BY KENT BRITAIN,* WA5VJB

# 75-ohm "Cheap Yagis" for 70-cm ATV

This month we are going to take advantage of some 75-ohm matching techniques for a Cheap Yagi so it can be directly connected to your TV set to let you view amateur television (ATV) transmissions on the 70-cm band. Many ATV repeaters take advantage of CATV channels 57 and 58 being inside our 420–450 MHz ham band, with 57's video carrier at 421.25 MHz and 58's at 427.25 MHz. This means all you have to do to watch these ATV repeaters is build one of these antennas, connect it to a cable-ready TV set, and tune to CATV channel 57 or 58, but connect the antenna rather than commercial cable. Be sure to check your local repeater guides to see if there is activity on these frequencies in your area (if there isn't, start some!)

By the way, there are a few ATV systems still using 434 MHz—none in Texas, but a few in the Northeast. The frequencies used are not compatible with cable-ready TVs, and a 50-ohm input down converter is usually used. To head off questions, no, I have never developed a 75-ohm Cheap Yagi for 434 MHz.

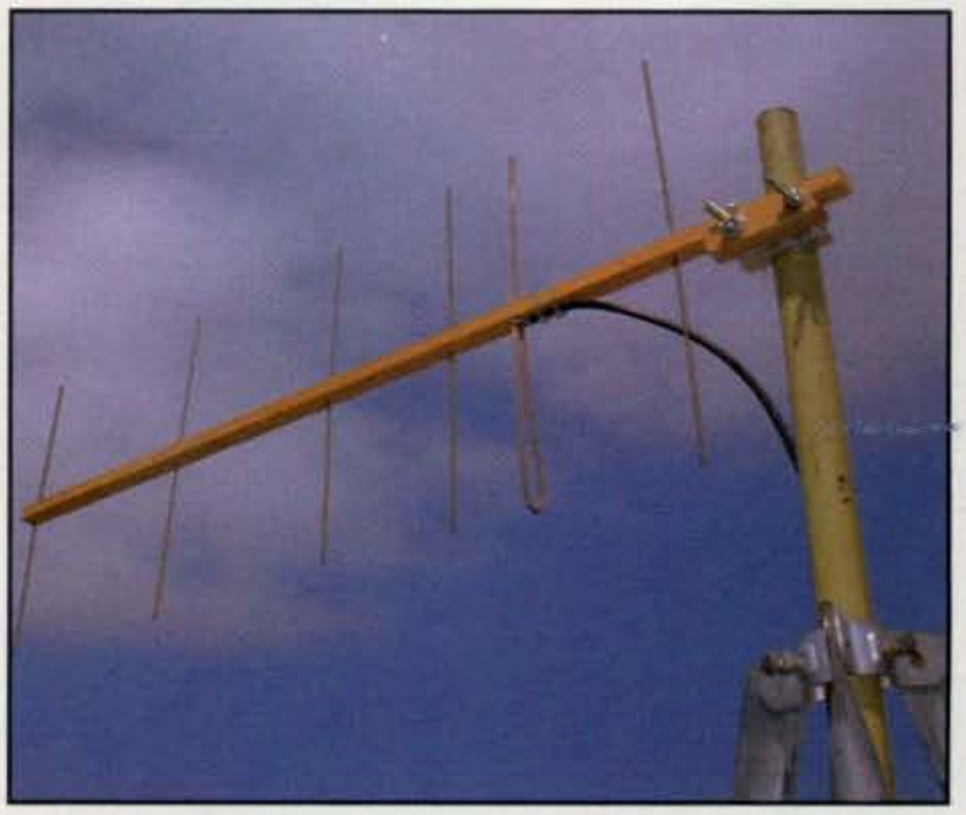

*Photo A– An ATV Cheap Yagi. This antenna will cover the two popular amateur television channels at the lower end of the 70-cm band.*

## Impedance Secrets of the Cheap Yagi

The J driven element used in my Cheap Yagis has about a 150-ohm impedance if you just mount one all by itself. By using the loading effects of the Yagi reflector and directors, I bring the impedance of the driven element down to 50 ohms. This gives a direct impedance match to 50-ohm coax—no T-bars, no gamma capacitors, no baluns. Just by widening the spacing a bit, it is easy to come up with a 75-ohm version (see photo A and fig. 1). By controlling the element spacings, Cheap Yagis can be designed to directly match feedlines from about 20 ohms to just over 100 ohms. I once used this to design a telemetry antenna for use with 93-ohm coax, but most of the antennas have been for 50- and 75-ohm coax. From the technical side, the higher impedance matching results in a Yagi with slightly lower gain but a bit wider bandwidth. For those wide TV signals, this works out pretty well.

