Easy Antenna Reference

Quick basics for a quick decision.

Keith Woodward VK2AT
19 Dolphin Ave.
Taree NSW 2430
Australia

If you're a beginner, or find yourself moving to a new QTH, a most important consideration is what antenna can be erected for the bands on which you intend to operate. The purpose of this article is not to give designs down to every last nut and bolt, but to discuss some basics and point you in the direction of an antenna that may meet your needs. And while these suggestions are mainly related to the HF bands, all the antennas here may also be used for VHF operation.

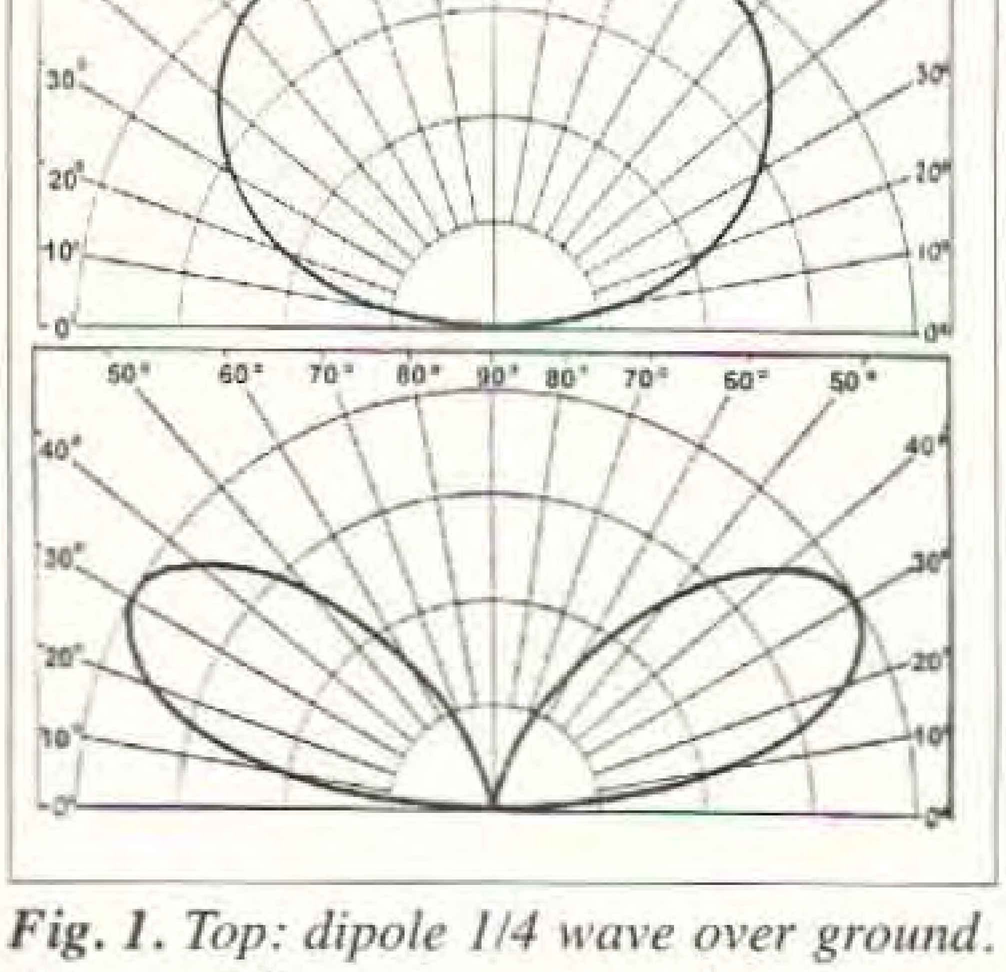

Fig. 1. Top: dipole 1/4 wave over ground. Bottom: 1/2 wave over ground.

The most basic antenna is the half-wave dipole. Most amateurs just run their half-wave dipole up the flag mast and see how it waves. The results that may be achieved with this simple antenna deserve some consideration. If you refer to **Fig. 1**, you will notice that the radiation pattern of the antenna will vary considerably with height. In the case of a quarter wavelength above ground, a large amount of your transmission will be confined to high-angle radiation. Increasing the height to one half-wavelength will lower the radiation angles considerably.

