Book Review

By: Whitham D. Reeve

Title: ***Van Nostrand Momentum Book Series***
Publisher: Van Nostrand Company for the Commission on College Physics
Cost: A few US$ plus shipping
Date published: 1964 through 1967

In the mid-1960s, Van Nostrand Co. published a series of inexpensive, small books on various aspects of physics for the Commission on College Physics at University of Colorado, Boulder. These books "were conceived with a purpose . . . to serve the inquiring mind. . . . Each Momentum Book is a lucid and accurate analysis of an area of modern and classical physics." Each book is about 130 – 150 pages long and is written by one or two authorities in the field at that time. There are at least 19 books in the series, listed below, and they are available used from booksellers around the country (for example, go to: http://www.abebooks.com/).

Here are the books of which I know (* indicates I do not have):

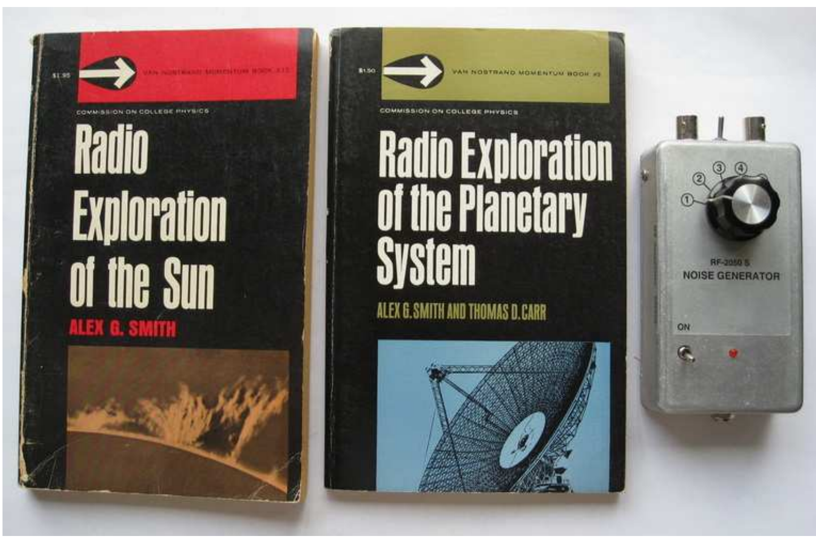
Volume No.	Title	Author	Pages	Year
1	Elementary Particles	D. Frisch, A. Thorndike	153	1964
2	Radio Exploration of the Planetary System	A. Smith, T. Carr	148	1964
3	The Discovery of the Electron	D. Anderson	138	1964
4	Waves and Oscillations	R. Waldron	135	1964
5	Crystals and Light	E. Wood	160 *	1964
6	Temperatures Very Low and Very High	M. Zemansky	127	1964
7	Polarized Light	W. Shurcliff, S. Ballard	*	Unk
8	Structure of Atomic Nuclei	C. Cook	142	1964
9	An Introduction to the Special Theory of Relativity	R. Katz		1964
10	Radioactivity and Its Measurement	W. Mann, S. Garfinkel	168	1966
11	Plasmas – Laboratory and Cosmic	F. Boley	154	1966
12	Infrared Radiation	I. Simon	*	1966
13	The Physics of Musical Sound	J. Josephs	*	Unk
14	The Freezing of Supercooled Liquids	C. Knight	*	1967
15	Radio Exploration of the Sun	A. Smith	159	1967
16	Magnetics	L.W.McKeehan	*	Unk
17	The World of High Pressure	J. Stewart	*	1967
18	Magneto-Hydrodynamics	N. Little	122	1967
19	The Winds	G. M. Hidy	*	Unk

You ask, why would I be interested in books that were written 45 years ago? For one thing, most principles of physics were discovered much longer ago than that and have not changed. For another, the books are short, light, well written, easy to read and, as a bonus, these books are real bargains.

I purchased 11 of the 18 in paperback for a few dollars each over a period of about a year. I believe hard-cover versions are available, too, but all the copies I see listed by used book dealers are paperback. The books I received all were in very good condition and all were library discards. Several still had their original library cards, and none of them had ever been checked out. Portions of some books may be a little dated, but they are well worth reading, particularly if you want an overview of some aspect of physics and do not want to plow through the math. Their short length makes them easy to read.

It is clear the authors were instructed by the series editor to keep the material understandable, and I think they did a good job. I find that many current technical books are either mathematically opaque, poorly written, full of errors, too expensive to bother with, or all of these. I enjoyed reading these books because they are from an era when authors and publishers did there job well, an era long gone unfortunately.