## Construction

Dimensions for the driven element are in fig. 2; element lengths and spacing for 6-element, 9-element, and 11-element versions are in Table I. With the 6-element expect about 10.5 dBi gain, the 9-element just over 12 dBi gain, and the 11-element just over 13 dBi gain. All three antennas showed about a 30-dB front-to-back ratio.

Start all your measurements from the reflector. It's best if you start there for each element. When you try to measure cumulatively—that is, + 5 inches, + 5.5 inches, etc.—there is nearly always a cumulative error that creeps in. It's the total position, not the relative position, of the elements of a Yagi we want to optimize.

I like to use 1/2" × 3/4" wood for my booms. You can get away with 3/4" × 3/4", but I wouldn't use anything thicker. For the elements I used RadioShack ground-rod wire. This solid aluminum wire runs about $5.00 for 40 feet, enough to build

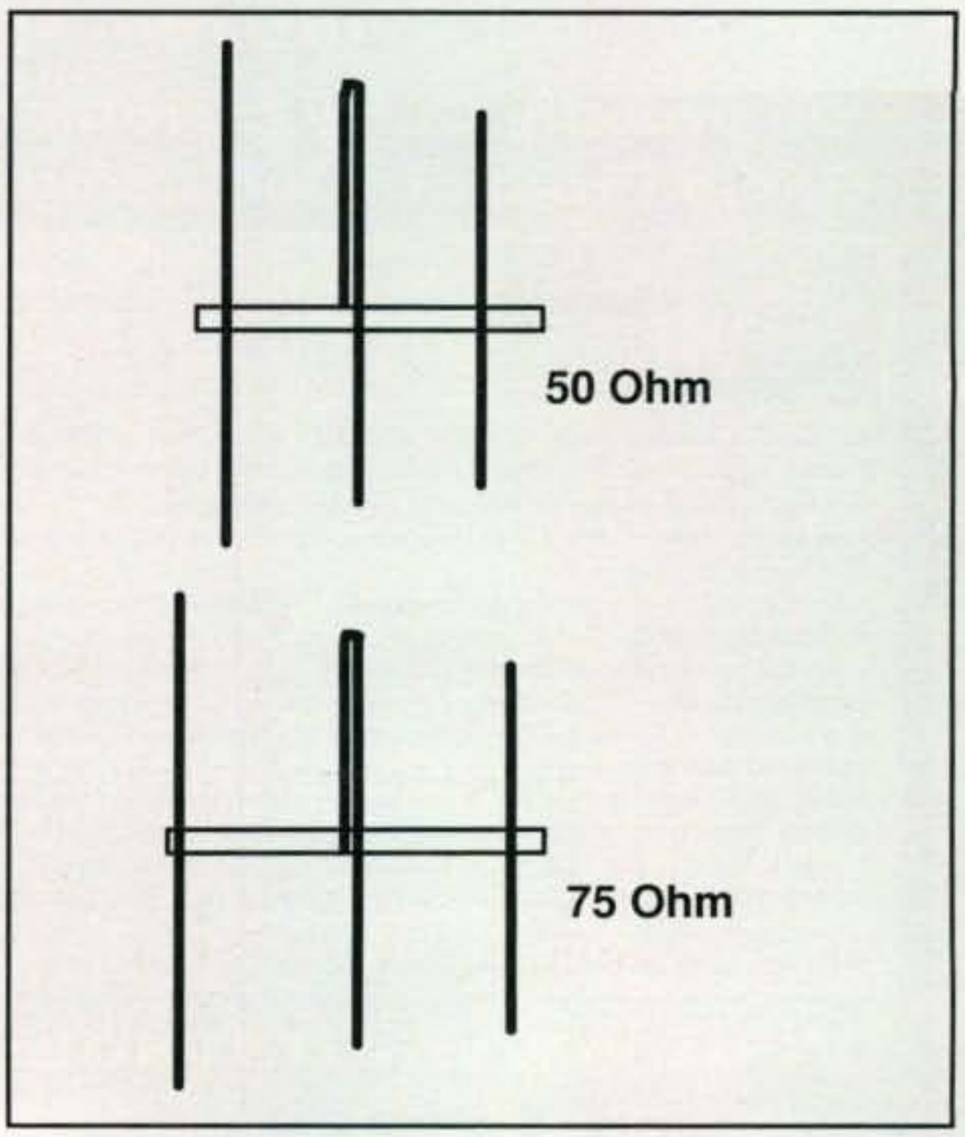


*Fig. 1– 50-ohm and 75-ohm spacing.*

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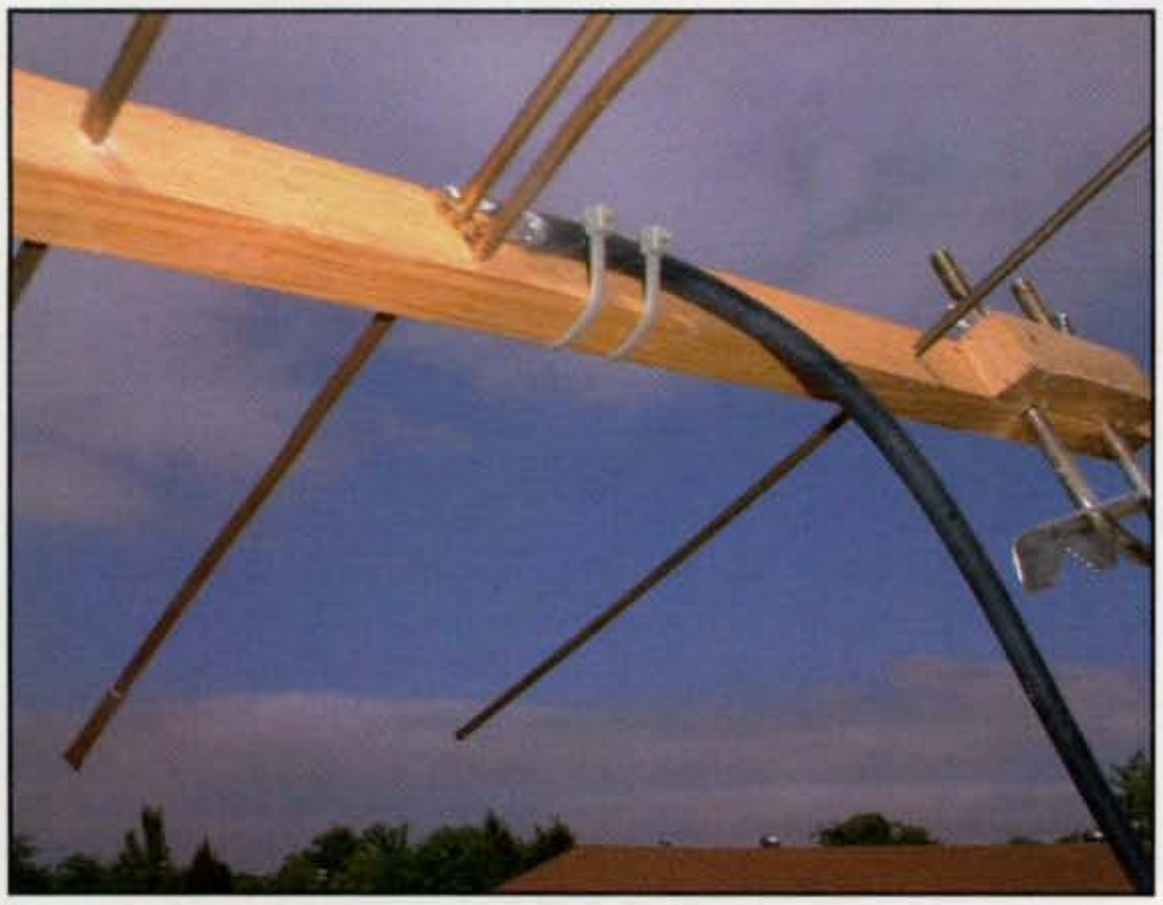

