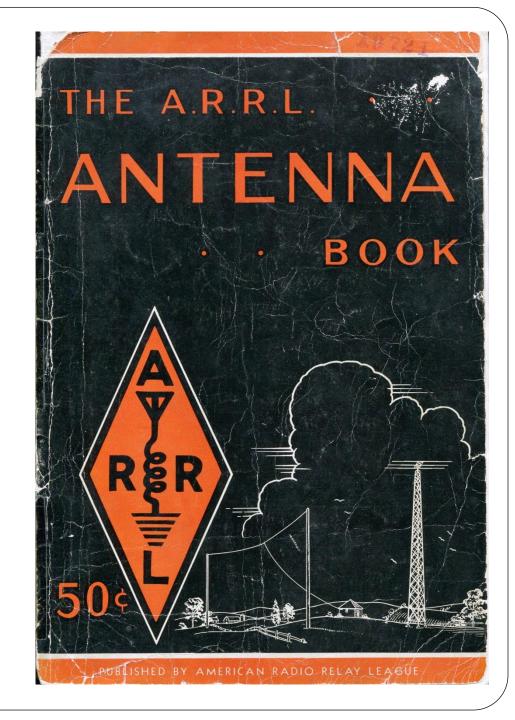
The ARRL Antenna Book in the Internet Age

Ward Silver NØAX

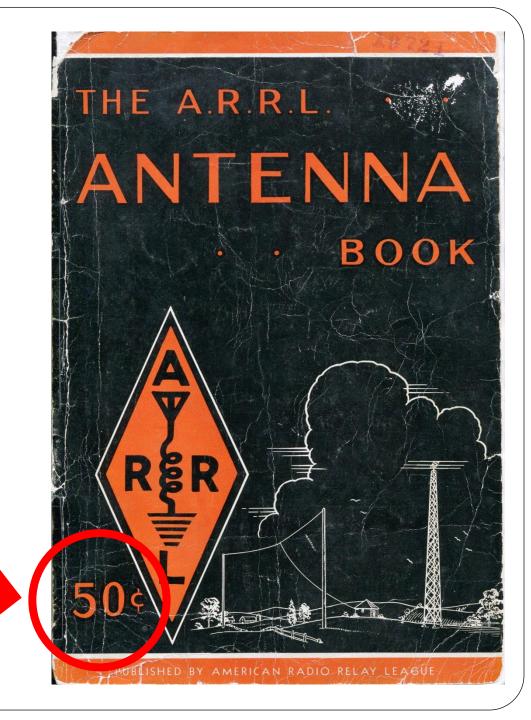
Dayton Hamvention 2016 – Antenna Forum

Some History

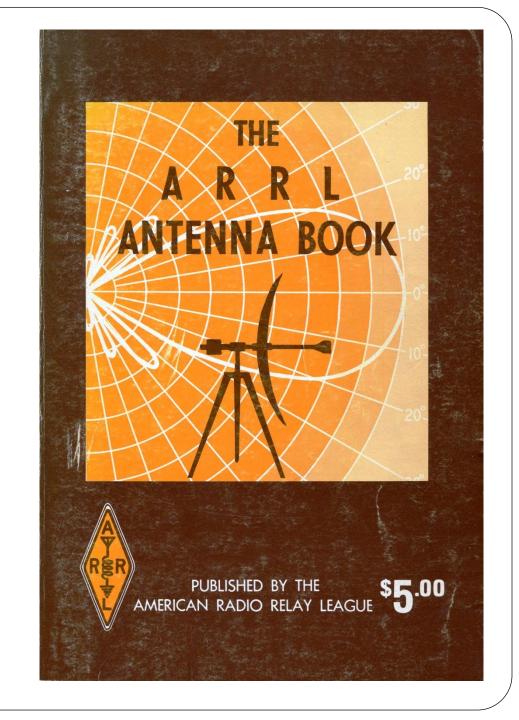
- First Edition 1939
- Edited by QST
 Technical Editor,
 George Grammer
 W1DF and Asst QST
 Technical Editor,
 Byron Goodman
 W1DX
- 139 pages (about the size of a single issue of *QST*)