If you wish to confine yourself mainly to close contact, within, say, 1000 miles, then the lower height is of no concern. To extend this range then, if possible, elevate the antenna to around the half-wavelength mark. Reference to **Table 1** will show approximate heights above ground for the common HF bands. You can see why some tall trees, or artificial supports, will be handy for the lower frequency bands. Another consideration with antennas close to the ground, and other objects, is the loss from absorption or shielding. If this cannot be avoided, then go ahead and enjoy the results obtained.

I personally have enjoyed many QSOs using very low dipoles, necessary because of the restrictions of city and suburban allotments. However, long-distance contacts over 1000 miles were the exception rather than the rule on the lower frequency bands then being used. On occasion I have deliberately used very low dipoles on 3.5 and 7.0 MHz to obtain "local" coverage with excellent results.

With reasonable elevation, angles of radiation can be lowered by vertically stacking two dipoles. A simple method

HEIGHT	160	80	40	20	15	10
1/2 WAVE	83.3	41.7	21.1	10.6	7.1	5.3
1/4 WAVE	41.7	21.0	10.6	5.3	3.6	2.7

Table 1. Typical heights for horizontal dipoles. All figures are in meters and rounded off to one decimal place.

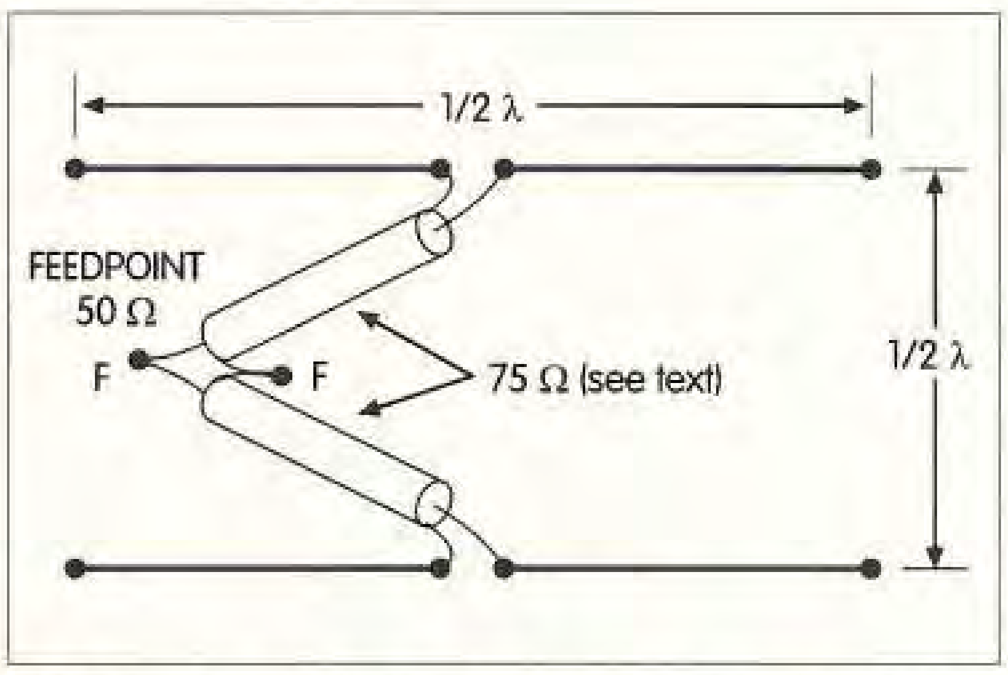

Fig. 2. Stacked dipoles. Approximately 2.5–3 dB gain, lowered angle of radiation, simple matching, broad horizontal figure-8 lobes.

of doing this is shown in **Fig. 2**. Please note that when calculating the matching harness, the correct velocity factor must be taken into consideration. With a nominal velocity factor of 0.66, then two 5/4 wavelengths are required for the matching harness. With a higher velocity factor such as 0.80, it would be possible to use two 3/4-wavelength sections. The size of this array does limit it to the higher bands. The gain of 2.5–3.0 dBd plus the lowered angle of radiation make this a very useful antenna. It is simple to match and has a broad horizontal lobe extending in both directions broadside to the antenna.