*Photo B– Close-up of the driven element.*

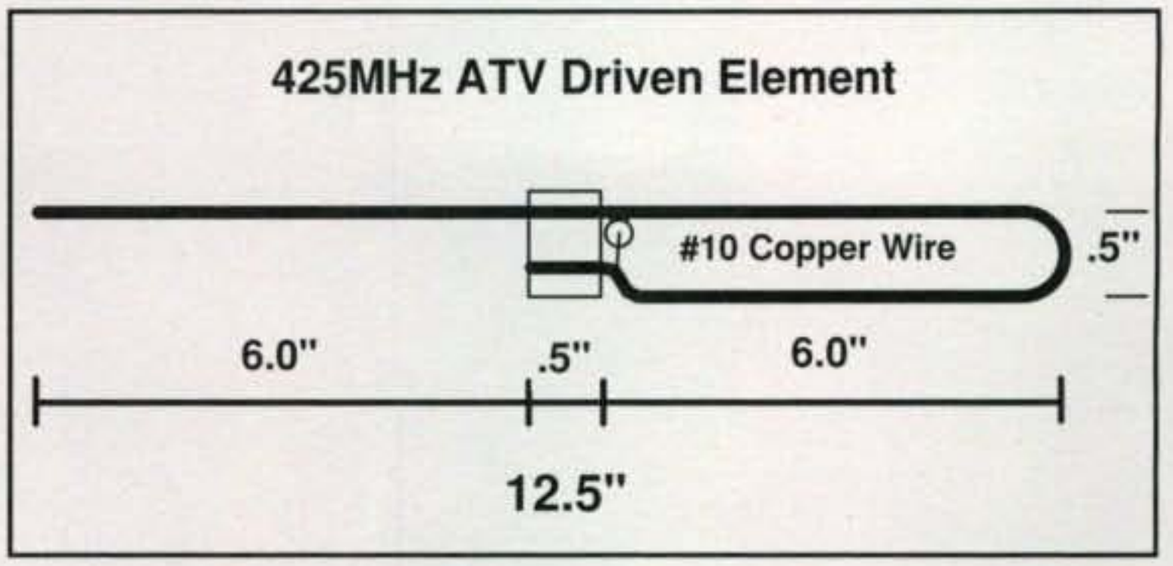


*Fig. 2– Driven-element dimensions for all three versions.*

a lot of Yagis. Silicon bronze welding rod, aluminum rod, copper electrical wire, and 1/8-inch hobby tubing have also been used. For the driven element you should use something to which you can solder. My personal choice is silicon bronze welding rod, which is available at welding supply stores by the pound. In addition, #10 and #12 copper wire work well.

If you want to use 3/16-inch diameter elements, make each director .2 inch shorter. Keep the reflector and driven elements the same length. It's kind of fat, but if you have a lot of 1/4-inch rod and want to use it, make the directors .3 inch shorter than the 1/8-inch dimensions. Again, the reflector and driven elements stay the original length.

The coax is directly soldered to the driven element. The coax shield goes to the center of the driven element; the coax center goes near the tip of the J. Be sure to use RG-59, at least for the first foot or two. RG-6 is good, but it's hard to find these days with a copper shield.

The elements can be held in place with a drop of "super glue," epoxy, or RTV type adhesives. If you plan to mount the antenna outside, a coat of spar varnish or even house paint greatly extends the elements' life. Be sure to put good coat of paint, RTV, or some kind of sealant on the coax braid at the driven element to keep water from wicking back down the coax. In Texas weather they seem to last about four years when I mount them outside. Inside they will last for decades.

I have had a lot of feedback on the driven-element dimensions. "Is that .5-inch loop spacing from the center lines or the edges of the elements?" The width of the loop is not a critical dimension. While watching on the network analyzer I bent one from about 1/4 inch to nearly 3 inches with little change in impedance.