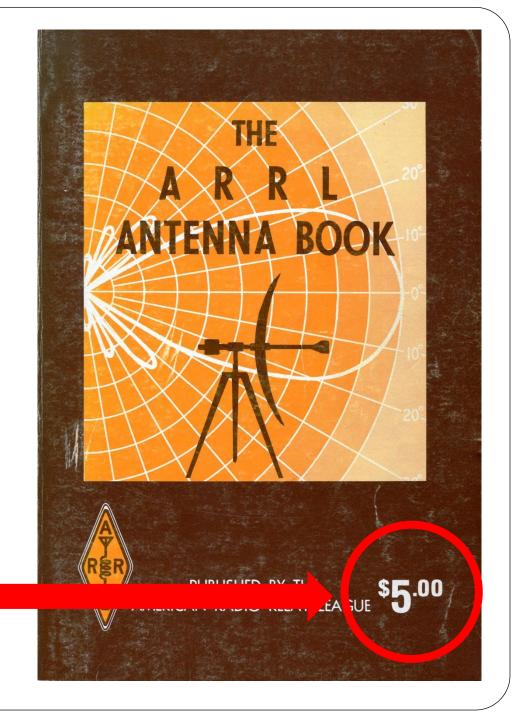
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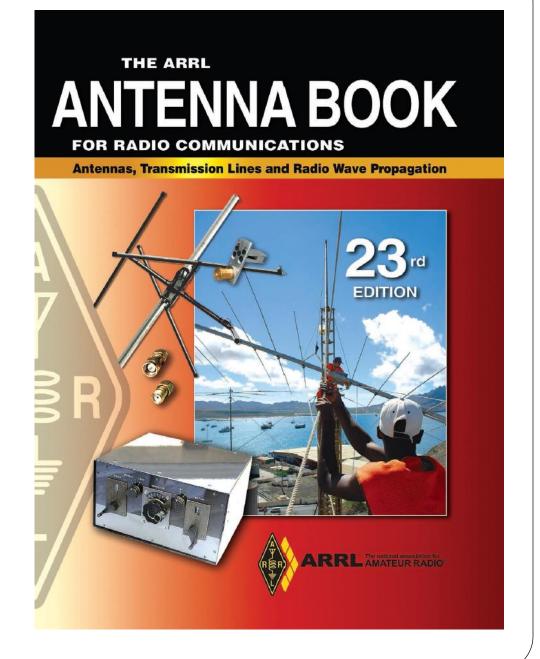
- 1950-70's editions (this is the 13th edition - 1974)
- Edited by Gerry Hall K1TD
- 336 pages
- Reflects changes brought about by WWII advances
- Coaxial cable, aluminum, traps, rotators!

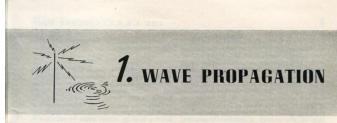


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- Coaxial cable, aluminum, rotators!
- More changes



- Current size and format
- Many excellent editors, most recently Dean Straw N6BV
- More than 1000 pages
- Comes with CD-ROM and supplementary website but it's still ≈ 4 pounds...oof!





POLARIZATION-GROUND AND SKY WAVES-THE IONOSPHERE-ULTRA-HIGH FREQUENCIES - WAVE PROPAGATION AND THE ANTENNA

to why this or that type of antenna is better than another are to be found in the nature of radio waves and the ways in which they travel. The behavior of waves of different frequencies gives the clue to the important points in antenna design, besides being an interesting subject in its own right. With a few fundamental facts in mind, much that on the surface is highly mysterious becomes susceptible to reasonable explanation; thus an elementary knowledge of wave propagation not only leads to a clearer idea of what to expect, but also may be the means of avoiding false conclusions

Unlike transmitting or receiving apparatus, radio waves cannot be seen or touched. We know them only indirectly, by their effects. We know that they travel with the speed of light (300,000 km., or 186,000 miles, per second in vacuum), that they are electro-magnetic, and that they can be refracted and reflected.

