One hundred sixty meters is at its best in the wintertime, so if you're even thinking about operating on "Topband," have we got an antenna for you!

A Coaxial Inverted-L Antenna For Topband

BY DR. THEODORE J. (TED) COHEN,* N4XX

Given the wavelengths involved, installing an effective transmit antenna for the 160 meter band is no trivial matter. The antenna discussed here was first described by Coleman Rollman, W4TWW, in the August 1984 issue of CQ *magazine. We thought we'd let Ted Cohen, N4XX, present a somewhat different view of what he has found to be a fantastic performer on Topband, and show you how he squeezed it into his one-third acre suburban lot. —W2VU*

Among the many goals one could set in amateur radio today, working DX on the 160 meter band certainly would be one of the more difficult to achieve! Challenges abound, resulting not only from the propagation observed (*see, for example, the article on Topband propagation by Ted and Cary Oler that was published in the March and April 1998 issues of* CQ *[Note 1 below].—ed.*), but also from the need for large transmit and receive antennas. Living in an urban or suburban area makes "working" the band even more difficult, but there are solutions that can provide some surprising results. Suffice it to say that the coaxial inverted-L antenna described here yielded 100 countries—worked *and* confirmed—plus WAS (Worked All States) during the Topband season that extended from September 1, 1996 through March 31, 1997.

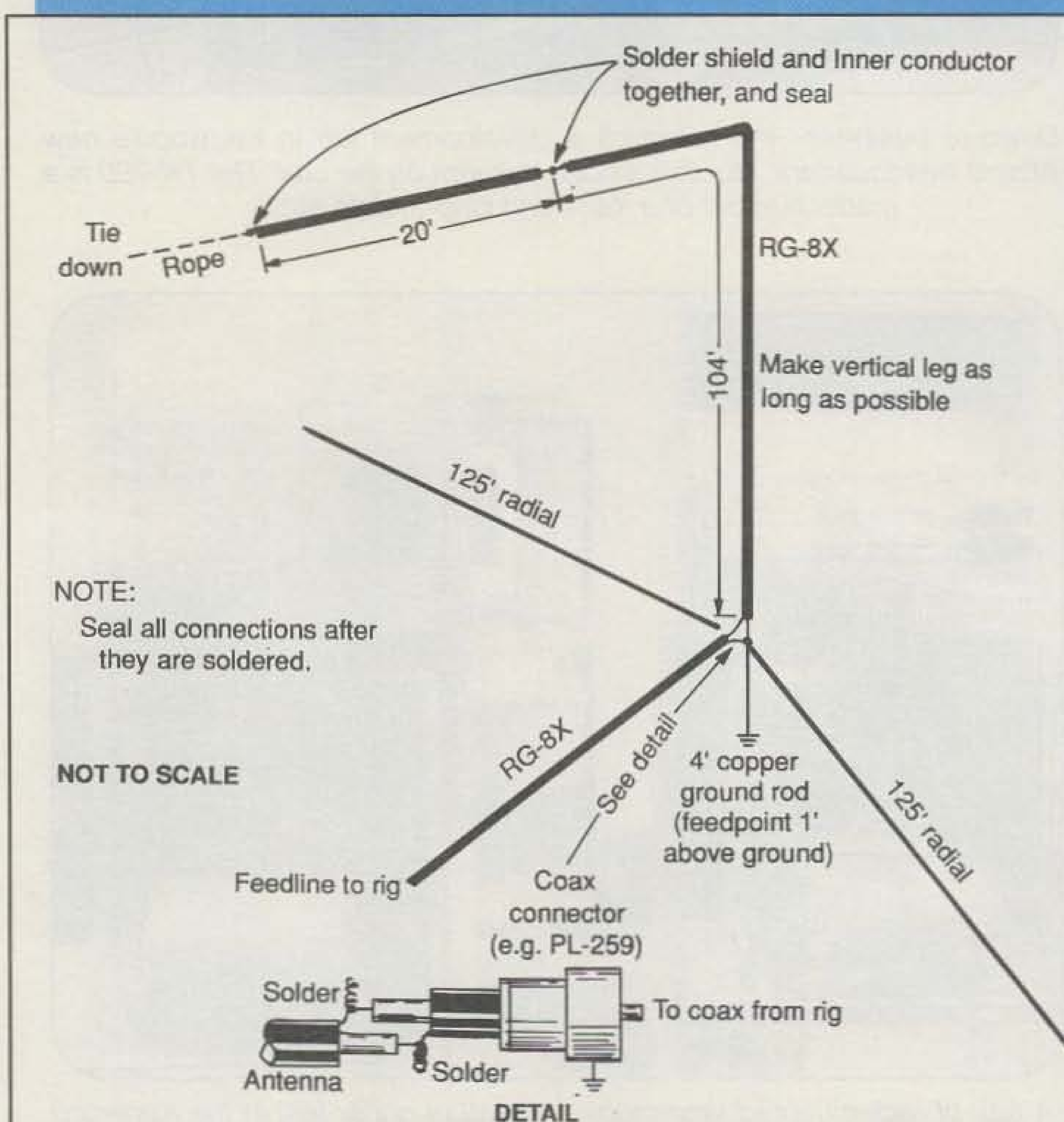

Fig. 1– A key step in constructing the Coaxial Inverted-L antenna is to invert the inner conductor and the braid of the coax at the feedpoint.

