

Title: ***Eyes on the Sky: A Spectrum of Telescopes***

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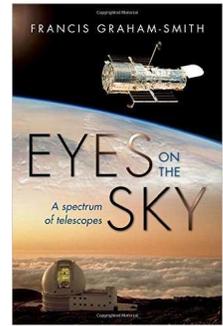
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Reviewer: Whitham D. Reeve



***Eyes on the Sky*** is an interesting but sometimes uneven nontechnical description of the telescopes used to study the sky. It is worth shopping around because the publisher's price is too high for the book's size and content. The author states that the aim of this book is "*to show how the techniques of observing over the whole of the spectrum are, in practice, closely related*". It starts with the visible spectrum and progresses upwards and then downwards in frequency. Upward frequencies are more conveniently discussed in terms of wavelengths and these are hundreds of nanometers ( $1 \text{ nm} = 10^{-9} \text{ m}$ ) to tens of picometers ( $10^{-12} \text{ m}$ ). Discussions of wavelengths longer than visible light usually are more convenient in terms of frequencies.

***Eyes on the Sky*** is a popular science book that covers a lot of ground at the expense of depth of discussion. I am not sure who the target audience is. Although the book uses no mathematics at all, a lot of the terminology will be unfamiliar to a lay reader. On the other hand, readers with some technical knowledge or a background in science or engineering probably will wish for more detail. I believe a typical reader is someone who is interested in what, where and when a particular telescope was used to observe the universe and no more. The book leaves out the how and why. Some discussions become bogged down in what seemed to me to be unnecessary details while others are quite thin in terms of details. Perhaps this shows the difficult task of writing a book like this and reflects my own bias. I found the author's discussions of the future of observing celestial electromagnetic radiation to be rather weak and not nearly as interesting as his discussions of the past and present.

Slightly more than half of the book covers infrared, visible, ultraviolet, x- and gamma-ray wavelengths, where gamma-rays are the shortest. The second half covers radio frequencies but substantial discussions go down only to the gigahertz range or so. Unfortunately and incorrectly, this book makes it appear there is no real radio astronomy below that. Another aspect of celestial observational science that is missing from ***Eyes on the Sky*** is gravitational wave detection. The well-publicized gravitational wave detectors do not use conventional large parabolic dish antennas or humongous mirrors and lenses. Nevertheless, they do depend on electromagnetic propagation for detecting the minute variations in space-time caused by the interactions of extreme celestial masses. Another recent method uses pulsar timing shifts to detect gravitational waves, a true dish antenna application. Even without mention of gravitational waves, the number of telescopes mentioned in this book is quite amazing if not bewildering.

The author has been involved in radio astronomy since the early 1950s, particularly in Britain. He is considered a pioneer but his nationalism and bias sometimes show through. As expected, his knowledge appears to be best of the places he worked (for example, Jodrell Bank). His emphasis in ***Eyes on the Sky*** is on the telescopes and techniques used to study cosmology with very little mention about the radio astronomy of our solar system. The book leaves the impression that all eyes on the sky are used to study the universe on grand cosmic scales

despite the fact much work has been done and is yet to be done to study our own solar system and importantly our own planet's space environment.

The book is easy to read and has many line drawings and black-white photographs and a couple handfuls of color plates, some of telescopes and others of celestial objects. For the most part I enjoyed reading it. The chapters are well organized, each covering a band of frequencies or wavelengths and discussing how celestial objects are studied in that band. The concepts of many telescopes are illustrated but these are somewhat uneven and, for me, not technical or detailed enough.

If nothing else, *Eyes on the Sky* does show the reader how much astronomy instrumentation has changed since Galileo Galilei built his first telescope just a few hundred years ago. It is interesting that this book spends some time discussing Galileo's scientific accomplishments but makes no mention of how those accomplishments got him placed under house arrest for the rest of his life by the unfortunate mixture of government and religion. Nowadays, all scientific research is funded by governments.

The author mentions many, many telescopes throughout his tour of the electromagnetic spectrum but some are notable by their absence. In particular, the Long Wavelength Array (LWA) is not mentioned at all, although its next-door neighbor the Jansky Very Large Array (VLA) is. Also, the Combined Array for Research in Millimeter-wave Astronomy (CARMA) and the solar observing radio telescopes at Owens Valley in California are skipped. Many space-based telescopes are mentioned but some more recent ones, particularly those dedicated to space weather research, are missing from the discussion.

I noted some important errors in the author's historical perspectives:

- ⊗ The author indicates that Arno Penzias and Robert Wilson were using a horn-reflector antenna to investigate radio noise associated with satellite communications when they discovered the cosmic microwave background radiation (CMBR) in 1964. The antenna originally was designed for satellite communications work but prior to their CMBR discovery, Penzias and Wilson had repurposed it to investigate at higher frequencies some earlier low frequency measurements indicating a large, radio-emitting halo around the Milky Way galaxy. They actually were engaged in radio astronomy when they discovered the CMBR, but they were not looking for it [Wilson];
- ⊗ The author says the number of dish antennas at the Very large Array in New Mexico was increased to thirty-six from the original twenty-seven (he does not say when). In fact, no dish antennas have been added and there still are only twenty-seven [NRAO];
- ⊗ The author briefly discusses Karl Jansky's discovery of the galactic radio background and gives the date of his discovery as 1933. In fact, Jansky noted the emissions in 1931 and investigated them in 1932 when he recognized their celestial origin. Jansky's paper describing his discovery was published in 1933 [Jansky].

#### Citations:

- [Jansky] Jansky, K., Electrical Disturbances Apparently of Extraterrestrial Origin, Proceedings of the IRE, Vol. 21, pg 1387, October 1933
- {NRAO} <http://www.vla.nrao.edu/>
- [Wilson] Wilson, R., The Cosmic Microwave Background Radiation, Nobel Lecture, 8 December 1978



**Reviewer** - Whitham Reeve is a contributing editor for the SARA journal, *Radio Astronomy*. He worked as an engineer and engineering firm owner/operator in the airline and telecommunications industries for more than 40 years and has lived in Anchorage, Alaska his entire life.