



**Auckland
to the Cavendish
to Sydney University**
A career in Radio Astronomy

New Zealand and the Beginnings of Radio Astronomy
A Process of Discovery

Bruce McAdam

University of Sydney

Where did the 80 years go?

- ◆ Education in New Zealand — 23 years 6 months
- ◆ Army & Dominion Physical Laboratory — 6 months
- ◆ Cavendish Laboratory, UK — 3 years 2 months
- ◆ Naval Research Laboratory, NZ — 2 years 3 months
- ◆ Sydney University Physics Dept. — 32 years 3 months
- ◆ Cosmology Distinction Course — 16 years
- ◆ Retirement — 3 years

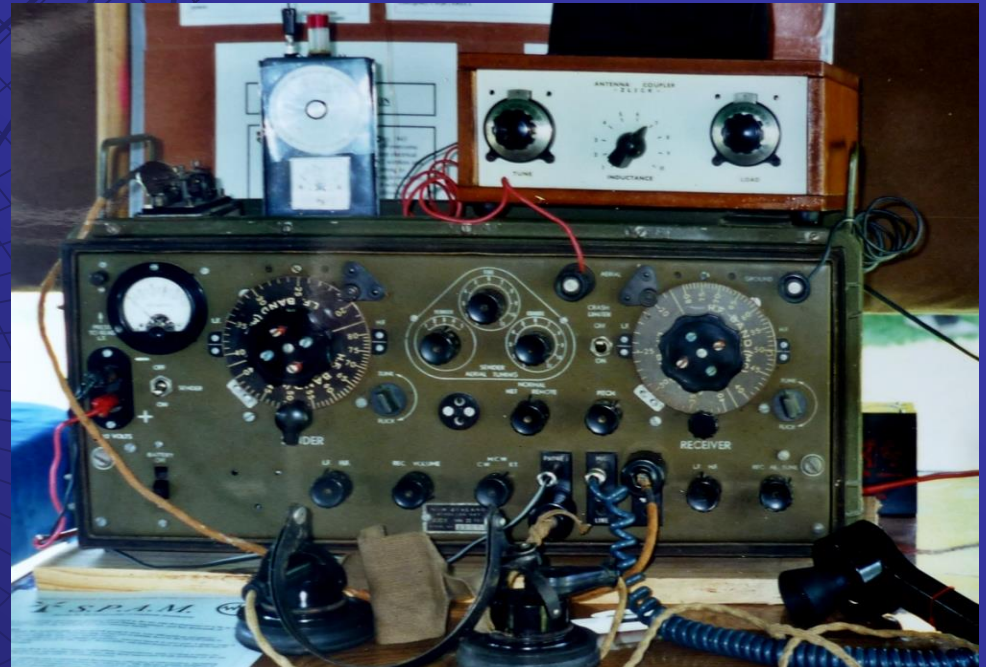
Triggers for a science career

a gift in mid 1944
in Cadet signals



Ham radio license 1946 – ZL1IA
Bought war surplus ZC1 transceiver 1947

Built from kitset in 1946;



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of Radio Astronomy;
31 January 2013

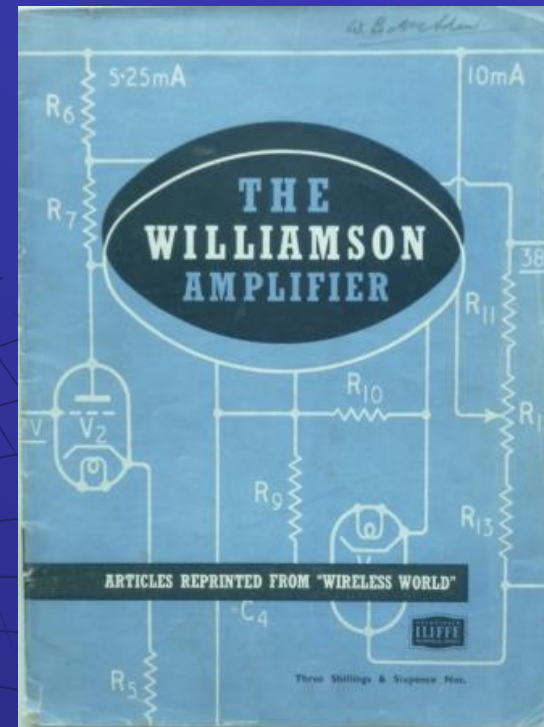
For many years from 1946 I subscribed to the monthly journal

Wireless World

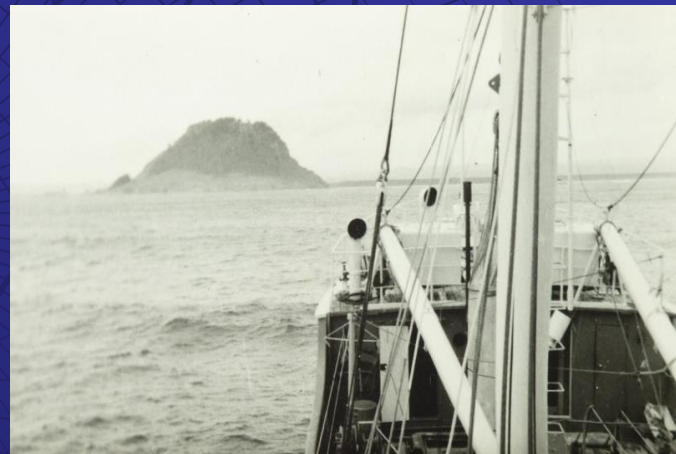
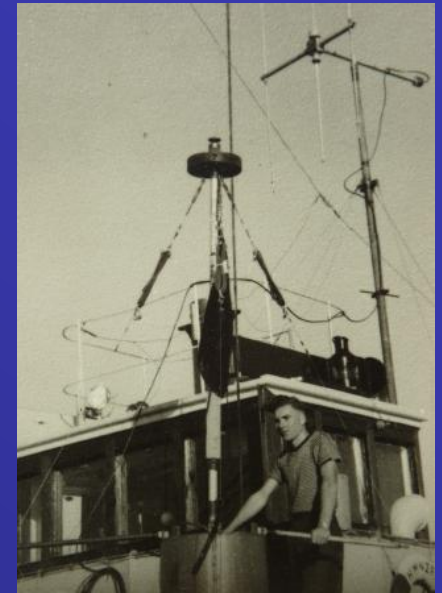
In a series from 1947 to 1950 WW published 6 articles on a design for a High-quality Amplifier which were reprinted in this supplement.

