The AZ-Special

A no-Compromise 88-foot 80-to-15-meter antenna

BY L. W. AURICK,* K3AZ

A RECENT move to a suburban subdivision found the writer with the usual problem of how to get the most out of limited antenna possibilities; do it with a minimum expenditure of money; obtain some gain where possible; and provide flexibility of use for most of the lower-frequency bands, 80-through 15-meters.

This appeared to be a tall order considering the typical third-of-an-acre we inhabit; with more than its share of trees (none of them properly located with respect to antennas), and a self-imposed restriction of no poles in the front yard.

Towers and triband beams were ruled out since the present condition of the sunspot cycle argued against a large investment at this time for an antenna system that would have only limited use on the higher frequencies. Furthermore, a compromise in the form of an "inverted V" would likely have to be made for both 80-and 40-meters, using the tower as the center support. That is, if the tower could even be located so as to serve this function.

The first solution was a commercial "all-band" vertical, and the addition of thirty-two carefully laid radials lying just beneath the grass. The antenna did "work" on all bands. but the lack of gain, as well as the location of the maximum radiation point (maximum current loop) at ground level left much to be desired. Back to the books.

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A compromise began to suggest itself in the form of a 66-foot 40-meter antenna which would also work on 15-meters. Practically everyone used something like this more than twenty years ago when 15-meters first became available. Fed with coax, it would "work" on both 15- and 40-meters, with an acceptable v.s.w.r. Fed with open-wire tuned feeders it would function as a two-section colinear (two-half-waves in phase) on 20-meters. This antenna would offer about 2 db gain on this band. While tuned-feeders of the correct length would permit the antenna to load and function on 75/80-meters, the efficiency of such a short antenna would not offer as much as the typical "inverted V". Then too, there is no gain on 15-meters where the antenna currents in adjacent sections are out of phase.

It began to appear that if the number of elements and phasing sections (to make the elements work in phase and produce gain) would work out to the right dimensions, the colinear could be the answer. With this type of an antenna, particularly if multiband operation is contemplated, one starts out by designing for the highest frequency band and accepts whatever the laws of physics provides