In restricted space circumstances, due consideration must be given to the use of vertical antennas. Vertical antennas, usually quarter-wave or loaded quarter-wave, require a good ground plane for best results. In restricted space, it is usually easier to elevate the base of the antenna and use several

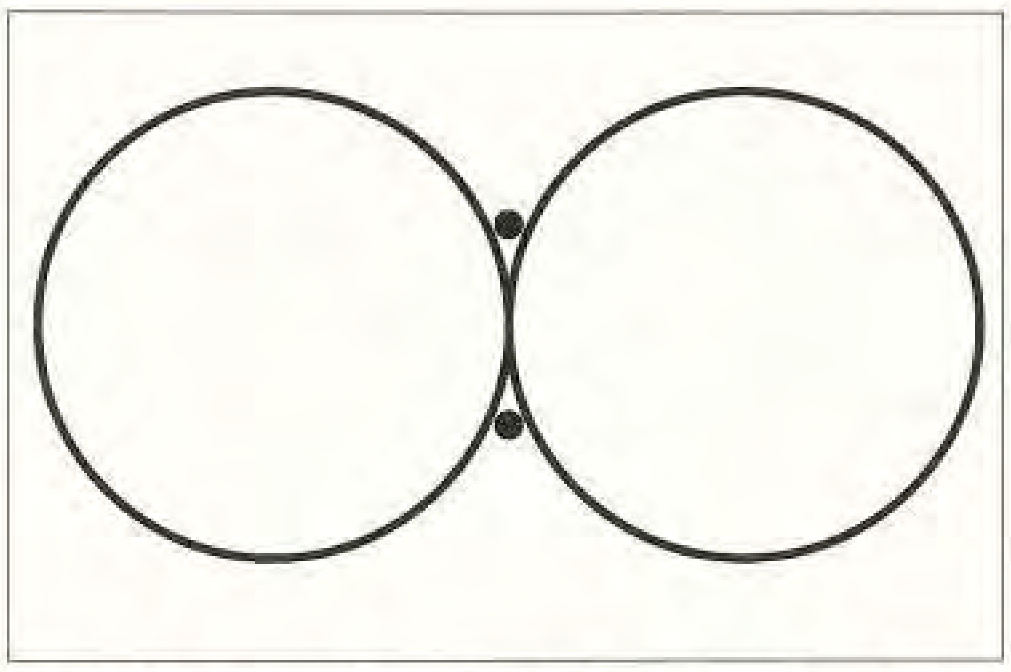

Fig. 4. Phased vertical dipoles. Spacing = 1/2 wavelength; phasing = 0 degrees; gain = approximately 2.5–3 dBd.

wire ground planes cut for resonance on the bands in use. The main advantage of the vertical antenna, other than its omnidirectional coverage, is its low angle of radiation. This explains why a simple vertical, well-matched, can give results which sometimes outperform those from horizontal antennas. In **Fig. 3**, a vertical antenna is shown with its radiation pattern. This is the theoretical pattern when the center is one-quarter of a wavelength above perfect ground.

A similar pattern will be achieved when a good resonant ground plane is provided with an elevated vertical antenna. Many commercial vertical antennas are available and cover more than one band. While these antennas serve a purpose, do not expect the same radiation efficiency as with a single-band vertical. As with the horizontal dipole, it is possible to combine two vertical antennas to increase the radiated signal strength in selected directions.

Two ways, out of many, of combining two vertical antennas are illustrated in **Figs. 4** and **5**. In **Fig. 4** two vertical antennas, separately matched to 50 ohms, are spaced a half-wavelength apart at the operating frequency. The same stacking harness as suggested for the stacked horizontal dipoles is used. A figure-eight polar diagram is the result of this combination and achieves approximately 2.5 to 3.0 dB gain over a single vertical antenna.