I built a Williamson Amplifier in 1951.

The *double T* high pass filter was a crucial part of my Ph D equipment for the 3C Survey



1951 to 1954 oceanographic field trips: Parua Bay (Endeavour) and Mayor Island (Isa Lei).



MSc thesis: The Radioactivity of Natural Bismuth

23 channel pulse analyser; 8ppm (1% loss)
1.5-6.6 MeV alpha pulses (250 keV resolution)

1952-54

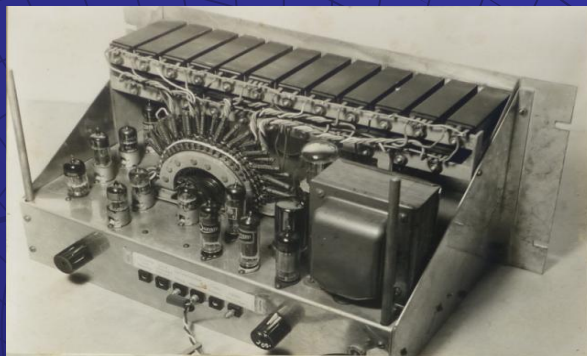


Plate 1. Rear View of the Analyser.

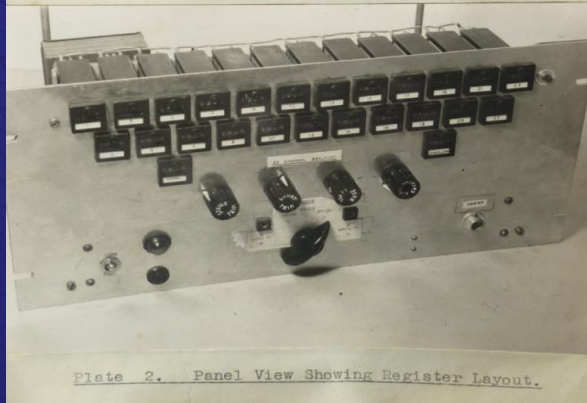


Plate 2. Panel View Showing Register Layout.

Ionization Chamber and gas filling line
Argon 4 atmos; 10 μ sec pulses



Plate 4. The Ionization Chamber and Gas Filling Line.

The half life of ^{209}Bi

Reported in 2003

$$T_{1/2} = 1.9 \times 10^{19} \text{ yr}$$

Detected 128 decays
in 5 days

letters to nature

Experimental detection of α -particles from the radioactive decay of natural bismuth

**Pierre de Marcillac, Noël Coron, Gérard Dambler, Jacques Leblanc
& Jean-Pierre Moalic**

*Institut d'Astrophysique Spatiale, CNRS & Université Paris Sud, UMR 8617,
Bât. 121, 91405 Orsay Cedex, France*

The only naturally occurring isotope of bismuth, ^{209}Bi , is commonly regarded as the heaviest stable isotope. But like most other heavy nuclei abundant in nature and characterized by an exceptionally long lifetime, it is metastable with respect to α -decay¹. However, the decay usually evades observation because the nuclear structure^{2,3} of ^{209}Bi gives rise to an extremely low decay probability and, moreover, generates low-energy α -particles difficult to detect. Indeed, dedicated experiments²⁻⁶ attempting to record the α -decay of ^{209}Bi in nuclear emulsions failed. However, scintillating bolometers⁷⁻⁹ operated at temperatures below 100 mK offer improved detection efficiency and sensitivity, whereas a broad palette of targets could be available¹⁰. Here we report the successful use of this method for the unambiguous detection of ^{209}Bi α -decay in bismuth germanate detectors cooled to 20 mK. We measure an energy release of $3,137 \pm 1$ (statistical) ± 2 (systematic) keV and a half-life of $(1.9 \pm 0.2) \times 10^{19}$ yr, which are in agreement with expected values.

**1955 Finished M Sc.
Joined Defence Scientific Corps
Seconded to Dominion Physical Laboratory**

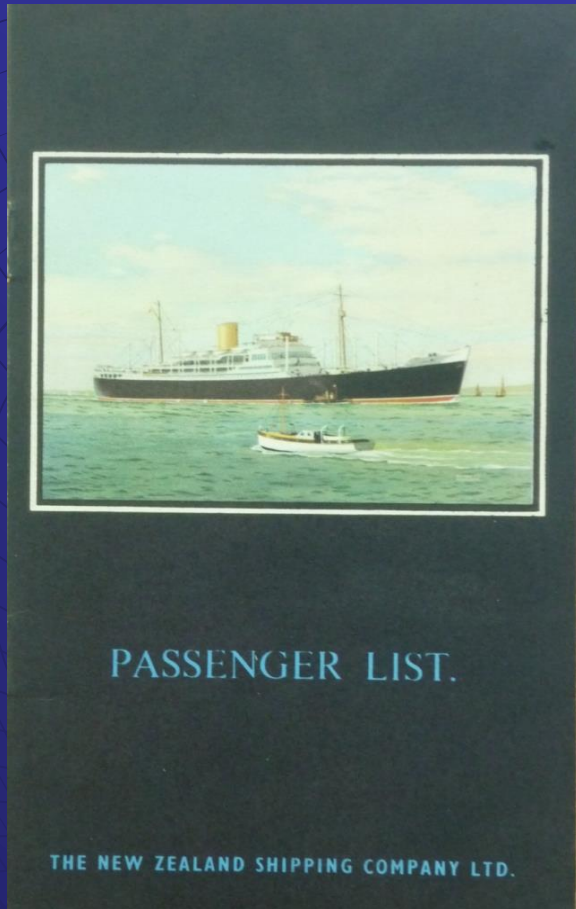


**AUC Physics
Staff & MSc students
1957**

RMS Rangitane - 1955

from Wellington, 27 August
via Panama
to Southampton, 26 September

and to Cambridge



344 passengers, including Roy Kerr,
Grahame Fraser & Mark Barber



September 1955 to November 1958

Cavendish Laboratory, Cambridge

Mullard Laboratory

Ionosphere Group: J.A. Ratcliffe + 8 staff, 16 students

Radio Astronomy Group:

staff Martin Ryle, Tony Hewish, Graham Smith,

with Bruce Elsmore, Peter Scheuer, Robin Conway,
John Baldwin, John Shakeshaft;