Antenna Design

The antenna, shown in fig. 1, is a 124 ft. coaxial, inverted-L. It bends at about the 70 foot level (thanks to a big black oak!) and runs to the 80 ft. level (thanks to a big white oak!). It then drops 10 feet or so; the end is tied to a fence using a slack nylon line. The antenna is made entirely of RG-8X, and it is shorted at the 104 ft. point (based on the velocity factor for this coax) as well as at the end. *The feed is inverted at the base, so the outer conductor of the coax antenna becomes the radiator* (see fig. 1).

I installed six 125 ft. and five 62.5 ft. (12 AWG, insulated) radials, bending

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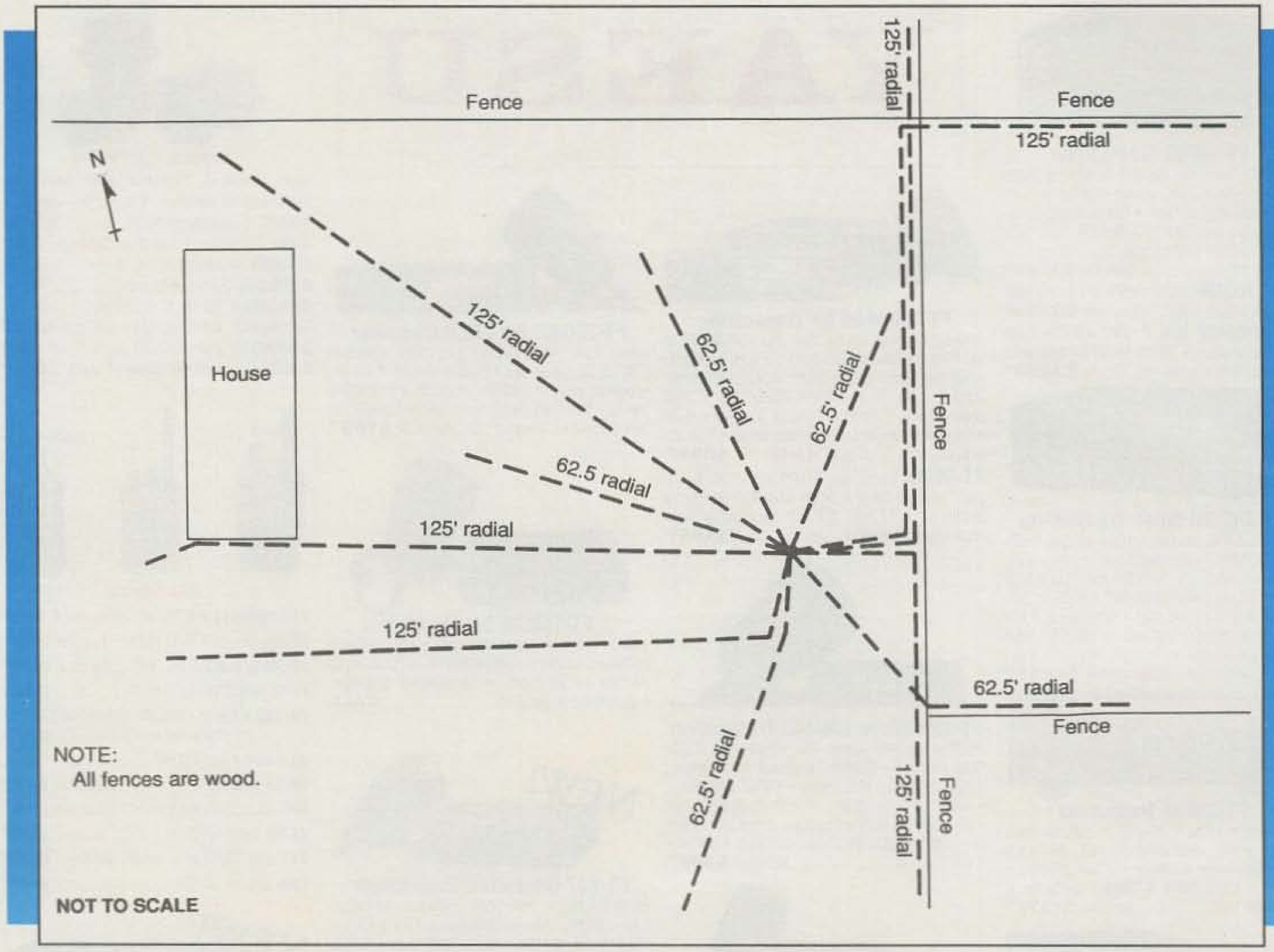

Fig. 2– The radial pattern of the 160 meter inverted-L at N4XX. What is important is to lay out as many radials as possible, so a large number of short radials is better than a few long ones.

them, as necessary, to go around trees and other obstacles (see fig. 2). Some of the radials are buried at a depth of 4 inches, while others run along my neighbors' fence lines. They are dispersed in azimuth as uniformly as was possible, but one could hardly call the pattern "ideal." Note, in particular, the paucity of radials to the east, toward North Africa. At the feedpoint, the antenna is tied to a 4 ft. RadioShack ground rod, which basically serves as a tie-down for the antenna and its radials. I used bungee cord (with a loop of coax) to take the strain off the antenna and to let it ride up and down as the wind moves the tree limbs. This is a better solution than using a weight and a pulley at the end of the antenna, given the number of children in the neighborhood and the attendant need to keep such a weight high off the ground.