In **Fig. 5** the two verticals are spaced one-quarter of a wavelength apart and connected together with a three-quarter-wavelength matching harness made of 50-ohm coaxial cable. This phasing of the antennas produces a cardioid unidirectional pattern, which gives a gain in the most favored direction of approximately 4 dB over the single vertical antenna. In accordance with the principle of not getting something for nothing, the radiation in the opposite direction is noticeably reduced.

Returning to horizontal antennas, there is a need to provide for more than one band of operation. The easiest method is to parallel two or more dipoles from the same feedpoint. I suggest, if possible, separating the dipoles by some distance. In one case I erected a five-band dipole, spacing the elements for each band approximately six inches apart with plastic spreaders. This operated quite successfully on 40, 30, 20, 15, and 10 meters. As with all dipoles, I made all the elements too long at the lower end of the band and pruned each band's elements until I achieved resonance at my favored frequency of operation.

It's time for an unpaid commercial announcement. Over the last nine

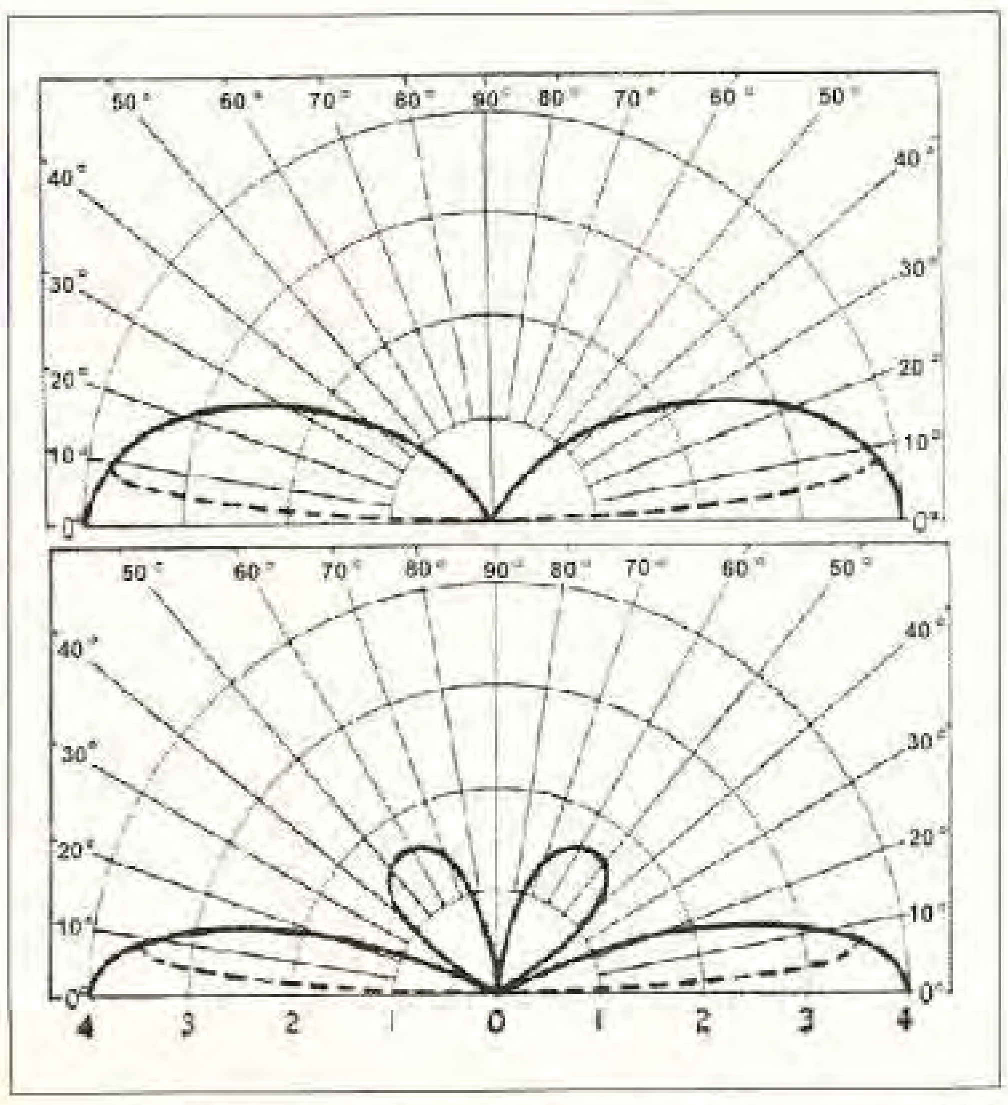

Fig. 3. Top: vertical dipole with center 1/4 wave above perfect ground. Bottom: the same, but center 1/2 wave above perfect ground.

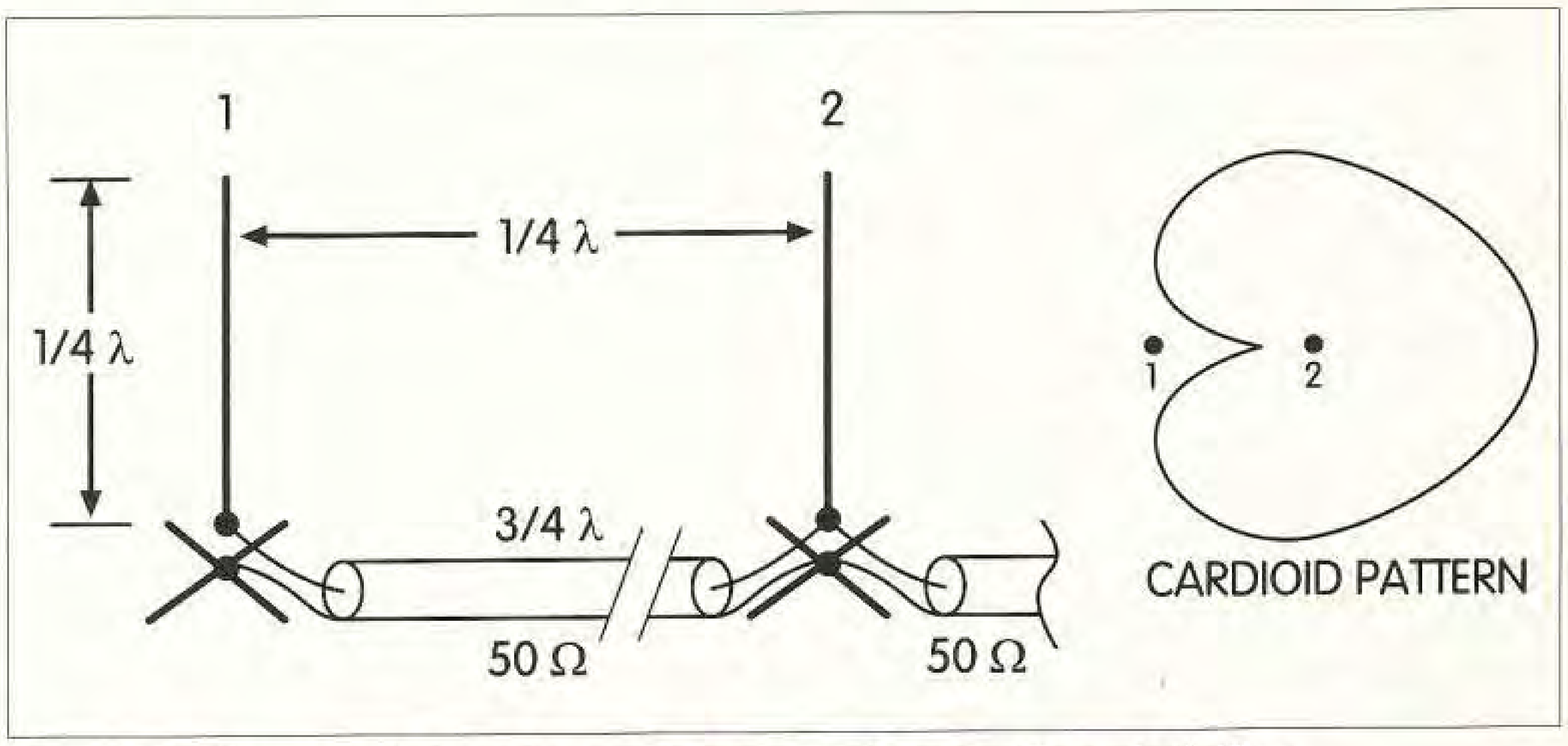

Fig. 5. Unidirectional phased ground planes; gain approximately 4 dBgp.