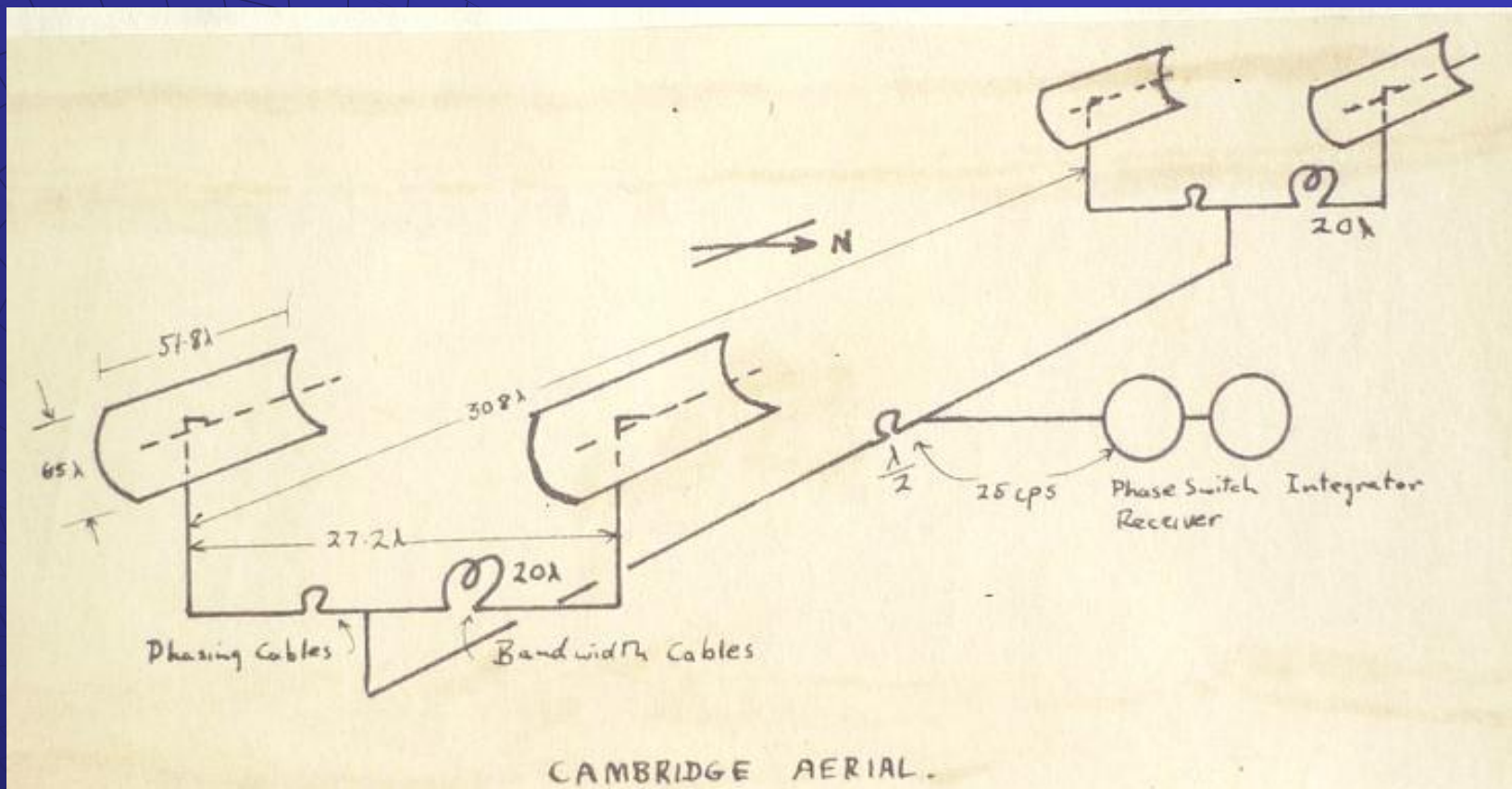
students:-

1954 George Whitfield, John Thomson

1955 David Edge, Carmen Costain, Jan Högbom, Bruce McAdam

1956 Paul Scott, Pat Leslie, Harriet Tunmer, Simon Archer, John Haseler

The Cambridge 3C interferometer