Of particular interest to amateur radio astronomers are Vol. 2, Radio Exploration of the Planetary System, and Vol. 15, Radio Exploration of the Sun (in photo below next to an RF-2050S noise generator). By the way, one of the authors of Vol. 2, Thomas Carr, was a founder of radio research at University of Florida. If you are like me, when you read a book about subject A that ties in with another subject B, you want to also read about subject B. An example of this is in Radio Exploration of the Sun. You cannot study the Sun for very long before you realize you need to know something about plasmas. That is where Vol. 11, Plasmas – Laboratory and Cosmic, comes in. Also, in your work with radio and radio waves, you need to know something about them. Vol. 4, Waves and Oscillations, covers the subject well. It turns out this volume has more algebra in it than the others, but I guess that is the nature of radio waves. In any case, the math in this book is easy to follow. When thinking about the Sun, stars and interstellar space, you find yourself thinking about very low and very high temperatures. Well, Vol. 6, Temperatures Very Low and Very High, covers them in an understandable way. When you think about charged particles moving about in planetary and stellar magnetic fields, you can find easy to understand and helpful information in Vol. 8, Structure of Atomic Nuclei.



Vol. 2, Radio Exploration of the Planetary System, is the first of these books that I ordered. In fact, it is the first book on radio astronomy that I ordered after I started to participate in the Radio Jove project in early 2008. I actually read it twice, once after first receiving it and again about one year later. To indicate the breadth of subject matter, here is a list of chapters: 1. The Beginnings of Radio Astronomy; 2. Tools and Techniques of the Planetary Radio Astronomer; 3. Thermal Radiation from the Moon and Planets; 4. The Radio Spectrum of Jupiter; 5. The Origins of Planetary Radio Signals; 6. Radar Astronomy; and 7. Radio Astronomy and the Space Age.

Each chapter has about a dozen references (mostly books written by pioneer researchers) and there is a General Bibliography at the end with another dozen books listed. I subsequently ordered several of the references from used book sellers at very low prices.

The 28 page chapter on Jupiter was written less than 10 years after Jupiter emissions were first identified by B. Burke and K. Franklin. It is the only chapter devoted to a single planet, indicating the significance of Jupiter to radio astronomy. The chapter includes several histograms showing the existence of Jupiter's three radio sources, A, B and C, and a very nice drawing of the cone of radiation by a hypothetical Jupiter ionosphere. There is an interesting discussion on the possibility of solar stimulation of Jupiter's noise storms counteracted by a chart showing the inverse relationship between sunspots and the average probability of Jupiter radio emission. The authors conclude by saying that there is some indication of a short-term, positive correlation between individual Jupiter storms and solar activity, while there is even clearer evidence of a long-term, negative correlation. The authors are careful to not take sides on this issue. Such correlations are not mentioned today (as far as I know). There is a lot of good, basic information in this chapter. Some of the details have been superseded by the exponential increase in our knowledge of Jupiter emissions since 1964, but that does not detract the reader looking for a basic understanding of planetary radio.

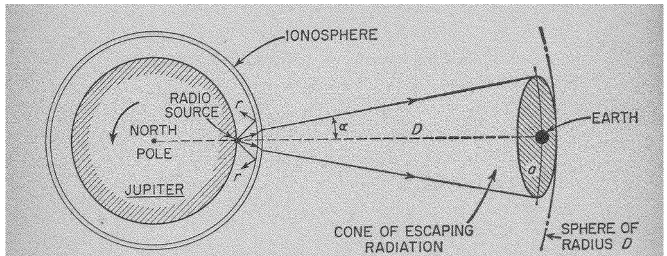
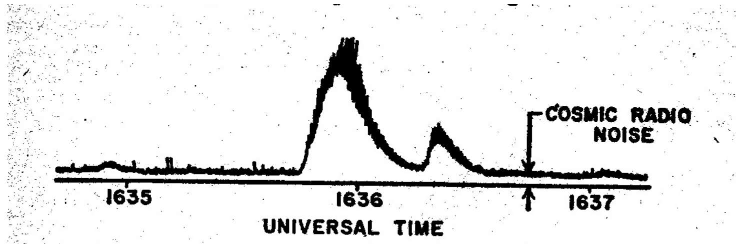


FIG. 4-4 Formation of a cone of radiation by a hypothetical Jovian ionosphere (distances not to scale).

