

THE WORLD'S FIRST FEMALE RADIO ASTRONOMER: DR ELIZABETH ALEXANDER, AND THE MYSTERIOUS 'NORFOLK ISLAND EFFECT'

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ABSTRACT: British-born and Cambridge-educated Dr Elizabeth Alexander was one of a number of individuals who independently discovered solar radio emission during World War II, while based in New Zealand. She also carried out a range of other research projects on radar and radio-meteorology, and wrote a series of 'secret' reports on these. In 1946, after the war, she published a short research paper on her solar radio emission project.

In this poster we provide biographical information about Dr Alexander and her investigation of what became known as the 'Norfolk Island Effect'. Largely thanks to WWII she happened to be in the right place at the right time to make an important breakthrough in what a few years later would be termed 'radio astronomy'. With the benefit of hindsight, we can now recognize Dr Elizabeth Alexander as the world's first female radio astronomer.

1. INTRODUCTION



During WWII scientists or radar staff in Australia, England, Germany, New Zealand and the USA all independently detected solar radio emission, although these discoveries, for the most part, remained 'Top Secret' until after the war.

The New Zealand discovery was made by Dr Elizabeth Alexander (left), who in 1942 was evacuated from Singapore to New Zealand, where she continued to carry out research on radar.

2. ELIZABETH ALEXANDER: A POTTED BIOGRAPHY

Frances Elizabeth Somerville Caldwell was born in England on 13 December 1908, but spent her early years in India, where her father was the first Professor of Chemistry at Patna Science College.

She returned to England for her secondary schooling, and then studied Physics and Geology at Cambridge, eventually graduating with a PhD in Geology.

During her doctoral years she met the New Zealander, Norman Stanley Alexander (1907–1997), who was studying for a PhD in Physics. They married and he was then appointed founding Professor of Physics at Raffles College in Singapore.

In Singapore Elizabeth (as she preferred to be known) worked for the Royal Navy, carrying out research on radar. On 4 January 1942, when the Japanese occupation of Singapore was inevitable, the Royal Navy evacuated her and their three small children to New Zealand, while Norman ended up a prisoner of war in Changi camp.

After the war Norman and Elizabeth eventually returned to Singapore, and the children stayed in England with Mary's sister. In 1952 Norman was appointed Professor of Physics at Ibadan University College and they moved to Nigeria. Elizabeth was a Junior Lecturer in the Agriculture Department.

Tragically, on 15 October 1958 she died from a stroke just two months before her 50th birthday, while trying to set up a Geology Department at the University College.

3. RADAR RESEARCH IN WELLINGTON



Once in Wellington, Elizabeth was appointed Head of Operations Research in the NZ Radar Development Laboratory, based in a nondescript office building (left).

She had her own experimental radar unit nearby, and was responsible for all RNZAF radar units. Her work included investigating any examples of 'anomalous' signals received at these radar stations. One of these was the mysterious 'Norfolk Island Effect'.

4. INVESTIGATING THE 'NORFOLK ISLAND EFFECT'

Between 27 March and 1 April 1945 there was an unexplained increase in 200 MHz 'noise' at the RNZAF radar station on Norfolk Island just after sunrise and before sunset.

This was dubbed the 'Norfolk Island Effect' and was investigated at the five RNZAF radar stations shown on the map, one on Norfolk Island, the others in Northland. Detections were made at all five radar stations (see the table), with Dr Alexander concluding that the emission derived from the Sun and was non-thermal.

Further monitoring between September and December 1945 only revealed solar radio bursts on several days in October.

Before leaving NZ in 1946 Dr Alexander wrote a 3-page paper on "The Sun's radio energy", which was published in the first edition of the new New Zealand journal *Radio and Electronics*. Elizabeth Alexander deserves to be recognized as the world's first female radio astronomer and an important part of New Zealand's scientific heritage.

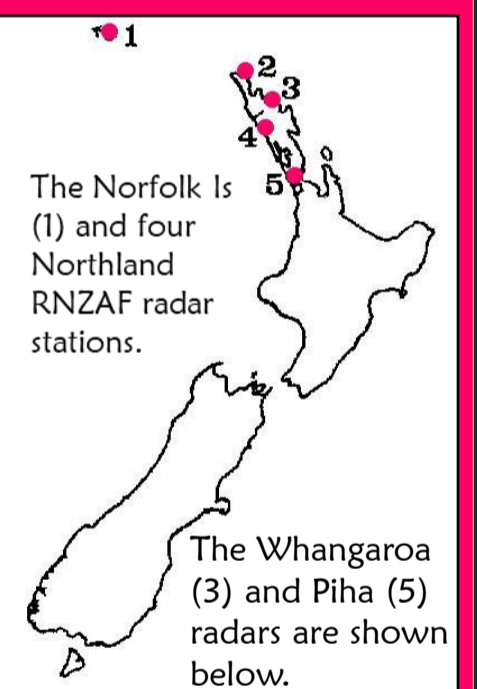
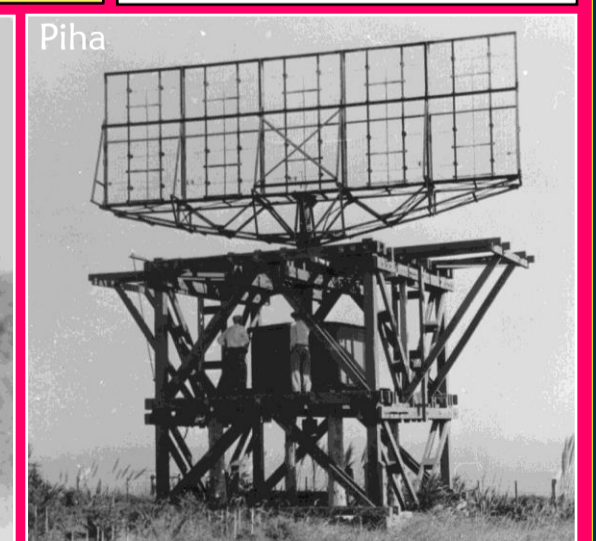


Table 1: Days when solar monitoring took place (●) and when solar radio emission was detected (⊙) at the different RNZAF radar stations

Radar Station	Date (April 1945)														Detection Days
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Norfolk Island			⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	5
North Cape		⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙						2
Whangaroa			⊙	⊙	⊙	⊙	⊙	⊙	⊙						5
Maunganui Bluff			⊙	⊙	⊙	⊙	⊙	⊙	⊙						5
Piha	●	●	●	●	●	●	●	●	●						3
Monitoring Stations	1	3	5	5	5	5	5	5	3	2	1	1	1	1	
Station Detections	0	1	2	2	3	2	2	2	2	1	1	1	0	1	



5. FURTHER READING

Fraser, G., 2017. The Norfolk Island Effect and the Whangaroa report. *Southern Stars*, 56(2), 11–17.

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