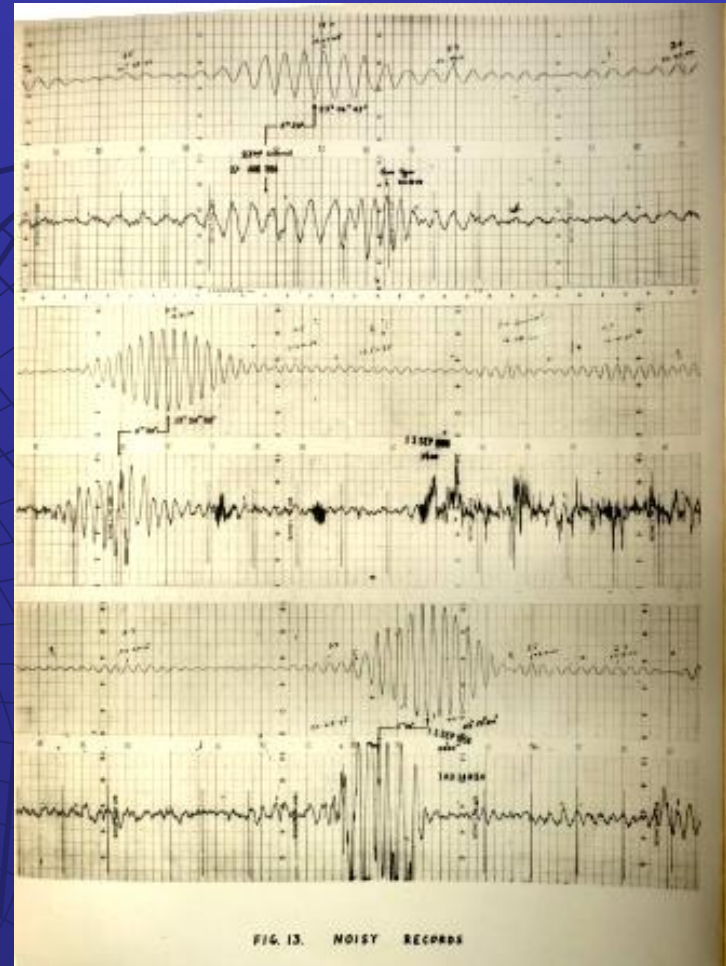


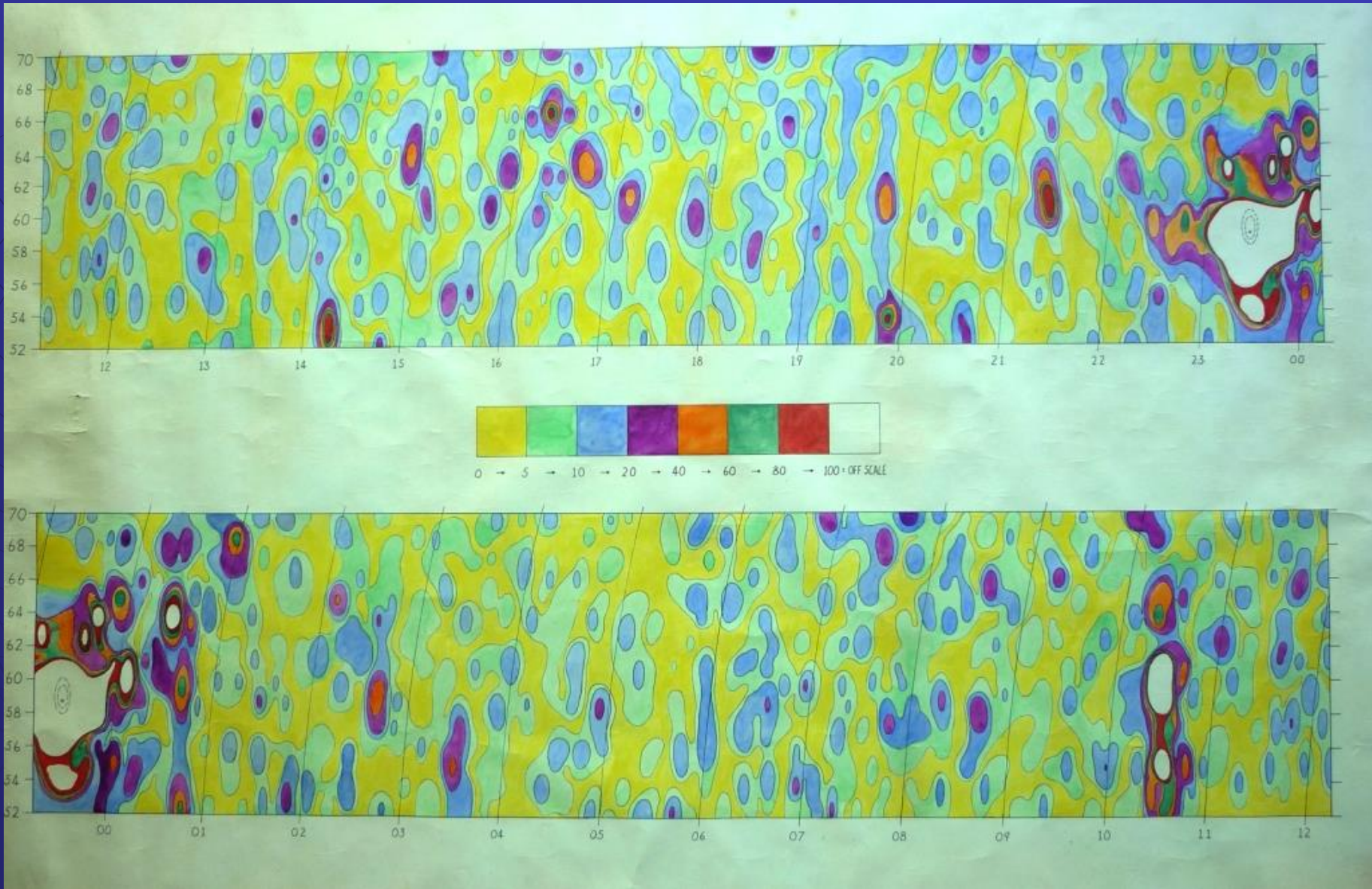
308 EW & 27.2 NS wavelengths

3C observations with a bandpass filter

The filter was tuned to the interferometer period of about 16 mHz with a bandwidth of 0.8 mHz