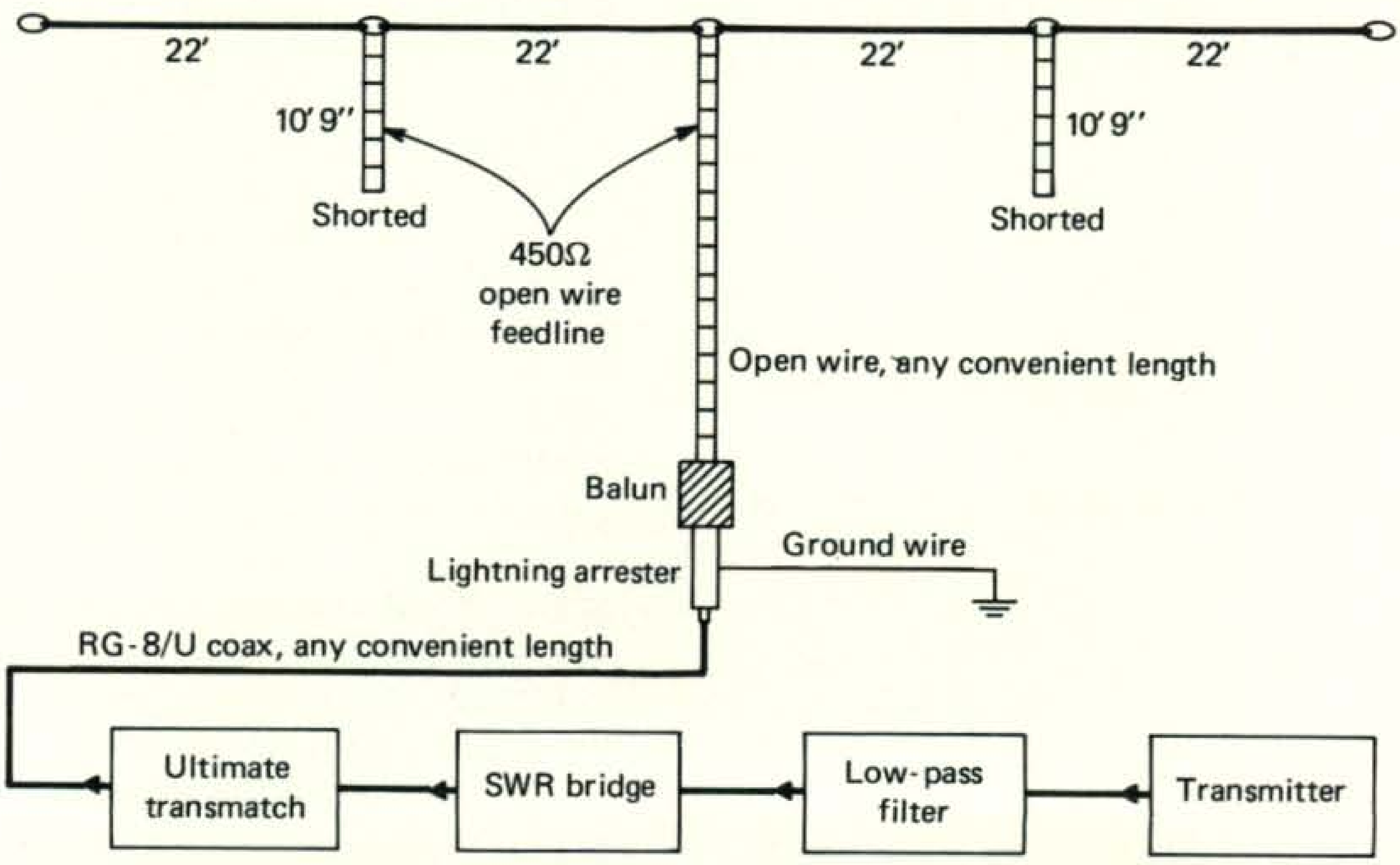

Fig. 1—The AZ-Special 80 through 15 meter no compromise limited space antenna.

for use on the other bands.

Was it possible that there was such a combination of frequency relationship, antenna length, and phasing section length, that an antenna could be put together to serve 80-to 15-meters, and even produce some gain?

Following a review of colinear antenna theory (2-, 3-, and 4-element designs) everything suddenly fit together to solve the particular requirements which had been established. No claim is made by the writer as to the originality of this design. The antenna has probably been around since the days of Hertz and Maxwell. However, except for the two-element version previously discussed, nowhere in the antenna literature has this amateur seen it suggested that an antenna of this type offered real multiband possibilities. As a bonus, there are no heavy and expensive loading coils to heat up, or load up with ice, and there is honest gain to be had on several bands.

The Solution

The antenna about to be described has been up for about 18 months and has given an excellent account of itself on all bands from 80- to 15-meters. Casual descriptions on-the-air have created considerable interest and so many requests for details that it was felt that this antenna should be set down for the benefit of hose with similar requirements. All the more so when one considers that an entire generation of hams now exists with little, if any, antenna knowledge beyond the commercially manufactured triband beam.

The configuration of the antenna is shown in fig. 1. It is a four-section colinear (four-half-waves in phase) on 15-meters. It is characterized by broadside radiation, that is, at right angles to the antenna, and is bi-directional on all bands. The four, 22-foot long, 15-meter half-wave sections contribute approximately 4 db gain. These sections, totaling 88-feet, also determine the overall length of the antenna. Between the inboard and outboard half waves, each side of center, there is a 10-foot 9-inch phasing section. These one-quarter wave phasing sections reverse the phase (current and voltage distribution) in the next (outboard) half-wave section so that the currents in each section are flowing in the same direction (in phase).

20-Meters

On this band, as on all of the others (except 15-meters), the phasing sections function as part of the antenna. They radiate, and contribute to the short length of the antenna. The antenna functions here as four-half-waves (each of them 32-feet, 9-inches long, which includes half of a phasing section), but not in phase. The two wavelengths (one each side of center) cause the lobes of maximum radiation to appear at approximately 45-degree angles to the antenna. At K3AZ the antenna is broadside NE and SW, and it seems to work well, on this band, in the anticipated directions of North, East, South and West. Central and South American, as well as African, European, US West Coast, Hawaiian, and Australian stations have reported favorably on the antenna, particularly when one considers the current state of the solar cycle, and the resultant generally poor band conditions.