## Using your ATV Antenna

I have had a pair of these antennas mounted in my attic for nearly 15 years. One is looking at a 421.25-MHz output of an ATV repeater. It's pretty strong and horizontal as I recall, so I am using the 9-element version. The second is looking at a 427.25-MHz ATV output and is vertically mounted. These are combined and come down to the TV in the shack. When I'm not looking at a local TV program, I just change the TV from broadcast to CATV mode for the tuner in its set-up menu, channel surf up to channel 57 or 58, and see what the local ATV crowd is doing that evening.

If you're planning to transmit as well as receive, you need to check in with your local ATV groups, as more and more are going to cross-band repeaters, with the input on a higher frequency band. All the ATV repeaters in this area had been using 915-MHz FM ATV inputs, but I think they all have gone to 1250-MHz FM these days because of all the 915-MHz noise.

This gives the best of both worlds. FM TV has about a 17-dB advantage over AM TV to get a P5 picture, so 2 watts of FM video is about equal to 100 watts of AM video. Now the ATVer can use a low-power transmitter and a standard cable-

**Cheap Yagi Dimensions**

| | Reflector | DE | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **6 elements** | | | | | | | | | | | |
| Spacing | 0 | 5.2 | 7.4 | 12.7 | 19.4 | 27.0 | — | — | — | — | — |
| Length | 13.75 | * | 12.5 | 12.4 | 12.4 | 11.25 | — | — | — | — | — |
| **9 elements** | | | | | | | | | | | |
| Spacing | 0 | 5.2 | 7.4 | 12.7 | 19.4 | 26.0 | 32.4 | 37.5 | 43.5 | — | — |
| Length | 13.75 | * | 12.5 | 12.4 | 12.4 | 12.0 | 12.0 | 12.0 | 11.5 | — | — |
| **11 elements** | | | | | | | | | | | |
| Spacing | 0 | 5.2 | 7.4 | 12.7 | 19.4 | 26.0 | 32.4 | 37.5 | 43.5 | 50.0 | 57.0 |
| Length | 13.75 | * | 12.5 | 12.4 | 12.4 | 12.0 | 12.0 | 12.0 | 11.75 | 11.75 | 11.25 |

*All dimensions are in Inches.*
**All versions use the same Driven element as shown in fig. 2.*
*All elements are 1/8-inch diameter material.*

*Table I– Element lengths and spacings (except for the driven element) for 6-, 9-, and 11-element Cheap Yagis.*

*Photo C– Temporary radials for your mobile.*

ready TV set. For those who still think AM ATV is best, I have a trivia question for you: Can you think of any geostationary satellites that transmit AM video? There is one, only one! The rest are FM or digital video.[1]

## Adding Emergency Radials to Your Mobile Rig

Just on a whim, I clipped my jumper cables to the back bumper (I may have one of the few cars that still have a metal bumper!), and then clipped those to a 50-foot extension cord, as seen in photo C. This picked up about 2 dB of field strength on 80 and 40 meters. It didn't do much for 20 meters and up, but 2 dB is almost like doubling your power. A clip-on radial doesn't do much for you on 10 or 15 meters, but it can really help on 160, 80, 60, and 40 meters. A full counterpoise with tuned element on each band is nice, but one for two long radials is easiest. Several radials soldered to a big alligator clip make a real quick ground plane. Something for your RV perhaps?

For those plastic cars, or ones with a lot of undercoating, I tried just going directly to the rig (see photo D) and clamped