The filter reduces both noise and confusion from sources at other declinations

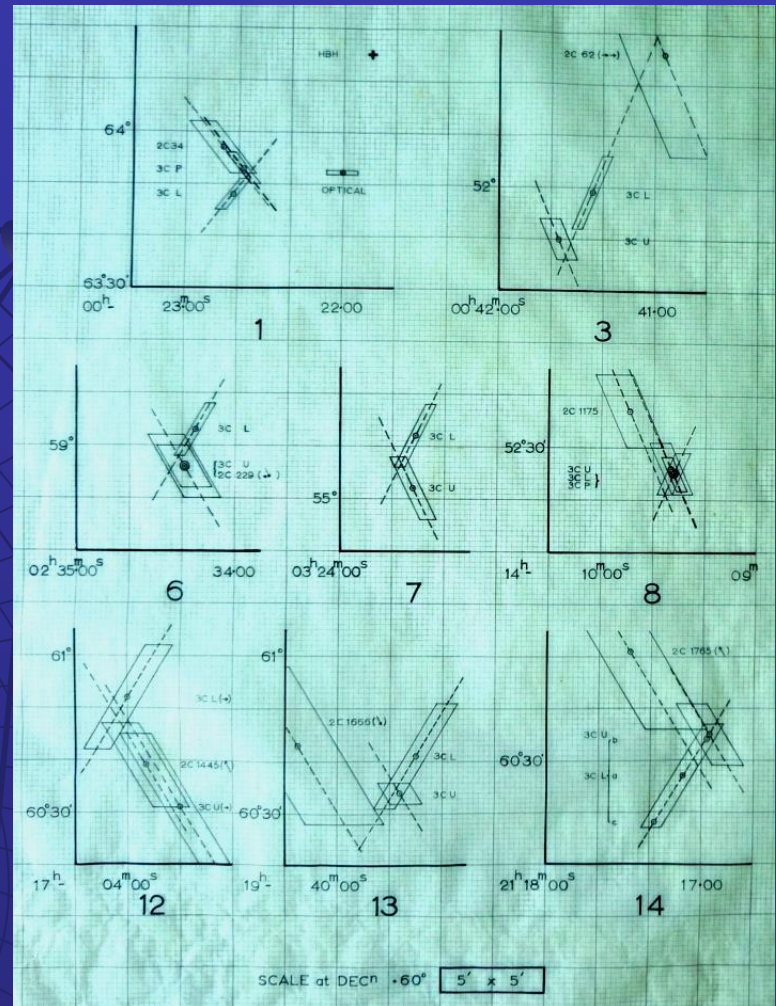




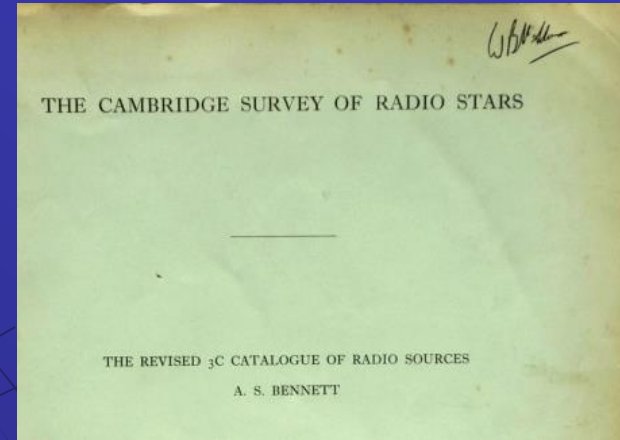
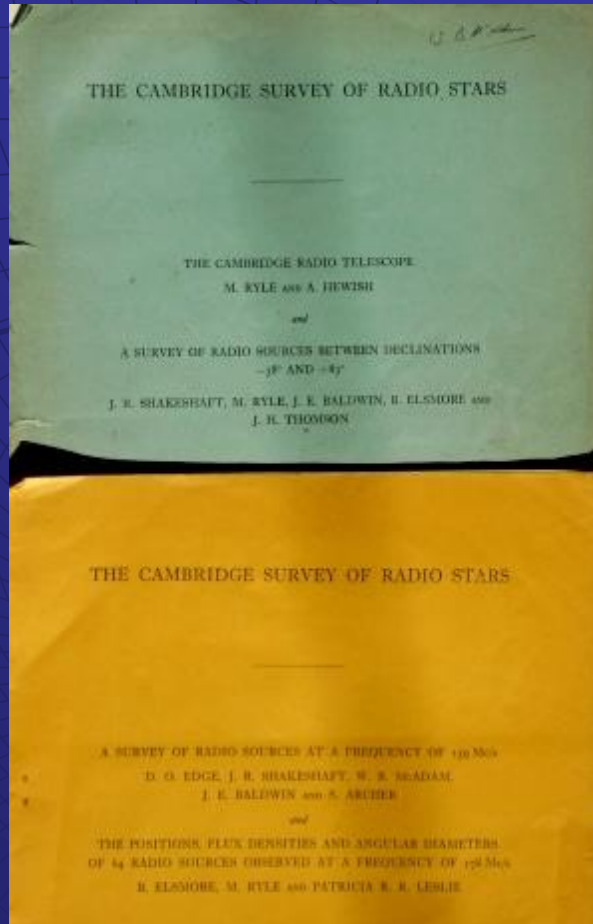
3C Survey positions

The 3C aerials were 6° off true EW so that upper and lower culmination beams crossed at 12°

This helped avoid lobe position errors for the overlap in northern sky.



Surveys of Stars or Sources?



The covers of 2C, 3C and 3CR

all state “RADIO STARS”

but the title pages

use “RADIO SOURCES”

RNZAF flight home at Entebbe; 5 November 1958

Dave Byers, Grahame Fraser, Tony Lewis, Sister Pope, Garry Cuff, Eddie Eide



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The Naval Research Laboratory Devonport, Auckland

The NZ Army, Navy and Air force
Seconded many of their
Defence Scientific Corps Officers
to this Laboratory
for the remaining years of active service.

Sydney University Astrophysics Group

In 1961

Bernard Mills

Alec Little

Arthur Watkinson

Bruce McAdam

Terry Butcher

Mick White

by 1970 add

Michael Large

Tony Turtle

Hugh Murdoch

Dave Crawford

Alan Le Marne

Jack Howes

John Horne

From the grant application to NSF in 1961. Note Pat O'Brien's name

22.

VII. PERSONNEL.

Construction and operation of the radio telescope is to be carried out jointly by the School of Physics, Chatterton Astronomy Department and the School of Electrical Engineering. The senior scientific staff engaged on the work in each department will be as follows: -

School of Physics

Chatterton Astronomy Department

<u>Name</u>	<u>Title</u>	<u>Proportion of time on project</u>
Dr. B. Y. Mills	Reader in Physics and Principal Investigator	70%
Mr. A. G. Little	Lecturer	70%
Dr. P. A. O'Brien	Senior Lecturer	60%
Dr. W. B. McAdam	Lecturer	70%

The Electrical Engineers designed much of the receiver system. These were the folk in 1961; Bob Frater joined as full-time research fellow when the NSF funding was approved.

23.

School of Electrical Engineering

<u>Name</u>	<u>Title</u>	<u>Proportion of time on project</u>
Professor W. N. Christiansen	Head of the School of Electrical Engineering	At present abroad, returning in 1962.
Professor R. E. Aitchison	Associate Professor in Communication Engineering	20%
Mr. C. T. Murray	Senior Lecturer in Electronics	50%
Mr. I. S. Docherty	Lecturer	10%

In addition: one technical officer, two laboratory technicians and four post-graduate students associated with the project at present. It is intended to appoint two research fellows working full-time on the project.



The Molonglo Cross as seen from the West.

TELEPHONES: SYDNEY, AUSTRALIA 660-0522

ITHACA, NEW YORK (607), 256-4341

CORNELL - SYDNEY UNIVERSITY ASTRONOMY CENTER

CORNELL UNIVERSITY
ITHACA, N. Y. 14850

&

THE UNIVERSITY OF SYDNEY
SYDNEY, N. S. W. 2006

JOINT DIRECTORS:

PROFESSOR T. GOLD
CORNELL UNIVERSITY

PROFESSOR H. MESSEL
THE UNIVERSITY OF SYDNEY

Cornell – Sydney University Astronomy Center

linked the Arecibo and
Molonglo research groups

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Minutes of the First Meeting of

The Cornell-Sydney University Astronomy Center

September 25-26, 1964

A meeting was held at Cornell University on Friday, September 25,
and Saturday, September 26, 1964.

Present:

Prof. H. Messel
Prof. R. Hanbury Brown
Dr. B. Y. Mills
Prof. C. B. A. McCusker

Dr. C. Hazard
Prof. F. D. Drake
Prof. M. H. Cohen
Prof. W. I. Axford
Prof. M. O. Harwit
Prof. J. P. Delvaile
Dr. B. Hapke

Prof. T. Gold
Prof. K. I. Greisen
Dr. G. Pettengill

Professor Gold acted as Chairman of the meeting.

1. Professor Gold extended a welcome to the visitors from Australia
and expressed regret that Professor Christiansen had been prevented from
attending by visa difficulties.