40-Meters

Here, the antenna, electrically 65-feet, 6-inches long each side of center (including the phasing sections), performs as two-half-waves in phase. Such a two-section colinear configuration theoretically provides approximately 2 db gain. On-the-air reports from domestic as well as DX stations indicate that this is the best 40-meter antenna this operator has ever used.

75-80 Meters

On this band the antenna (electrically 131 feet long) functions as an ordinary half wave dipole. All the electrical length is there, and there are no lossy coils responsible for its modest 88-foot expanse. Reports from throughout the U.S. and Canada as well as from European s.s.b. stations, average S9. This, with a modest 500-watts input.

Feeding the Array

The antenna is fed with 450-ohm open-wire line of the type commonly used today in TV installations. This line is readily available from Lafayette Radio and is stocked under their numbers 32 E 36130 in 100-foot coils; 32 E 36148 in 250-foot coils; and 32 E 36155 in 500-foot coils. The phasing sections are made of the same type of line and are permitted to dangle straight down. The line is "light," and it takes a rather strong breeze to move it.

One thing that the user of this antenna will have to accept as a fact of life is the substantial waves that will be present on the feedline. However, as W2DU and others have been telling us for some time, this does not cause a loss of power to the antenna when low-loss feedline is used. And this open-wire line is as low-loss as anything you are ever likey to see. The only loss is in the normal resistance of the wire itself, which is negligible, and you are never going to find a way to overcome this, anyway.

Make the feedline any convenient length to reach the shack, or a point outside, where you can convert from the balanced line to an unbalanced line by means of a balun. At K3AZ the feeders drop approximately fifty-five feet to the roof of a porch where they are connected to a W2AU ferrite balun. The balun is connected to a coax lightning arrester and a heavy wire is run from there to an 8-foot copper ground rod. RG-8/U coax runs from the other side of the coax-lightning arrester for approximately 35-feet, down the side of the porch, through the foundation to the basement, and up through the shack floor, behind the operating desk. Here the coax is terminated in an Ultimate Transmatch. The transceiver always looks at 50 ohms, and the v.s.w.r. between the Transmatch and the antenna is just ignored.

There are virtually no losses in the 450-ohm open-wire line, and the losses in the short length of RG-8/U coax are too small to even consider. As countless other amateurs still do, the writer, a purist at heart, was once committed to flat, or tuned lines. OK. Have your flat line and unity v.s.w.r. if you are using a long run of coax, but forget about it if you are using open-wire line, and want to take advantage of a real multiband antenna.

Summary

The use of the Ultimate Transmatch is the key to the practicality of this antenna. The writer would never be without one again. The balun is necessary for the obvious need to convert from the balanced to unbalanced feed, and the one used here does a fine job.

The antenna is supported between a 50-foot telescoping TV mast and a 50-foot "A" frame. It is truly a no-compromise 80- to 15-meter antenna. Just one limitation. The antenna must be mounted entirely horizontal. If the antenna is hung in an "inverted V" configuration there will be no gain on 40- and 15 meters.

If you don't have room for the 88-foot flattop, don't let that stop you either. At K3AZ there was only about 75-feet between the masts. Nine feet at each end were permitted to hang down. These ends were secured with an insulator and a light piece of nylon cord to keep them from flapping in the breeze.

This antenna has worked so well on each band, and at so little cost or effort, it will likely continue to be used even if more space becomes available at some future date.

Hope you'll give the AZ Special a try. If you do, please let me hear from you. ■

The Plumbers Delight

BY SAM GUCCIONE,* W3GVP

HAVE you ever wondered why the standard coaxial line impedance is 50 ohms? I have many times. Some years ago, I stumbled upon an excellent explanation of why 50 ohms is the standard. It goes something like this.

In a low loss coaxial transmission line, the only important dimensions are the inside diameter (i.d.) of the outer conductor, D, and the outside diameter (o.d.) of the inner conductor, d. Two characteristics of transmission lines which depend upon the ratio D/d are the characteristic impedance (Z_o) and the attenuation due to losses in the metallic conductors. The characteristic impedance is given by the familiar formula:

$$Z_o = \frac{138}{\sqrt{\epsilon_r}} \log_e D/d$$

where ϵ_r is the relative dielectric constant of the dielectric material between the inner and outer conductors. A normalized plot of the attenuation[1] is shown in fig. 1. The minimum attenuation occurs for a Z_o of 77 ohms.