Electro Magnetic Waves

The energy in a radio wave is divided equally between an electrostatic component and a magnetic component. The electrostatic lines of force and the corresponding magnetic lines are always at right angles to each other. Imagine, for instance, a lattice-work of horizontal an vertical strips; if we call the vertical strips t electrostatic lines of force then the horizon strips will represent the magnetic lines. whole lattice - that is, the plane containing set of crossed lines - would represent the front, and the direction of the wave tra always perpendicular to the wave front.

The intensity of the wave is usually exp in microvolts per meter, which is a measure the dielectric stress produced by the electro component, or the voltage induced in a cond one meter long held at right angles to the mag component.

Polarization

The direction of the electrostatic lines of force, or field, is also the direction of polarization of

THE answers to many of the questions as the wave. For instance, a wave with its electrostatic field vertical is said to be vertically polarized, and one with its electrostatic field horizontal is said to be horizontally polarized. An antenna which generates a vertically-polarized wave is itself said to be vertically polarized, and one which generates horizontally-polarized waves is said to be horizontally-polarized. That is, the polarization of the antenna is the same as that of the waves leaving it. The polarization of a high-frequency antenna is also the same as its position with respect to the earth's surface; in other words, a vertical antenna is vertically polarized and a horizontal antenna horizontally polarized.

Waves of low frequency travelling along the ground usually maintain their polarization in the same sense as generated at the antenna. At high frequencies, however, the polarization of the wave may change during travel. In fact, the polarization usually varies, sometimes quite rapidly, and often i ifferent paths.

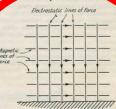


Fig. 1 — Representation of the electromagnetic and electrostatic fields of a vertically-polarized radio wave travelling along the ground. The arrows indicate the instantaneous directions of the fields for a wave travelling perpendicularly out of the page toward the reader. Reversal of the direction of one set of lines would reverse direction of travel, but there is no change in when both reverse.

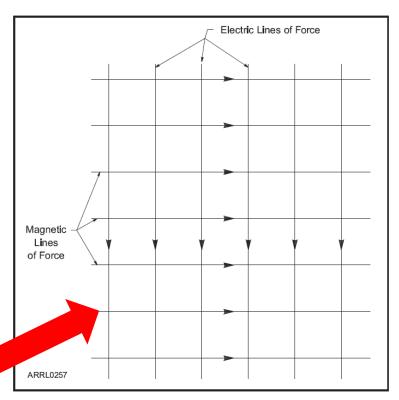


Figure 1.3 — Representation of electric and magnetic lines of force in an electromagnetic wavefront. Arrows indicate the instantaneous directions of the fields for a wavefront in a wave traveling toward you, out of the page. Reversing the direction of one of the fields would also reverse the direction of the wave.



As in the case of light waves, the angle of reflection is the same as the angle of incidence, so that a wave which strikes the surface at an angle of, for instance, 15 d from the same angle.

effected waves combine with the s, or those radiated at angles above orizontal, in various ways, depending upon t

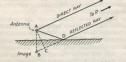


Fig. 301 - At any distant point, P, the field strength will be the resultant of two rays, one direct from the antenna, the other reflected from the ground. The reflected ray travels farther than the direct ray by the ce BC, where the reflected ray is considered to ate at the "image" antenna.

the height of the antenna, its length, and the character of the ground. At some vertical angles above the horizontal the direct and reflected aves may be exactly in phase - that is, t num field strengths of both waves at the same time at the same s of the fields are the sa angles the two waves the two. At other ve may be completely out of phase - that is, the fields are maximum at the same instant and the directions are opposite, at the same spot — so that

the distant point can be considered to be parallel. The reflected ray travels a greater distance in reaching P than the direct ray does, however, and this difference in path length accounts for the effect described in the preceding paragraph. If the path of the reflected ray is exactly a half wave longer than the path of the direct ray, the two waves will arrive out of phase. This correspond the condition illustrated in Fig. 203. C

f the path of the reflected re h longer than that changed from the ground, oth a perfectly-conducting

