Book Review

By: Whitham D. Reeve

Title: ***Radio Astronomy Projects***, 3rd Edition
Author: William Lonc
Publisher: Radio-Sky Publishing (www.radiosky.com)
Cost: US$26.95 plus US$6 shipping in US
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Just about the time I think my radio astronomy library is complete, I find another book. Such is ***Radio Astronomy Projects***, available in paperback from Radio-Sky Publishing. It has 6 chapters and several appendices in 292 pages and covers general concepts, VHF, UHF and SHF projects (about 50 MHz to almost 13 GHz) plus miscellaneous projects and other useful information. The book has a good index, which sets it apart from many books published in the last 10 years, both professional and non-professional. It is interesting that used copies can be purchased for around US$100 from Amazon.com while new ones can be purchased from the publisher for only US$26.95.

The author, William Lonc of the Astronomy and Physics Department of Saint Mary's University in Halifax Canada, says in the Preface "the book is meant to be a resource for building and using small non-professional radio telescopes, especially in the microwave part of the spectrum". The book really is a series of previously published short articles (some as short as two paragraphs). I have two main complaints - the book chapters are not well bridged and projects lack continuity, and the book could have been clean up to improve the information flow. The author uses an easy-to-read conversational writing style, but sometimes the writing is a little awkward.

If you are looking for detailed step-by-step instructions for setting up a complete radio astronomy observatory, this book is not for you. On the other hand, it is a good book for your library and I recommend it because it provides a good introduction to many topics. The author makes no grand claims, such as "this is the last book you need to buy", and has provided exactly what he meant – a resource. As I read through the book, I found myself thinking about the concepts and then looking through other references for details and procedures.

In all, there are 86 "projects" in ***Radio Astronomy Projects***. I found that, because individual projects really are descriptions of a certain topic and not necessarily related to other topics, they do not always have high individual value. However, taken as a whole, the book is a good resource, and its sum is greater than its parts. The value of this book for some readers may lay in the simplified and brief project descriptions.

Chapt. 1 is called Some General Concepts in the Table of Contents but relabeled Basic Ideas in the chapter itself. It consists of 24 projects and takes up about a quarter of the book pages. The projects are thought and calculation projects. Included are projects applicable to both optical and radio astronomy. For example, the author describes the concepts of right ascension, hour angle and sidereal time. Because of the Earth's rotation and movement through space in its orbit around the Sun, extraterrestrial objects are not at a fixed azimuth and elevation. Therefore, if we wish to study a particular object we first have to locate it and then track it. As the author points out, an understanding of space coordinates based on right ascension, hour angle and sidereal time cannot be easily gained from a narrative or verbal description. It is necessary to draw pictures

and work through examples. I found his descriptions and illustrations very handy, although I feel they could have been more complete and there could have been more examples. There is no discussion of declination. Chapt. 1 also includes introductions to radio interferometers, polarization, black bodies and noise.

Chapt. 2 has eight projects in the VHF and UHF frequency bands, from a couple hundred MHz to around 12 GHz. A few of the projects reflect the author's access to C-band TVRO (television receiver only) satellite dish antennas at approximately 4 GHz. These types of antennas can be found in junk yards and out-of-service condition on some hotel properties. If you are like me, you get ideas and inspiration from the works of others, and I think this chapter provides enough information for you to get started in the right direction. One obstacle to beginners in amateur radio astronomy is not knowing what to expect or perhaps expecting too much from overly simplified projects. Whenever I read articles about radio astronomy, I oftentimes wonder what I should hear in the speaker or see on the chart and how I should interpret those sounds or chart traces. This is where some of the projects in Chapt. 2 will be useful to the reader. For example, Project #8 is an interferometer at 147.950 MHz using "off-the-shelf radio amateur items". The author discusses the setup, the problems encountered and resulting chart traces.

Chapt. 3 includes an interesting group of twenty-nine projects in the microwave spectrum. There are several projects using the 4 GHz TVRO antenna from Chapt. 2 and a "plumber's delight" setup in the Ku band (about 12 GHz). In fact, all the projects in this chapter take place either in the C-band or Ku-band and use common dish antennas and other items. By the time you are done with this chapter, you will have a pretty good idea what you can do with a dish antenna. This chapter also includes a description of a large home-made horn antenna somewhat similar to the horn antenna used by Ewen and Purcell when they discovered the 21 cm interstellar hydrogen line (the photo below shows their antenna, now on display at NRAO Green Bank).