Two other important transmission line characteristics which are functions of D/d (that is, Z_o) are the breakdown voltage and the power carrying capacity. The breakdown voltage as a function of Z_o is shown in fig. 1. The highest breakdown voltage occurs at a Z_o of 60 ohms.

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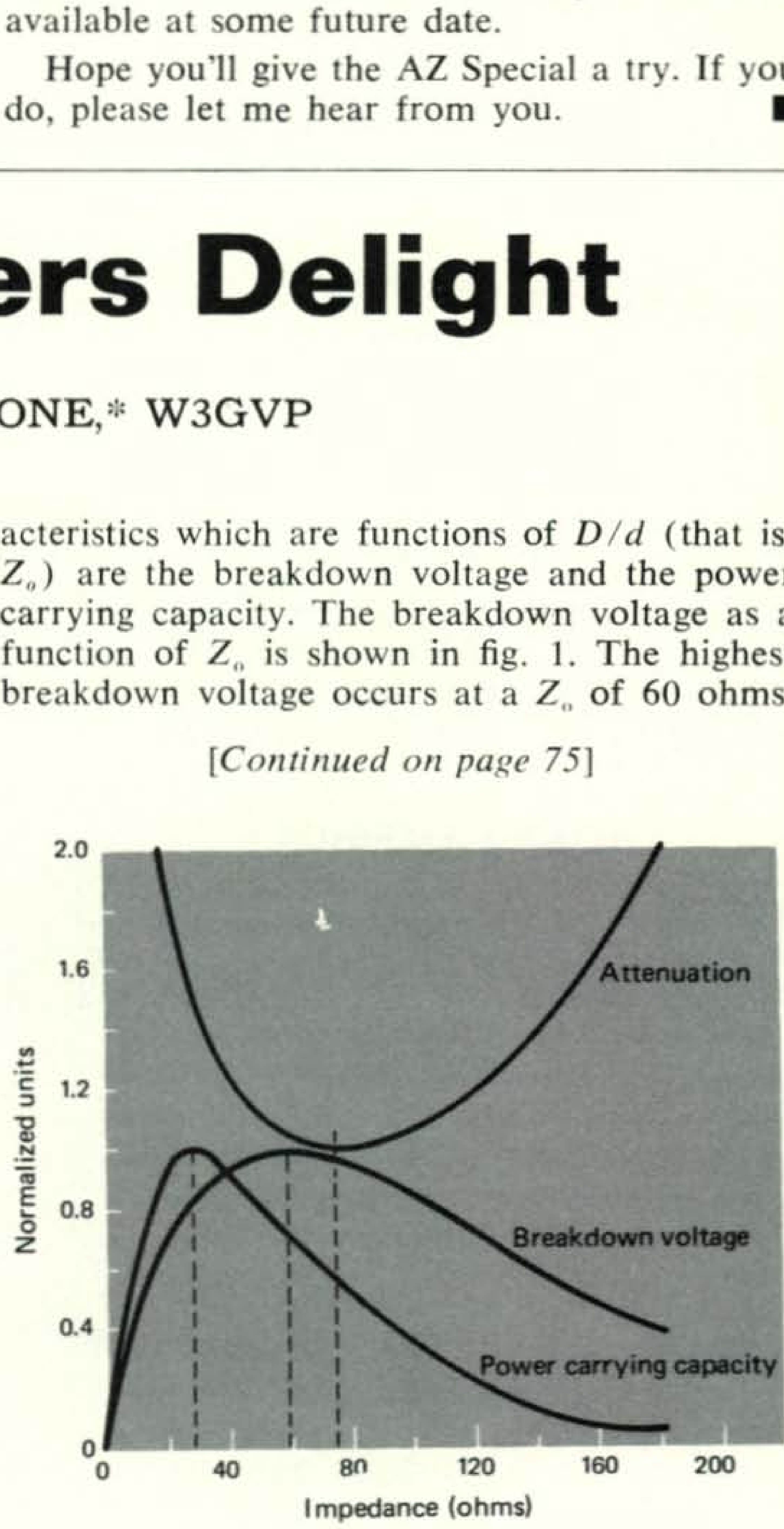

Fig. 1—Transmission line properties versus Impedance.

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[1]T. Moreno, *Microwave Transmission Design Data*, Dover Publications, New York, pp. 63-65.