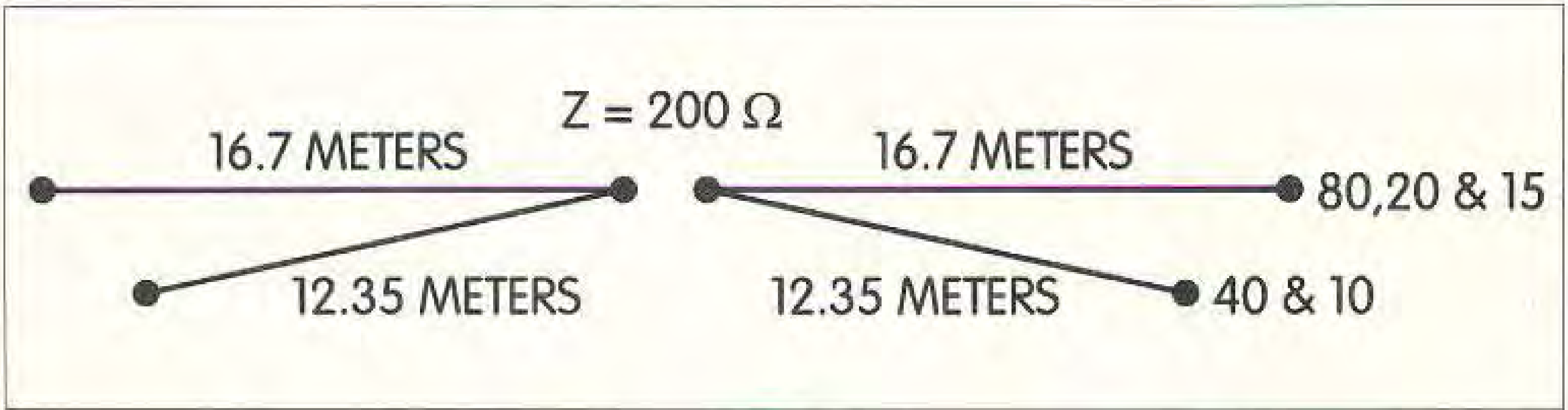

Fig. 6. Multiband antenna.

months, I have been in antenna heaven with my new MFJ-259 Antenna Analyzer. This has been a joy to use and has saved me untold hours during antenna construction and testing. Other methods of SWR testing may be used, but quite frankly my other test equipment is tending to gather dust.

Fig. 6 shows an antenna which quite a few of my amateur friends have tried with good results. While I have not tried this antenna myself, those whom I have worked on the air using the antenna have been quite happy with its performance. The elements are chosen not to be self-resonant on any band, but to exhibit a mean impedance of approximately 200 ohms at the feedpoint on 80, 40, 20, 15, and 10 meters. It may be fed with an open-wire, such as air-spaced 300-ohm line, a four-to-one balun, or two lengths of coaxial cable. The last method is claimed to reduce noise pickup by the feeder. The two lengths of coaxial cable should be exactly the same length—RG-58CU would be suitable for reasonably short runs. Ground the two braids at the shack and join the braids at the antenna end. The two inner conductors are joined to the antenna and to a 4:1 balun at the shack.

While theoretically the antenna should have an impedance of approximately 200 ohms on all five bands, you will probably need an antenna tuner to achieve a good match.

This does not exhaust the antenna possibilities for HF operation, but hopefully will be sufficient to help you examine your options for a quick start with a new antenna setup. 73