Chapt. 4 is titled Miscellaneous Projects. It covers what appears to be a random collection of thoughts including temperature effects on radio telescopes, data logging and recording. Temperature effects probably limit the accuracy of amateur radio astronomy measurements more than anything else. We experience drifts in oscillator frequency and chart time bases and changes in chart baselines due to temperature effects. In the first project the author compares the temperature performance of a 6AL5 vacuum tube diode detector to a semiconductor diode. I recall using the Joint Army-Navy (JAN) equivalent to the 6AL5, the 5726, in aviation radio equipment. The results described in this chapter would not be too surprising to anyone who has worked with both tube and semiconductor technologies – the 6AL5 provided much better temperature stability than the semiconductor diode. The temperature dependence of semiconductor performance is well-known but, of course, their application as detectors is much simpler and much more reliable than vacuum tubes, proving once again that engineering and design are really just a series of tradeoffs. The author does not propose solutions to temperature problems but he does describe what can happen.

A project in Chapt. 4 on data logging briefly describes using a Radio Shack digital multimeter (DMM) with built-in logging capability. I felt the data logger application here was not very helpful even though all amateur radio astronomers need at least a DMM, and it makes sense to

get one with built-in data logging capability. Of course, most of data loggers require a connection to a PC but more expensive products have some data storage capability. Stand-alone data loggers can be built quite easily (for example, see the February/March 2010 issue of the SARA Journal). Other projects described in Chapt. 4 are too brief and of little value. For example, Project #8, Very Low Frequency Observations, is of very little value. A project involving a magnetometer caught my attention. The author said that "you too can have your very own terrestrial magnetic field observatory" but he provided no information on how to go about this.

Signal Processing Projects are covered in 25 pages in Chapt. 5. This chapter exposes the reader to some of the terminology and methods such as data averaging and autocorrelation. These are techniques for extracting weak emissions from noisy data, but the explanations are not in-depth and the unfamiliar reader will be left wondering how they work and how to use them. I think the author should have provided examples of the calculations involved or at least provided references for further study. On the other hand, these methods generally are needed for pulsar detection and cosmic microwave background measurements, and amateur radio astronomers who strive to simply see solar emissions on a Radio-SkyPipe chart or hear them in an audio recording do not need them.

Chapt. 6 contains descriptions of Student Projects. These are interesting to read because they provide a description of the equipment and techniques used as well as charted results and calculations. For example, Project #6 describes "Verification of Fringe Periodicity of a Two Element Radio Telescope." It is a nice supplement to the interferometer descriptions in Chapt. 1.

The appendices include such things as a brief list of strong radio sources, a chart for calculating local sidereal time (LST), sundial corrections (of questionable value unless you rely on a sundial), conversion between time and angles, and some excerpts from Karl Jansky's and Grote Reber's original papers. I found that the LST calculator is oversimplified and does not work without additional corrections if your geographical longitude is not close to the middle of your time zone. For example, Alaska covers an angular distance of 58 degrees or almost four hours of angle (UTC-9 to UTC-13), yet it has only two time zones with most of it in UTC-9. Using the author's calculation method for my location gave a 2 hour error.

In conclusion, I believe ***Radio Astronomy Projects*** is a good resource for the beginning amateur radio astronomer in spite of its shortcomings. The book describes many different projects that could be undertaken at a fairly low cost. Distractions are the lack of continuity from project to project and, in some cases, incomplete or overly brief descriptions.

Biography – Whitham D. Reeve

Whitham Reeve was born in Anchorage, Alaska and has lived there his entire life. He became interested in electronics in 1958 and worked in the airline industry in the 1960s and 1970s as an avionics technician, engineer and manager responsible for the design, installation and maintenance of electronic equipment and systems in large airplanes. For the next 37 years he worked as an engineer in the telecommunications and electric utility industries with the last 32 years as owner and operator of Reeve Engineers, an Anchorage-based consulting engineering firm. Mr. Reeve is a registered professional electrical engineer with BSEE and MEE degrees. He has written a number of books for practicing engineers and enjoys writing about technical subjects. Since 2008 he has been building a radio science observatory for studying electromagnetic phenomena associated with the Sun, Earth and other planets.