BY BILL ORR, W6SAI

RADIO FUNdamentals

THINGS TO LEARN, PROJECTS TO BUILD, AND GEAR TO USE

A DX Antenna For Sunspot Cycle 23

Yes! It looks like the first sunspots of Cycle 23 are at hand. Good news! Our thanks to George, W3ASK, who liberally salted the ionosphere during the early months of this year. We also musn't forget the members of the Northern California DX Club who celebrated the appearance of the new sunspots by throwing a dummy load off the Golden Gate Bridge into the Pacific Ocean.

"So far," one of the members grumbled, "my dummy load gives me better reception than my big beam. Now that the cycle is going up, the least I can do is deep-six the load and reconnect my receiver to the antenna!"

Well, time to think about new antennas for Cycle 23. I had considered this opportunity for some months. Now was the time to act! I didn't have a beam for 20 meters, and my home was cleverly placed on the lot in such a position that any simple wire antenna that I could squeeze onto my property plopped its main lobe into central Africa, an area remarkably devoid of amateur radio operators. It wasn't easy to work into Europe on 14 MHz with this setup. I didn't want to take down my 18 MHz beam, so what to do?

The Full-Wave Dipole

My antenna analyzer program quickly told me that given the direction in which I could erect a wire antenna, my best bet was a full-wave job that had a clover-leaf pattern. One of the leaves would be aimed directly at Europe.

The problem was, if the full-wave antenna was fed in the center, as is the general case, it instantly would become two half-waves in phase and provide a narrow beam at right angles to the wire. That wasn't what I was looking for.

How about feeding it at a point of maximum current in one of the half-wave sections? That would provide the proper current relationship in the antenna, with the appropriate pattern.

The first run of the computer program produced a wire about 68 feet long, fed about 17 feet from one end (fig. 1). At the design frequency of 14.2 MHz the feedpoint impedance is about 86 ohms. This configuration looks suspiciously like a multiband off-center fed antenna, but it is not. It is a one-band job with a pattern quite different than a dipole.

Building The Antenna

It was easy to build the antenna. I had an old klystron magnet coil (courtesy of the scrap pile at a local electronics outfit) that had thousands of feet of #16 enamel wire on it. I wound off about 70 feet. I used an Alpha-Delta model Delta-C antenna hardware kit consisting of a center insulator and two end insulators. The

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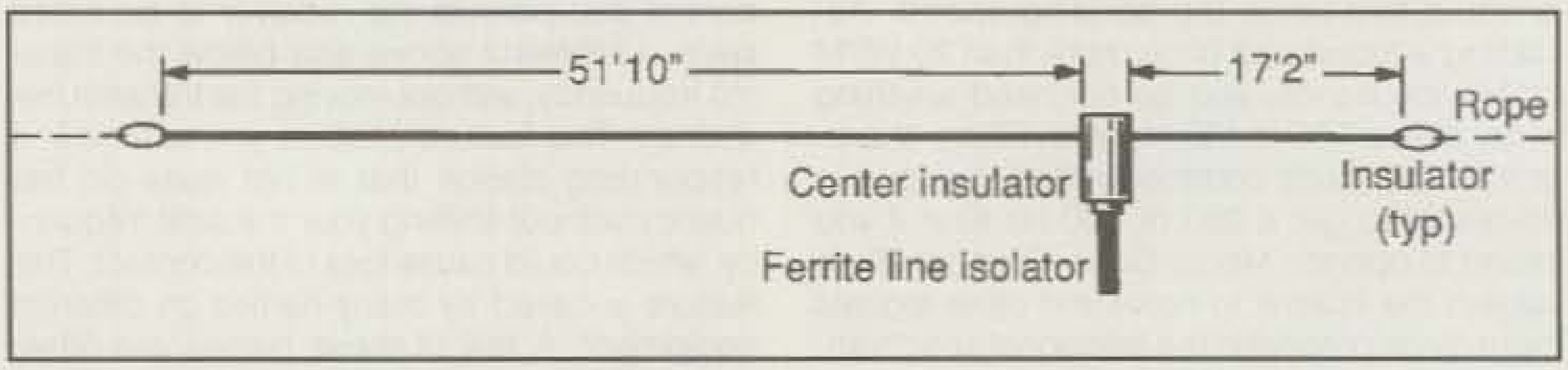

Fig. 1– The full-wave dipole for 20 meters. Azimuth plot is a cloverleaf. Feedpoint impedance is about 86 ohms.

