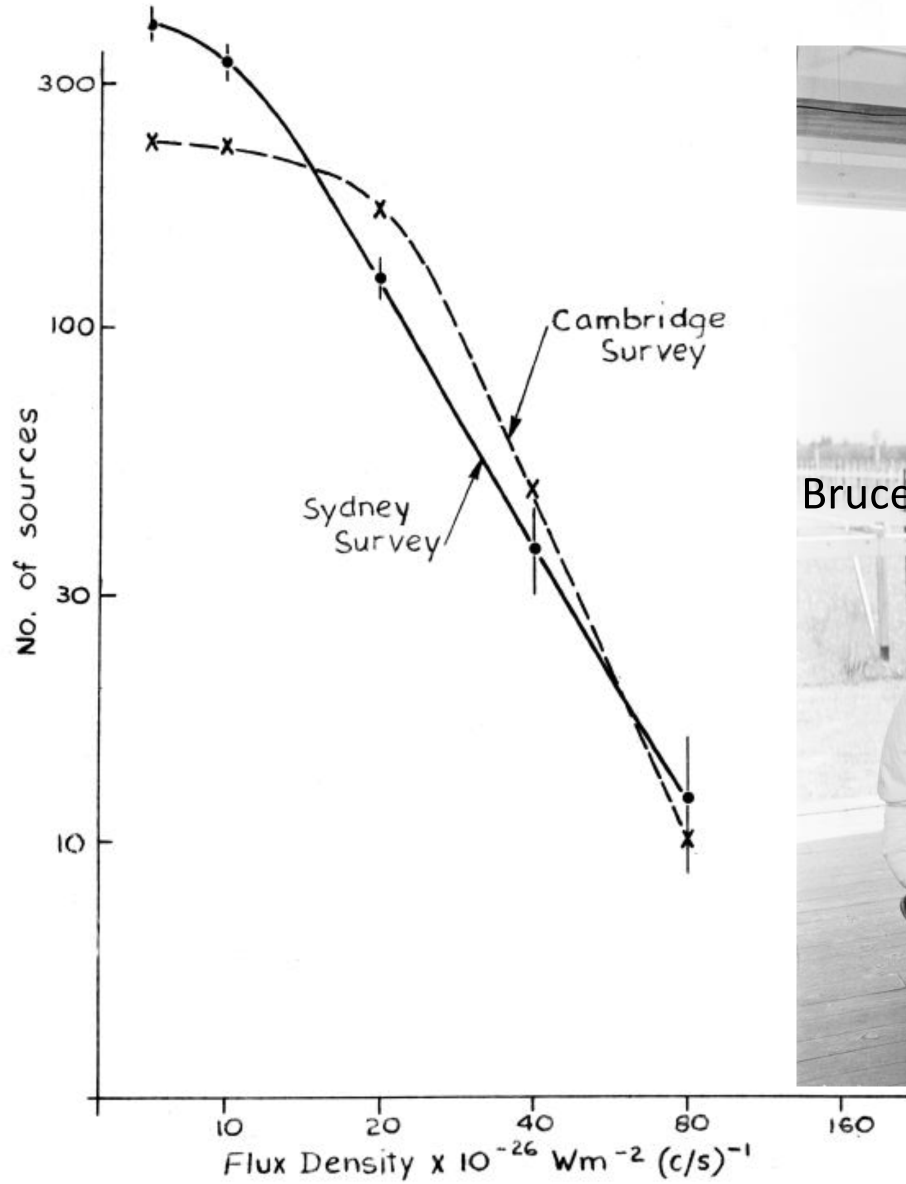
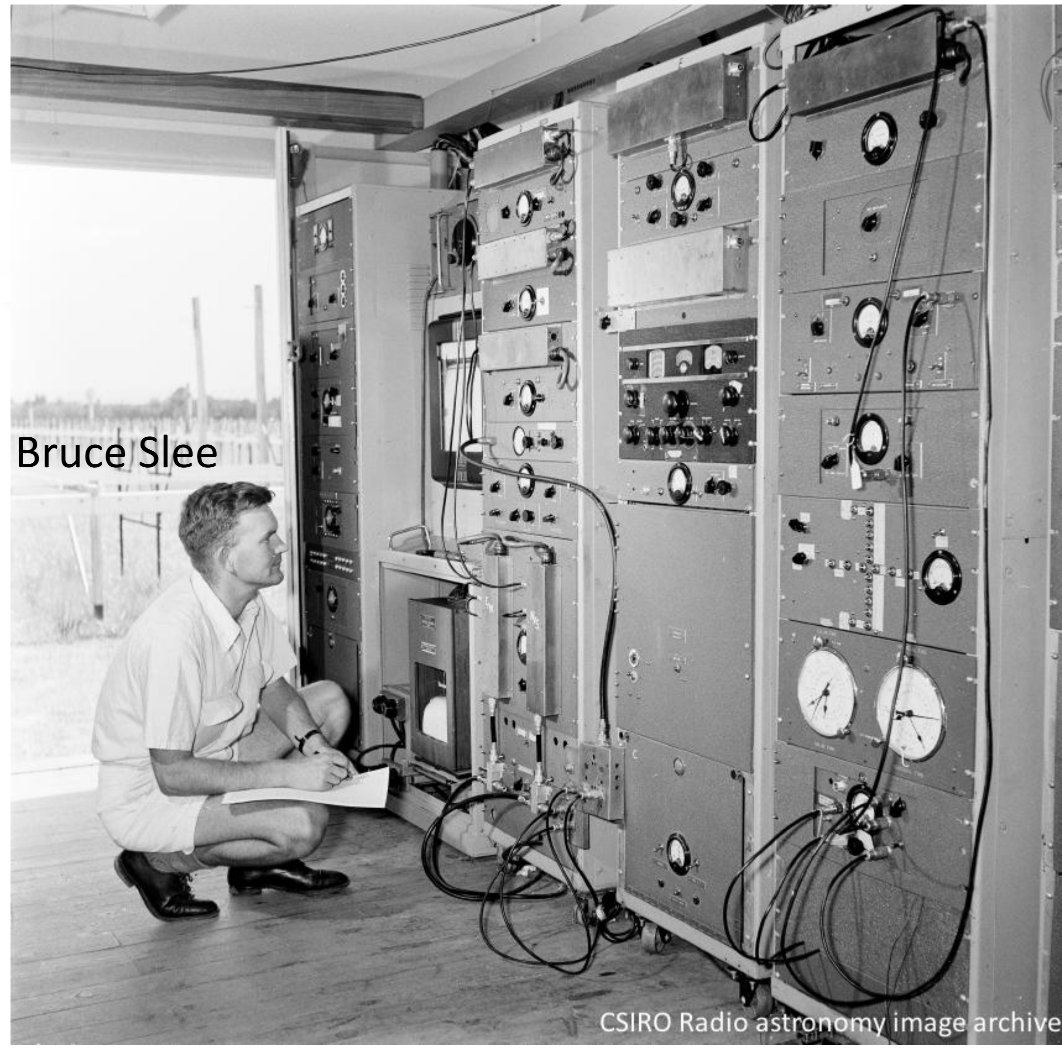
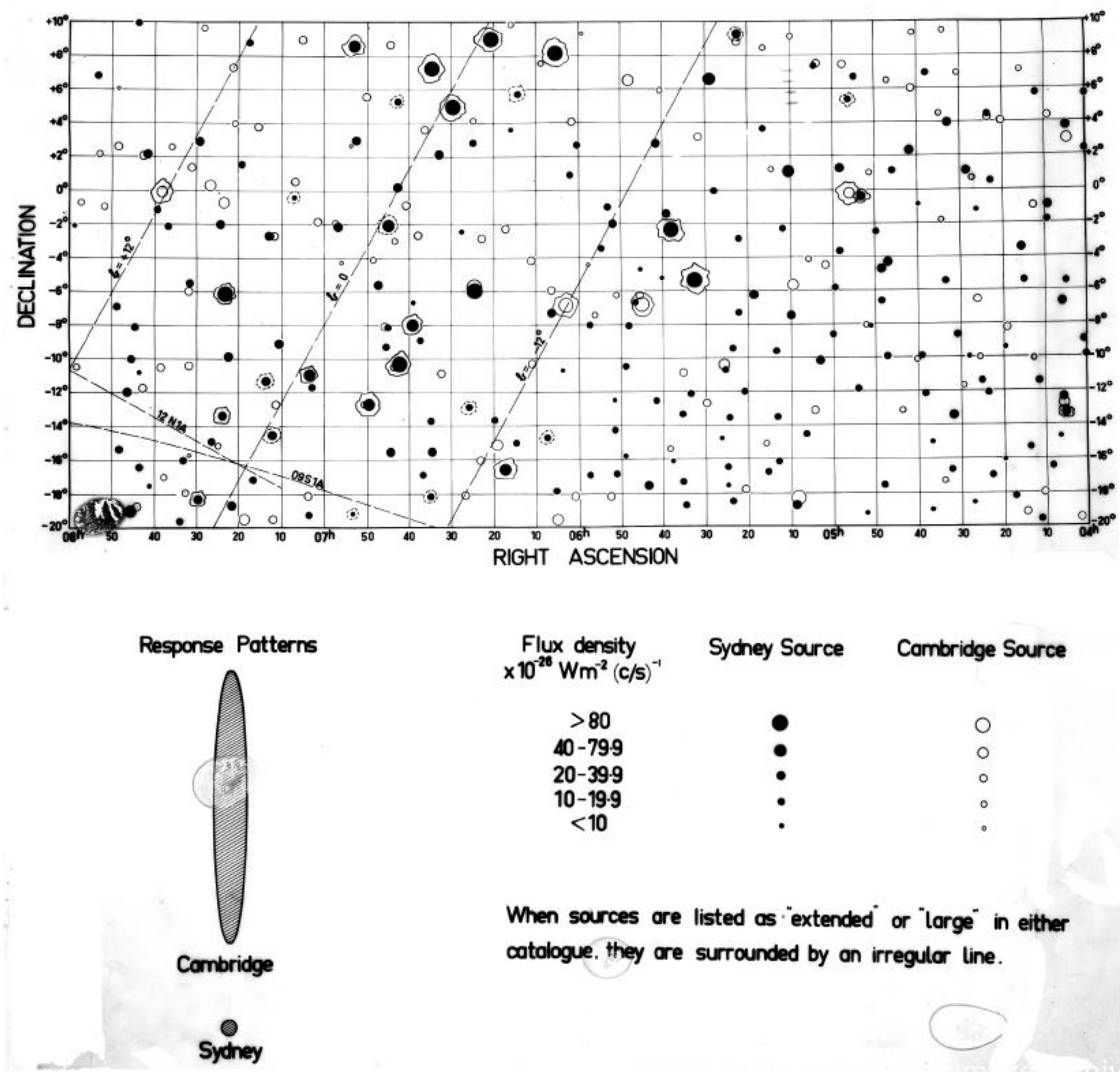


FIG. 5



Controversy with Cambridge



Conclusion

- In 1958 Mills attended the Paris Symposium on Radio Astronomy and then IAU General Assembly in Moscow
- Awarded Doctor of Science in Engineering for thesis covering development of the Mills Cross
- End of an Era –> Schism at CSIRO Radiophysics