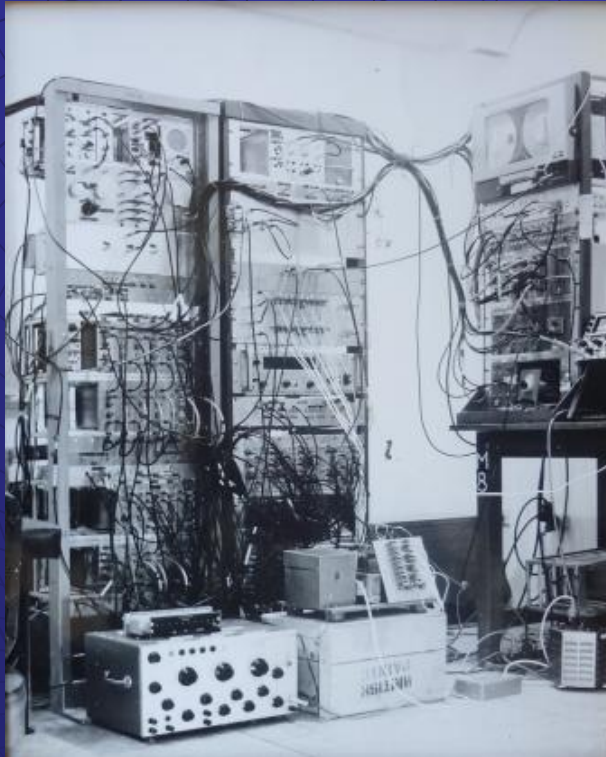
Construction of feeds took until 1964 for EW and September 1967 for the complex NS arm



Don Campbell in 1962



Multi phasing gave 3 EW fan beams and 33 pencil beams



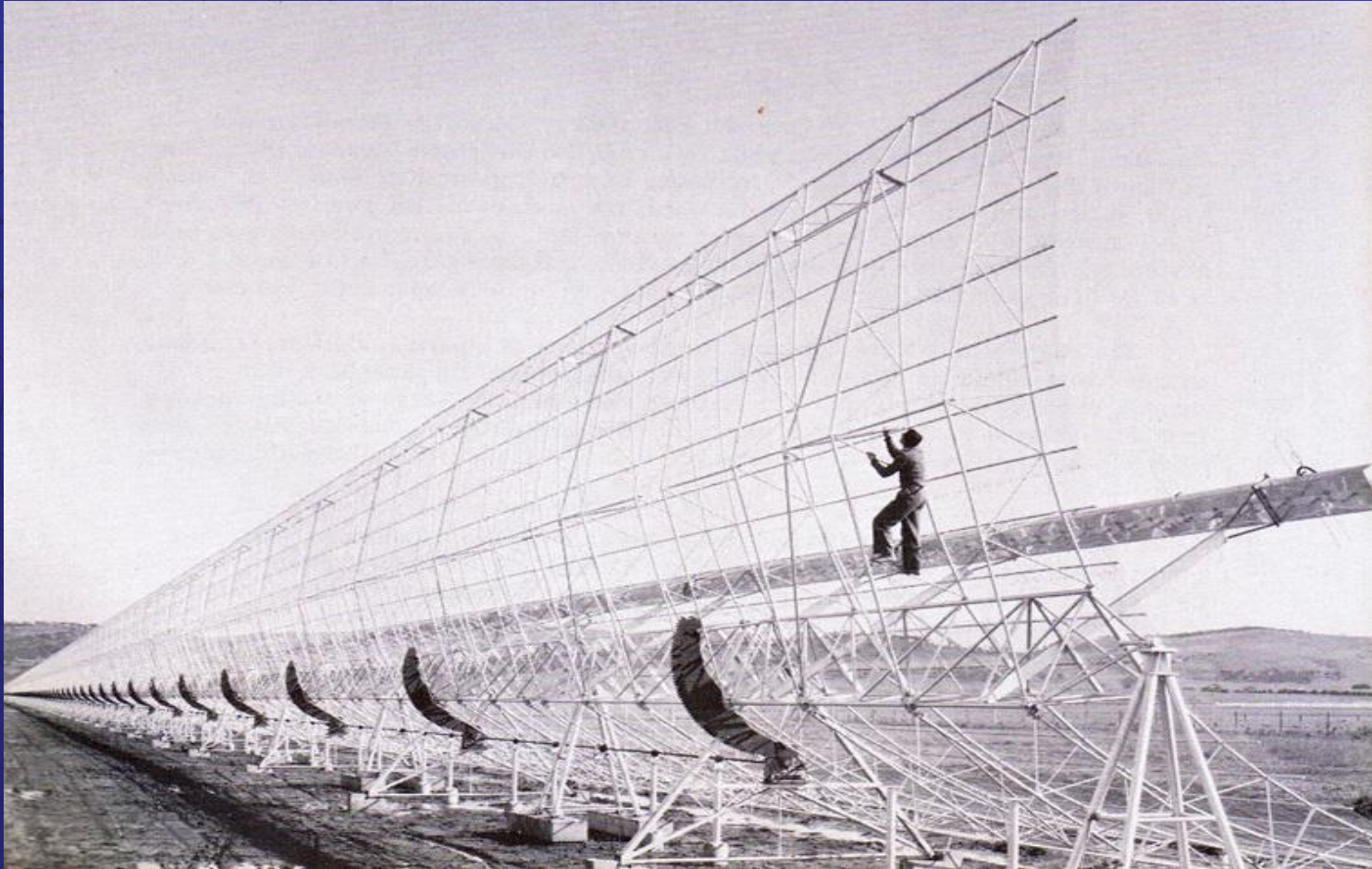
Output was on digital tape



Control desk with on-line monitoring of 11 pencil beams, total power and an immediate contour plot of the zone