The SWR is about 1.3:1 at 1830 kHz. It was higher before the full complement of radials was installed. I simply added radials until the SWR was sufficiently low as to provide tuner-free operation. With a good radial system, neither inductors nor capacitors, nor a tuner, should be required to tune the antenna.

How It Works

The antenna is one-half of a coaxial dipole (also referred to as a "double bazooka"). This antenna is recognized for providing a good impedance match over a wide range of frequencies *for its band of operation.* (Note: This is a single-band antenna.) According to Morris Lundberg, K4KEF, it was designed by the staff of the Massachusetts Institute of Technology (MIT) during WW II for radar applications (see <http://pacnet.ne.mediaone.net/resources/bazooka.txt> for more information). The outer shield of the antenna operates as a quarter-wave vertical. The inner conductor, which does not radiate, acts as a quarter-wave shorted stub. As such, it presents a high resistive impedance to the feed point at resonance. Off resonance, according to Lundberg, the stub reactance changes in a way that increases the bandwidth of the antenna. The shorted length of coax (or other conductor) beyond the short near the end of the antenna acts as a thick extension of the radiating element, which also acts to increase the bandwidth.

On-the-Air Results

The first contact with the new antenna was with John, ON4UN. For the conditions that existed at the time, the 500 W signal from the inverted-L was 10 dB stronger than was the signal from a six-band (160–10 meter) trap dipole that I had installed at the 40–45 ft. level (also in the trees). This contact was followed by QSOs with ON9CIB, CT1DVV, SM5EDX, C6A/N4RP, KP2/KW8N, and P40W, all worked on CW (the mode of choice on Topband!) and on the first or second call. As noted above, the inverted-L, which serves as both my transmit and receive antenna, quickly netted 100 countries, worked and confirmed. And while Topband conditions over the past two seasons have been relatively poor, my DX totals today stand at 154 countries and 30 zones—and all thanks to the great performance of the coaxial inverted-L.

Other Considerations

Where the inverted-L antenna is shorted depends on the type of coax you are using. For example, if I had used RG-8, with a velocity factor of .66, the short would have been (roughly) at the 88 ft. point, although the total length of the antenna would have remained at 124 ft. You can use any type of wire beyond the short, including twin-lead (shorted at both ends and tied to both the inner conductor and outer shield at the end of the coaxial antenna line), wire, coax (shorted at the end), and so forth. You do need to install at least one or two quarter-wave radials. The more radials you can put out, the better. Thus, for example, it is better to put out ten short (e.g., 1/8-wavelength) radials than two 1/4-wavelength radials. (See notes below if you are considering the possibility of erecting an antenna of this type).

Conclusions

Working Topband is a challenge! Propagation, in many ways, is unlike anything you will experience on the 80–10 meter bands, antennas are necessarily large (long), and competition for DX QSOs grows with each passing year. When all is said and done, however, achieving DXCC and/or the lowest rung on the WAZ ladder (30 zones) on this band is viewed by many as being among the most rewarding achievements of their amateur careers.

Bibliography

1. Oler, C. and T. Cohen, "The 160 Meter Band—An Enigma Shrouded in a Mystery," *CQ*, March (Part I) and April (Part II) 1998 (readers may access this article on-line through the web site of the Solar Terrestrial Dispatch: <http://www.spacew.com/cq/html> or click on the html link within <http://www.spacew.com/cq>).

2. The total antenna length in feet is given by 230/F (F is in MHz). Thus, for an operating frequency of 1.85 MHz, the length is ~124 ft.

3. The total coax length required in feet (to the point where the antenna is shorted or another type of wire is used) for a velocity factor of 0.66 (RG-8) is given by 162.5/F (MHz). This is ~ 88 ft. at 1850 kHz. It is at this length (height) that the coax should be shorted. It also should be shorted at the 124 ft. point (the tip of the antenna). If desired, other wire can be used beyond the 88-ft. point to bring the total length of the antenna to 124 ft.

4. RG-8X has a velocity factor of 0.78. Using this type of coax, the antenna should still be 124 ft. long, but it should be shorted at the 104 ft. point. (For RG-8X, the coax length in feet (base to short) is given by [(492)/2]*0.78}/F, where F is in MHz.)

5. Inverted-L antennas for other bands are, of course, fashioned in the same manner.

Acknowledgements

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