Image Antennas

ten convenient to use the concept of an tenna to show the effect of reflection. As shows, the reflected ray has the same ngth (AD equals BD) that it would if it ted at a second antenna, of the same charstics as the real antenna, but situated below



Fig. 302 - Horizontal and vertical half-wave an

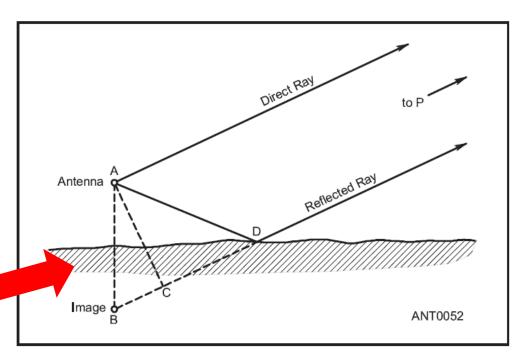
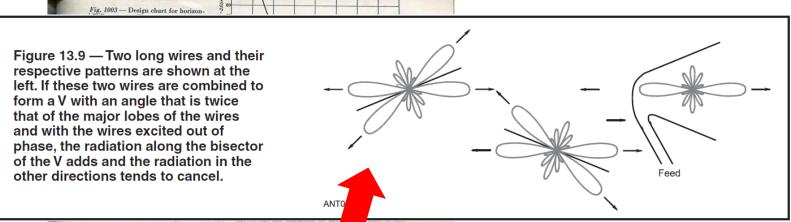


Figure 3.38 — At any distant point, P, the field strength will be the vector sum of the direct ray and the reflected ray. The reflected ray travels farther than the direct ray by the distance BC, where the reflected ray is considered to originate at the image antenna.



ground slopes, the antenna should be made parallel to the ground and preferably with the open end of the V down the slope.

The gain of the V beam can be increased by stacking two beams one above the other, a half-wavelength apart, and feeding them so that the legs on one side are in phase with each other and out-of-phase with the legs on the other side. This will result in a greatly lowered angle of radiation. The bottom V should be at least a greatly labelength above the precent of t

Two Paragrams can be broadsided to form a "W" greater gain. However, two feed lines are quired and this fact, plus the five poles required

normally employed by amat stricts the use to one band, all to be quite effective in company work.

The V can be made uniodic by terminating the o
ground through resistors,
dissipate almost half the p
and the ground connecti
one. Because of the prac

one Because of the prac

details a solution of the V to
resistors must
it to the antenna
be an excellent
iculties involved,
ed, although they

Feeding the

The V beam is most conveniently fed by feeders, since they permit multi-band operation

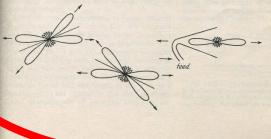


Fig. 1002 — Two long wires and their respective patterns are shown the left. If these two wires are combined to form a "V" whose angle is twice that of the major lobes of the wires, and the wires are excited out-of-phase, the radiation along the bisector of the V adds and the radiation in the other

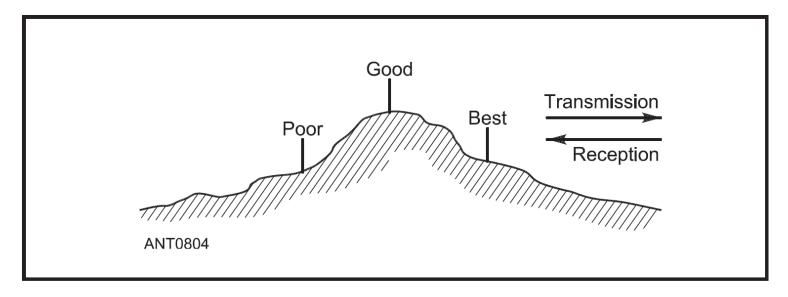


Figure 4.5 — Propagation conditions are generally best when the antenna is located slightly below the top of a hill on the side facing the distant station. Communication is poor when there is a sharp rise immediately in front of the antenna in the direction of communication.