In 1965 The EW arm was ready

It was used as a fan beam 1964-'67; Cross '67-'78; MOST '81-2001



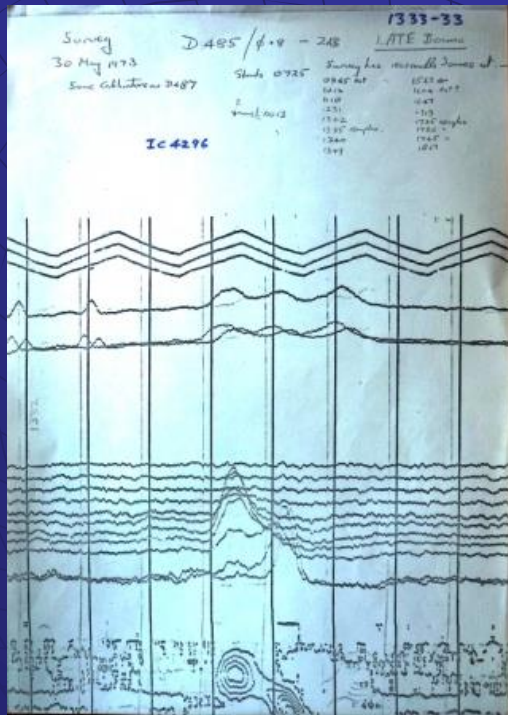
Terry Butcher on the cantilever ribs

The NS arm observed as the Cross, Sept 1967 to Aug 1978

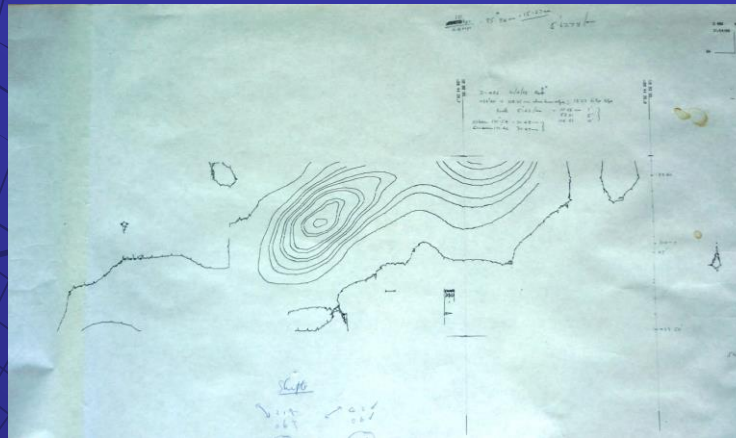
Since 25 August 1978 this arm has not been used



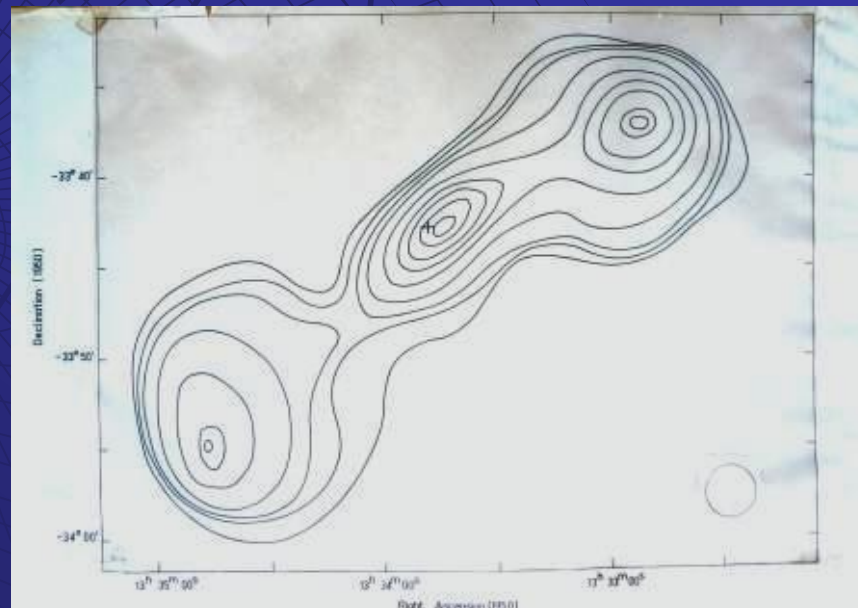
Production of a contour map for extended source 1333-33, using three dec zones



Fax plot of D 485



Computer map from the digital data of D 486



Hand drawn contours using all 3 zones of computer output

Structure of Extended Sources

two major projects

116 sources
408 MHz
Richard Schilizzi
1975

Mem. R. astr. Soc. (1975) 79, 1-73.

OBSERVATIONS OF EXTENDED SOURCES AT 408 MHz—I
THE RADIO STRUCTURES

R. T. Schilizzi and W. B. McAdam*

School of Physics, University of Sydney, NSW 2006

(Communicated by B. Y. Mills)

(Received 1974 December 30; in original form 1974 October 8)

383 sources
843 MHz
Paul Jones
1992

THE ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES, 80:137-203, 1992 May
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THE STRUCTURE OF SOUTHERN EXTRAGALACTIC RADIO SOURCES

PAUL A. JONES AND W. BRUCE McADAM

Department of Astrophysics, School of Physics, University of Sydney, NSW 2006 Australia

Received 1991 July 16; accepted 1991 October 9

Individual source observations: Combining Molonglo with Fleurs and VLA gave better results

Mon. Not. R. astr. Soc. (1977) 179, *Short Communication*, 51F-54F

A new determination of the position of the Vela pulsar

W. M. Goss and R. N. Manchester *Division of Radiophysics, CSIRO, Box 76, PO Epping, New South Wales 2121, Australia*

W. B. McAdam *School of Physics, University of Sydney, Australia*

R. H. Frater *School of Electrical Engineering, University of Sydney, New South Wales 2006, Australia*

Received 1977 February 21

Summary. Observations have been made with the Fleurs synthesis telescope at 1415 MHz and the Molonglo radio telescope at 408 MHz to determine the position of the Vela pulsar, PSR0833-45. When combined with earlier measurements, the new data give a mean position with rms errors of about 0.8 arcsec. This mean position is quite close to the optical identification suggested by Laizer (1976).

Mon. Not. R. astr. Soc. (1987) 226, 979-988

The very low-brightness relic radio galaxy 1401-33

W. M. Goss* *Kapteyn Astronomical Institute, Postbus 800, 9700 AV Groningen, The Netherlands*

W. B. McAdam *School of Physics, University of Sydney, Sydney, NSW 2006, Australia*

K. J. Wellington *CSIRO, Division of Radiophysics, PO Box 76, Epping, NSW 2121, Australia*

R. D. Ekers *National Radio Astronomy Observatory, PO Box 0, Socorro, NM 87801, USA*

Accepted 1987 February 10. Received 1987 February 10; in original form 1986 December 10

Summary. The very unusual steep-spectrum low-brightness radio source 1401-33 has been imaged using the Very Large Array (VLA) at 1.49 GHz and the Molonglo Observatory Synthesis Telescope (MOST) at 0.843 GHz. The source has an angular size of 20×9 arcmin² (240×110 kpc) and the spectral index lies in the range from -1.2 to -2.4. A compact radio source is associated with the 11.6-mag elliptical galaxy NGC 5419; it has been mapped at 14.92, 4.86 and 1.49 GHz with beams down to 0.6 arcsec and has no obvious connections with the extended source. The latter is most likely a relic radio galaxy, perhaps of the head-tail type, which is confined in the poor cluster around NGC 5419.