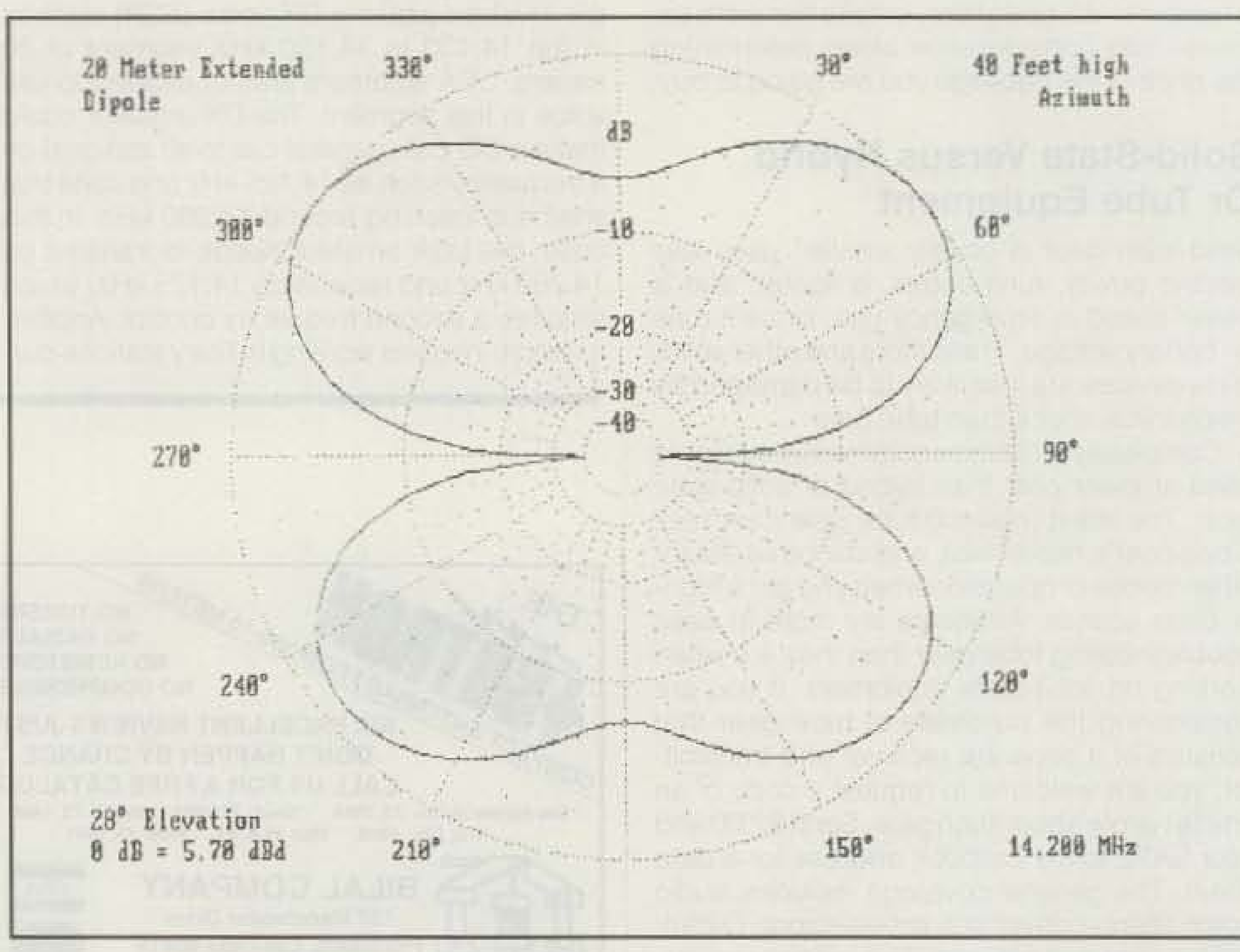

Fig. 2– Azimuth plot of full-wave dipole. North is at the top of the screen. The gain figure (lower left) represents ground reflection gain.

light gray color of the devices blended nicely with the smoggy atmosphere. Below the center insulator, I placed a Radio Works C1-2K ferrite line isolator.

Everything went together in about an hour, and I eagerly checked the antenna out with my MFJ-259 analyzer—resonance at 14,200 kHz, just where I wanted it. I had erected it at a height of 40 feet. The results matched the computer program very closely, so it looked like it was time to try the antenna on the air.

The Computer Analysis

I used an analysis program of Brian Beezley, K6STI.[1] The azimuth plot of the antenna is shown in fig. 2. Lobe maxima are at an angle of about 50 degrees to the wire, and large nulls appear at 90 and 180 degrees. In real-life, over an imperfect ground, I doubt if these nulls are as deep as they look, or as wide as they appear to be. Time will tell.

I next ran an elevation plot (fig. 3). The pattern is not quite a mirror-image, as the feedpoint of the antenna is off-center, but it looks as if the pattern difference is only about one dB.

The elevation angle of the main lobe is about 28 degrees, and that is a function of antenna height above ground. I'm stuck with that! Even so, the lobe exhibits energy at a 10 degree angle that is only about 4 dB below maximum.