Most amateur radio astronomers who observe Jupiter radio emissions also observe solar radio emissions because the same radio setup can be used for both. Therefore, Vo. 15, Radio Exploration of the Sun by Alex Smith, should be of interest. The book follows the same layout as Vol. 2, probably because it had the same author. Here are the chapters: 1. How it Began; 2. Physics of the Sun; 3. Instruments of Solar Radio Research; 4. Radio Signals from the Quiet Sun; 5. Radio Signals from the Active Sun; 6. In the Moon's Shadow; 7. Echoes from the Sun; 8. The Earth and the Sun. Again, there are about a dozen references at the end of each chapter, and each chapter also includes a list of books "For Further Reading" (something missing from Vol. 2).

Chapter 2 has a section called "Amateur Observations of the Radio Sun." Today, we know that a large group of sunspots near the center of the Sun's disc indicates favorable conditions for reception of solar emissions by an ordinary shortwave receiver. However, maybe that was not so obvious in 1967. Here is what the author says: "*The sound that we are listening for is a rapid increase in the hissing noise, succeeded by a smooth*



decline to the original level, often following the rather typical form of the events shown (right)*. If a signal is suspected of being station interference it can quickly be identified by a slight retuning of the receiver, which will eliminate a station but not the broad-band solar noise.*"

Also described here is an early (1964) attempt at using satellites to study the Sun – the Orbiting Geophysical Observatory, OGO. The advantage to using space probes was apparent then – to eliminate the detrimental effects of the Earth's ionosphere on reception at decameter wavelengths (frequencies below around 20 MHz). OGO was launched into an orbit that took it as far as 93,000 miles and as close as 175 miles from Earth. It had a long antenna similar to a tape measure – coiled at launch and unfurled in orbit. However, the antenna failed to fully deploy and blocked the horizon scanner's view of the Earth, As a result the satellite itself failed to stabilize properly in orbit. Such were, and still are, the risks of space flight. Not mentioned in the book because they were launched after it was written, the OGO series actually consisted of six satellites launched between 1964 and 1969.

Chapter 4 has an understandable discussion of brightness temperature, starting first with the concepts of blackbody radiation. We are shown the radiation curve from Planck's law over very short wavelengths (0 – 3,000 nm) with the Sun's actual measured curve overlaid on it. The chart also shows the Rayleigh-Jeans approximation, which closely approaches Planck's law at longer wavelengths (frequencies below, say, approximately 50,000 GHz). The author then explains the idea of brightness and brightness temperature. Brightness temperature is the temperature of an emission source (such as the Sun) on the assumption that it radiates as a blackbody. Brightness temperature is a handy concept in both optical and radio astronomy even though it may not be known if the source being observed actually behaves like a blackbody. When we say a source has a brightness temperature of, say, 100,000 kelvin at a certain frequency, we are saying its brightness (flux density per unit solid angle) is the same as if we were observing a blackbody at that temperature.

Amateur radio astronomers frequently hear that the Sun has emitted a certain type of burst, such as a Type II or Type III burst. In fact, there are five burst types, and these are explained very well and without any mathematical fanfare in chapter 5. The Sun's radio emissions include synchrotron and cyclotron radiation. Both are caused by a similar mechanism where electrons spiral around magnetic field lines at their gyrofrequency. Since the spiraling electrons are constantly accelerated, they radiate, a process called cyclotron radiation. If the electron has an initial energy in the relativistic range, where its speed is a significant fraction of the speed of light and its apparent mass has noticeably increased as a result, it will radiate not only at its fundamental gyrofrequency but also at a number of harmonics. The more nearly the electrons approach the speed of light, the more numerous and prominent the harmonics become. Eventually the fundamental frequency disappears and all radiation is concentrated in a very large number of closely spaced harmonics that merge to form a broad continuum. This type of radiation is called synchrotron radiation.

There still was a lot of mystery in the Sun when this book was written. Now, 43 years later, we have a much better understanding of it, but there still are many mysteries to solve. The equipment capabilities of amateur radio astronomers today far surpass the equipment capabilities of the 1960s, especially in terms of downstream signal and data processing. By reading how things were done then and comparing to what we can do today, we can have a lot of fun and learn to improve our techniques and data at the same time.

If you would like to read additional reviews of older but relevant books as well as about current books on radio astronomy, please send me an email.

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.

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The list of books on page 1 of this review was updated on 7 October 2018 with information provided in an email from Stephan Lange.

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