Seeking a gamma ray source 1706-44 with the Durham Cosmic Ray Group, Feb 1993

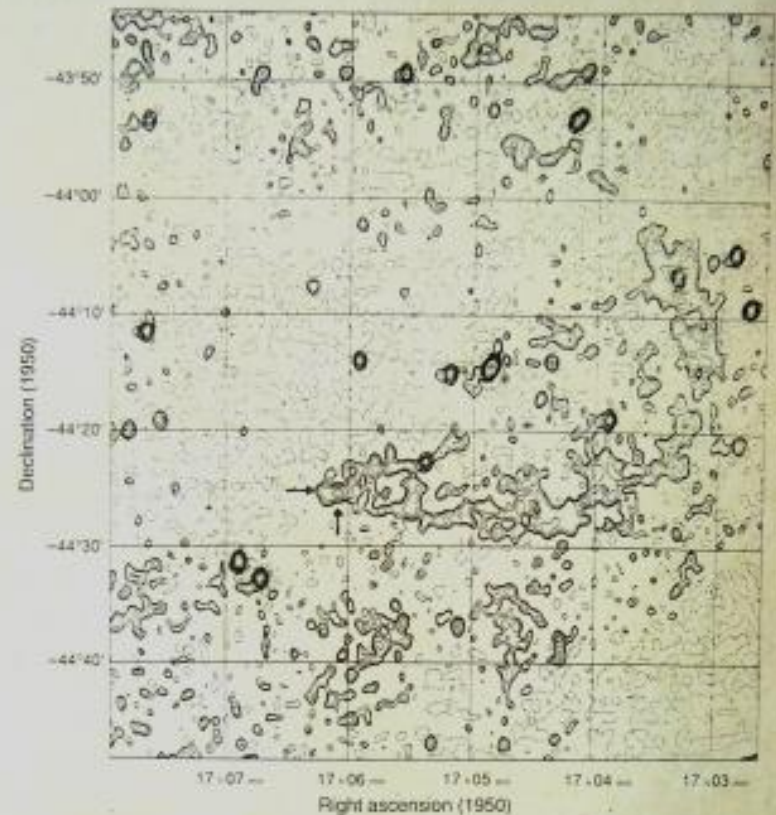
LETTERS TO NATURE

A supernova remnant associated with the young gamma-ray pulsar PSR1706-44

W. B. McAdam*, J. L. Osborne† & M. L. Parkinson†‡

* School of Physics, University of Sydney, New South Wales 2006,
Australia

† Department of Physics, University of Durham, Durham DH1 3LE, UK



The Centre of the Cross

Now, in 2013, the EW arm is the SKAMP
– the SKA Molonglo prototype

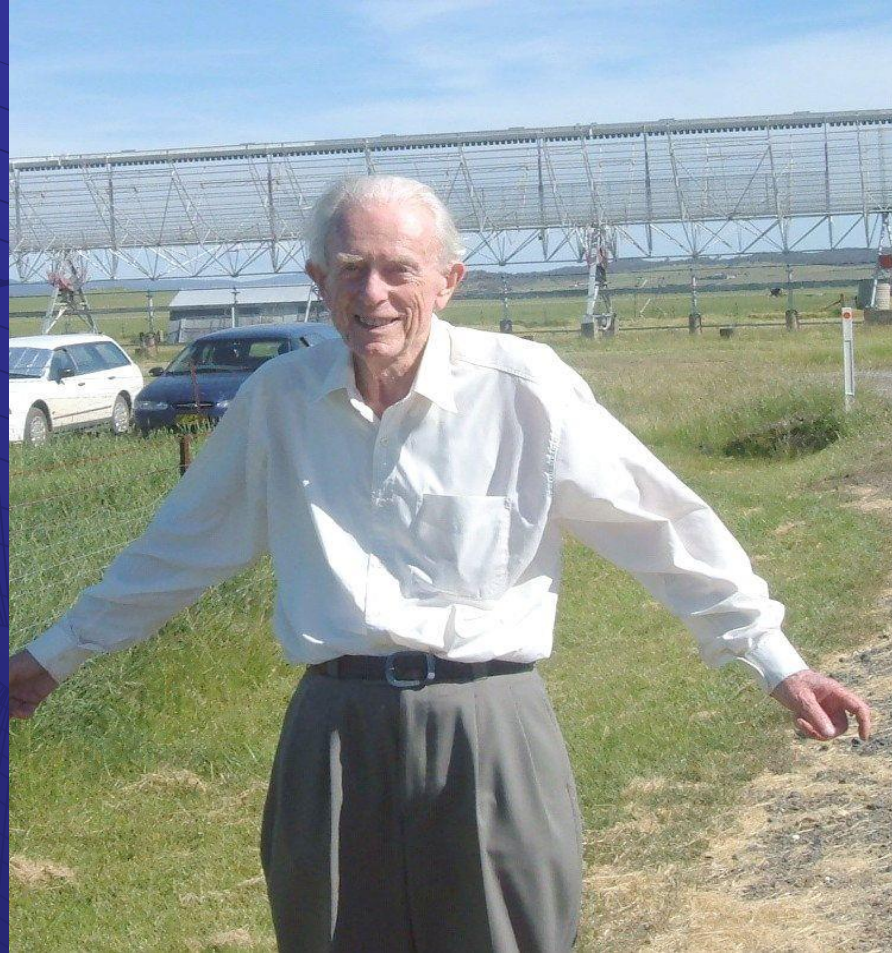


A Career in Summary

- ◆ **1936 Hillcrest Primary School**
- ◆ **1944 Hamilton High School**
introduction to electronics; gift of a 49 valve
- ◆ **1949 Auckland University College**
- ◆ **1950 assistant to E H Sagar; underwater acoustics**
- ◆ **1953 Temporary Part-time Junior Lecturer**
- ◆ **1955 NZ Defence Scientific Corps**
move to the Cavendish;
Martin Ryle, Tony Hewish, Graham Smith
- ◆ **1958 return to Naval Research Laboratory, Auckland**
- ◆ **1961 Sydney University: join Bernie Mills**
- ◆ **1993 Chair, Cosmology Distinction Course**
- ◆ **2009-11 Distinction Courses closed; retirement!**

The End – in memory of Bernie Mills

1920 - 2011



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