What have I gained over a simple center-fed dipole placed in the same position? Look at fig. 4. At a 28 degree elevation angle it looks as if I picked up about 3 dB at an azimuth angle of 45 degrees—the direction of Europe! Not bad for a few extra feet of wire.

At a 50 degree azimuth angle the increase in gain of the extended antenna clearly shows up (fig. 5). And down at about a 10 degree

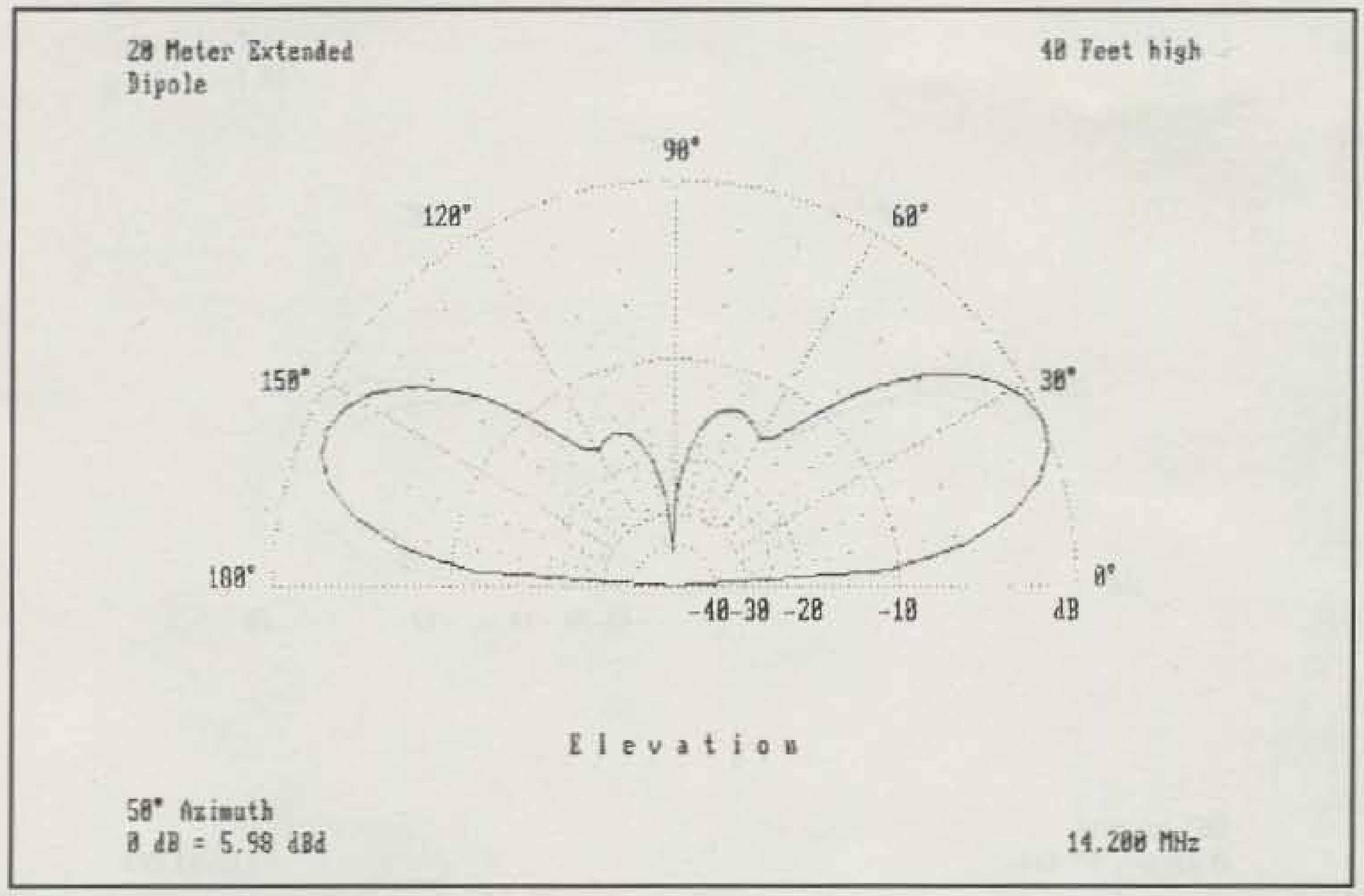

Fig. 3– Elevation plot of full-wave dipole at 40 feet. Angle of main lobe depends upon height of antenna above ground.