New in the 23rd Edition

New Stuff!

- High-performance at VHF/UHF by GØKSC
- Expanded treatment of HF ground effects by N6LF
- MF, LF propagation update by K9LA
- HFTA data set generation service by K6TU
- Grounding and bonding of antenna systems
- Updated tower work and safety by K4ZA
- Harmonic filters using coaxial stubs (W2VJN, K9YC)
- NEC-2/NEC-4 and 4nec2 comparison by W8WWV
- Radial articles from *NCJ* by K3LC

More New Stuff!

- Wide-band 80/75 meter antennas
- Multi-band antennas
- Moxons and Extended Double Zepps
- High-performance VHF/UHF beams by GØKSC
- Low-band receiving antennas
- More satellite antenna systems
- More balun designs and examples
- Software www.arrl.org/arrl-antenna-book-reference
- Lots of supplementary material on the CD-ROM

New Areas to Cover

- Better treatment of "grounding"
- UHF and microwave antennas
- Continue to improve ground effect treatment
- How to account for the effects of terrain
- Mobile and portable antennas
- Stealthy installations
- Advances in receiving antennas and arrays
- Size and shape-adjusting antennas
- Meta- and other new materials

Antenna Book Philosophy

Philosophy to Date - One-stop Shop

- Basic theory and principles, including propagation
- Design equations and evaluation methods
- Best current practices in common uses
- Antenna and tower safety, tools and hardware
- Grounding, bonding, electrical safety
- "Reference" antenna designs
- Collections of "cookbook" designs
- Properties of materials

Antenna Technology Expansion

First Edition

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Thirteenth Edition

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23rd Edition

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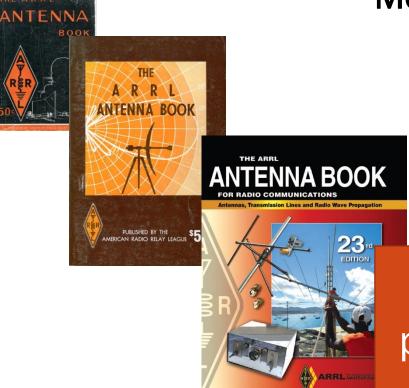
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Gain Reference Project Index Author's Index



More bands & modes



2000+
pages and
20+
pounds
????

I Don't Think So!

Challenges Going Forward

Challenges Going Forward

- Enormous amounts of material is available on-line (some of it is even true...)
- Most people under the age of 50 prefer electronic format on laptops, tablets, smartphones, ???
- Information is not hidden or expensive
- Paper takes longer to get and is expensive to store and deliver (and heavy)
- What are the *essential elements* that make a reference useful?

What is the Antenna Book For?

- Who is the "average" ham?
- What does the average need to know?
- What about the expert ham?
- What about the brand-new ham?
- What does the reader need to learn?
- How can the Antenna Book teach it?

These are all important questions!

Antenna "Book" Essentials

- <u>Curated</u> material, reviewed by experts, selected for the particular application (i.e. ham radio)
- Teaching materials that are <u>effective</u> for the particular audience (i.e. hams)
- Best practices distilled into reference applications, <u>readily adaptable</u> to individual circumstances
- <u>Reference designs</u> that identify important design decisions, assumptions, and criteria
- Available to hams at a <u>reasonable cost in the format they</u> <u>want</u>

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The New Reality

- Print is going away we <u>all</u> just have to get used to the idea
- Publishing reference works in the digital age is a hard problem if you can't give it away!
- Will curating and editorial review survive? Your support will be the answer...TBD!

The Antenna Book – 24th Edition

• Needs material on DIRT!



As dirty as a little boy!

THANK YOU!!!