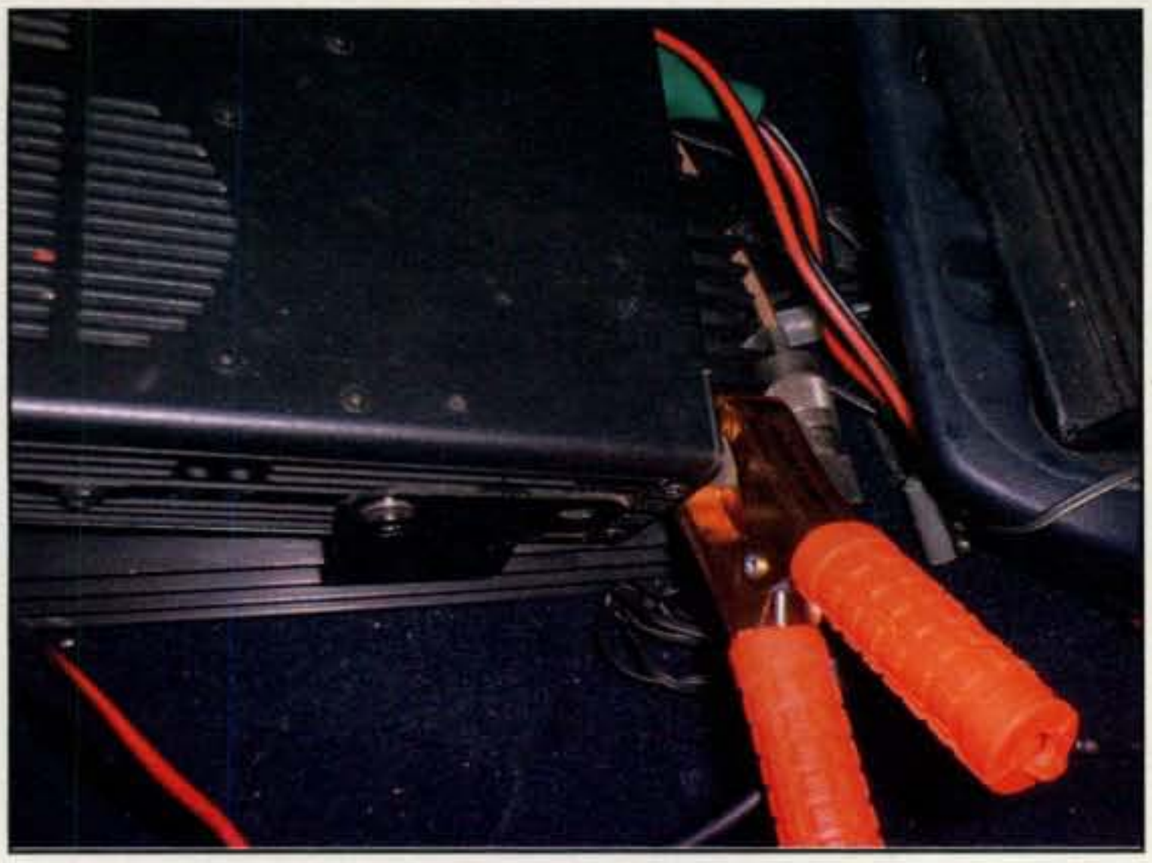

*Photo D– Taking the ground radials directly to the rig.*

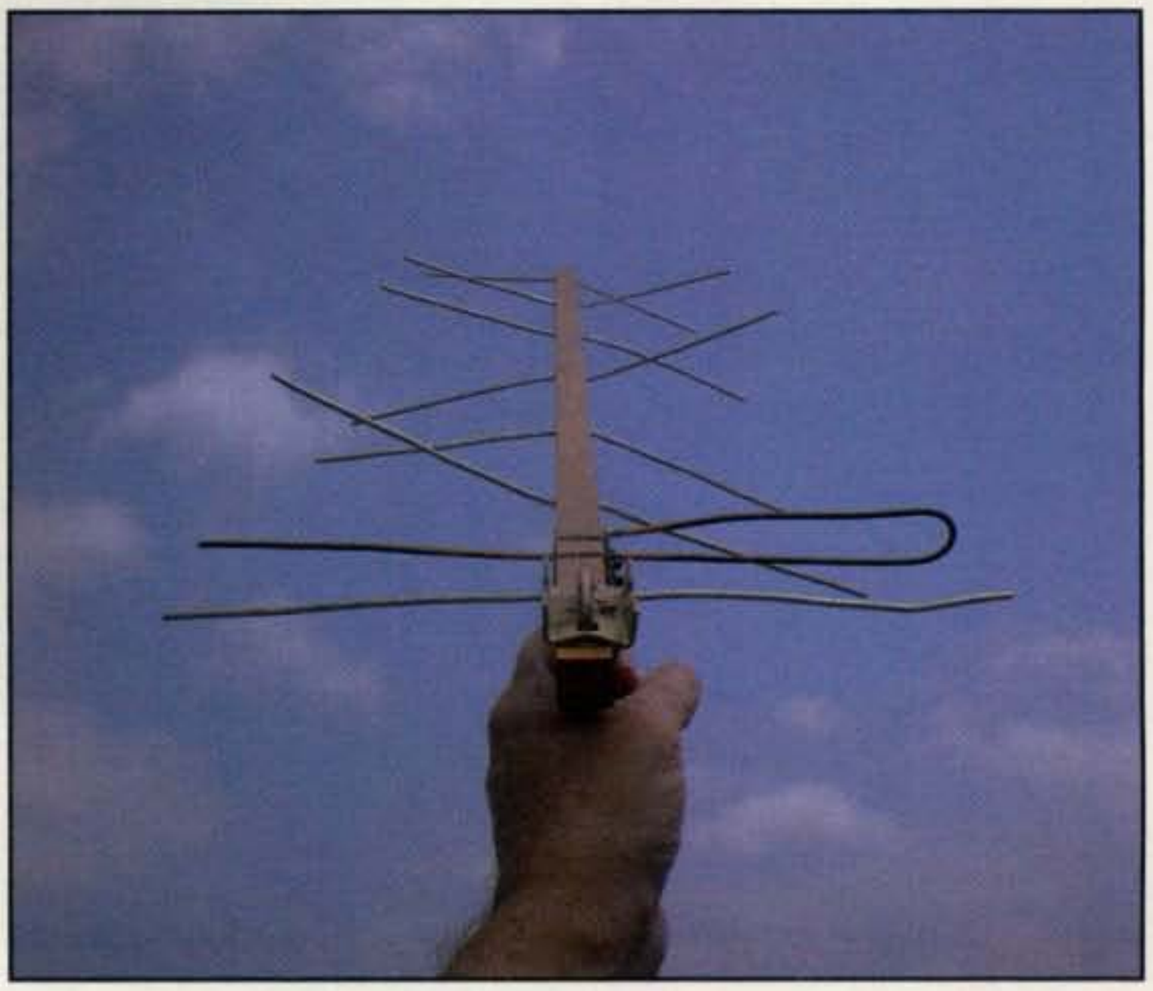

*Photo E– Element-to-element alignment. This one looks like the first time I tried to build a Yagi using a round boom and a hand drill. (See "e-mail Question" below.)*

the jumper cables directly to the PL-259 connector. The results were pretty much the same—about 2 dB on 40 and 80 meters.

## Quick Check for Radials

A better ground plane drives your vertical down in frequency. If that extra piece of wire moves the SWR dip on your vertical from, say, 3850 to 3830 kHz, you have a better ground plane and a more efficient antenna. If it goes up, put it back the way you had it!

With the "stick"-type antennas you have to shorten the whip a bit, although physically shortening the antenna is not the way you really want to do it, and you will not be gaining much improved efficiency.

With today's motorized antennas you just move the slider to put the antenna back on your favorite frequency. The antenna now has a few less turns in its loading coil, less coil loss, and more efficiency. Double winner! *Remember: Ground-plane changes that make a vertical antenna go down in frequency are good changes!*

## e-mail Question: "How bad can I build it?"

Getting all those elements carefully lined up sure makes a pretty Yagi, but how aligned do they have to be? Marc, WBØTEM, has done more of this kind of measurement than I have. On his antenna range he took one of his 11-element Yagi and started bending elements—some up, some down—until all the elements were bent relative to the driven element. Until the element tilt exceeded 20 degrees, the effect was unmeasurable, and that's not for one element, but for all elements in all directions. Therefore, a little twist in an element may make it look squirrelly, but it should still talk fine.

73. Kent, WA5VJB

## Note

1. The satellite is transmitting PAL video, not NTSC, and transmits into India. Only a simple down converter is necessary for reception. Because of the high power requirements, it only has one transponder versus the typical 16 or 32 transponders.