

Title: *Four Pillars of Radio Astronomy: Mills, Christiansen, Wild, Bracewell*

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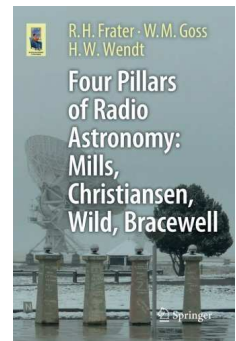
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Reviewer: Whitham D. Reeve



Readers interested in radio astronomy history should seriously consider acquiring this book. However, avoid the publisher and shop around at book sellers such as AbeBooks.com to find a more reasonably priced copy. The 38 USD price from the publisher is too high for such a small book, and buyers should be able to save quite a few bucks by shopping around.

Four Pillars of Radio Astronomy is written on the basis that the four so-named pillars, Bernard Mills, Chris Christiansen, Paul Wild and Ron Bracewell, developed the foundations of modern radio astronomy. As stated in chapter 1, Introduction, *They were unique as they started their journey in a small team immediately after WWII under the mentorship of Joe Pawsey. They would go on to establish worldwide reputations and the leaders in their fields, and the instruments and techniques they developed would underpin much of modern radio astronomy.* These four worked in research, industry and academia so they all had well-rounded experience, which was transferred to many others in various research fields, particularly radio astronomy.

The authors personally knew and worked with the book's principals, who did most of their radio astronomy work in Australia but also worked in other parts of the world. Their book is based on both personal and published accounts. The word *pillars* in the title metaphorically refers to the parabolic dish supports built at Stanford University by Ron Bracewell and were used for solar radio astronomy from 1962 to 1973. Ten of the original 32 pillars were moved in 2012 to the Karl G. Jansky Very Large Array in New Mexico and placed in the form of a sundial (SARA members had an opportunity to contribute to this effort). The image right shows SARA Vice President Tom Hagen contemplating the sundial while touring the facility during the 2017 SARA Western Conference in Socorro. Five pillars are visible and one of the VLA antennas can be seen in the right-background.



The book contains eight chapters and six appendices. An early chapter provides some basics and history of radio astronomy. A separate chapter is devoted to each of the four pillars. These describe the person's strengths in radio astronomy as well as their early life and some anecdotes about their activities. Mills' strengths were cross-

type radio telescope antenna arrays and radio sources associated with radio galaxies and Milky Way nebulae – *discrete sources*. A version of the Mills Cross antenna array was built in Maryland USA and was used by B. Burke and K. Franklin to discover Jupiter radio emissions in 1955. Christiansen's strengths were radio telescope design and Earth-rotational synthesis, Wild's strengths were radio astronomy and the Sun, and Bracewell's strengths were mathematics and imaging. The authors argue that, together, these individual strengths covered the full range of radio astronomy and immeasurably helped its rapid progress beginning shortly after World War II.

If the development of radio astronomy itself is viewed as a series of chapters, then a chapter in its development closed with the death of each pillar (all died between 2007 and 2011). Clearly, their legacies still endure. The book has numerous interesting black-white photographs of early radio setups and antennas. At times I wished for more technical detail in the descriptions of these facilities. References, including technical references, are provided at the end of each chapter and I attempted to locate several of them online; however, with a few exceptions, the papers I searched for seemed to be available only as paper copies in libraries in Australia.

It would be hard to believe that any serious student of radio astronomy would not have heard of Mills, Christiansen, Wild and Bracewell. I consider myself a serious student, so it is no coincidence that over the last ten years I have acquired and read many books and papers written by these men. These include Pawsey's and Bracewell's book ***Radio Astronomy***, which was originally published in 1955 [Pawsey]. I also have a copy of Bracewell's book ***The Fourier Transform and Its Applications*** originally published in 1965 and updated through 1986 [Bracewell]. Fourier transforms are used in many aspects of imaging, digital signal processing and antenna analysis.

Christiansen's co-authored book ***Radio Telescopes***, originally published in 1969 and updated through 1985, also is on my bookshelf [Christiansen]. Wild wrote as author and co-author many papers on solar radio astronomy, which is a favorite subject of mine. His work in the late 1940s and early 1950s established the theory behind and identified the different types of solar radio bursts, and it provided the foundation for future research on solar radio emissions and how the Sun works; for example, see [Wild-1, Wild-2 and Wild-3].

To be clear, many other people were heavily involved in the development of radio astronomy after World War II. From my perspective as an amateur who has studied radio astronomy for only ten years, assigning high status to a few important individuals chosen from a field of many would be a very difficult task. But maybe to the authors it was easy.

According to the authors, the four pillars influenced subjects beyond radio astronomy, and a chapter is devoted to this. The appendices cover a wide range of topics including *What is a Radio Telescope?*, *Supercomputing Cluster* (computer clusters in Australia named after various Australian radio astronomy pioneers), *Time Line of Key Events* in radio astronomy and a list of *Abbreviations*, among others.

Overall, I enjoyed reading ***Four Pillars of Radio Astronomy***, and I think others will too. For me, the book filled a number of gaps in my meager knowledge of radio astronomy history.

Citations:

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- [Wild-1] Wild, J. P. and McCready, L., Observations of the Spectrum of High-Intensity Solar Radiation at Metre Wavelengths, I. The Apparatus and Spectral Types of Solar Burst Observed, CSIRO Australia, 1950
- [Wild-2] Wild, J.P., Observations of the Spectrum of High-Intensity Solar Radiation at Metre Wavelengths, II. Outbursts, CSIRO Australia, 1950
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