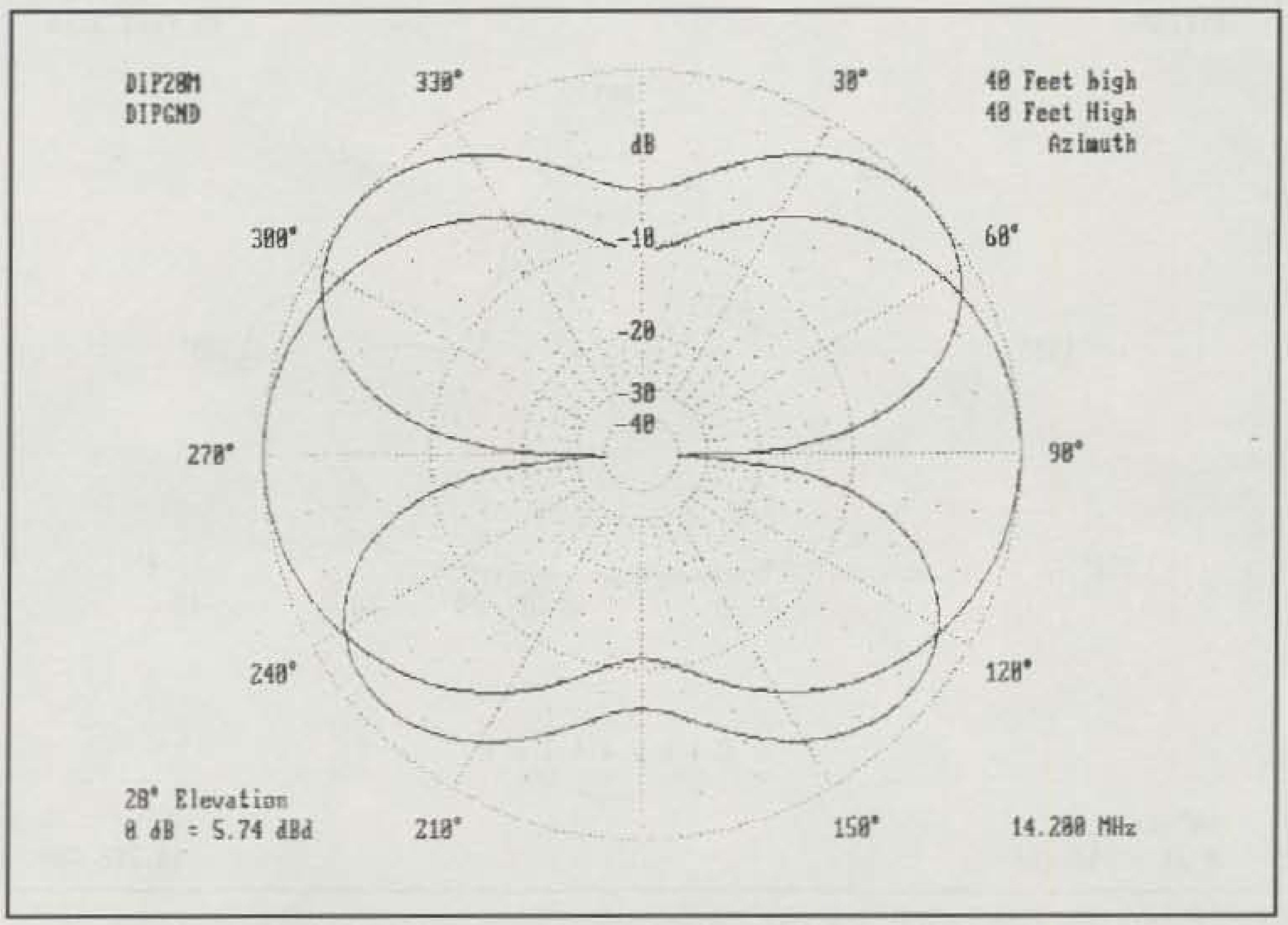

Fig. 4– Elevation plot of full-wave antenna compared to half-wave dipole. Note increase in gain at azimuth angles near line of antenna—about 3 dB!

angle it looks as if the improvement is on the order of 3 dB.

The last check was to observe the elevation patterns at a 10 degree azimuth angle, almost in line with the antenna (fig. 6). Here the extended dipole shows its worth. The 4 dB advantage is clearly apparent at 10 degrees, and carries through up to the angle of maximum power.

Where does the gain come from? Well, the antenna takes power from where I don't want it (straight up) and directs it where I do want it. The actual power gain of the antenna itself over a dipole is less than one decibel. It is merely that the antenna takes advantage of ground reflection and provides enhanced, low-angle radiation where it will do some good.

Feeding The Antenna

The input resistance at resonance of this antenna provides pause for thought. It is about 86 ohms. If a 75 ohm transmission line were used, the SWR would be very low. However, no one I know uses such a line, nor are there any SWR meters easily available that work with a 75 ohm line. The solution? Use a 50 ohm line.

This is not as bad as it seems. SWR at antenna resonance is about 1.7, slowly rising as the

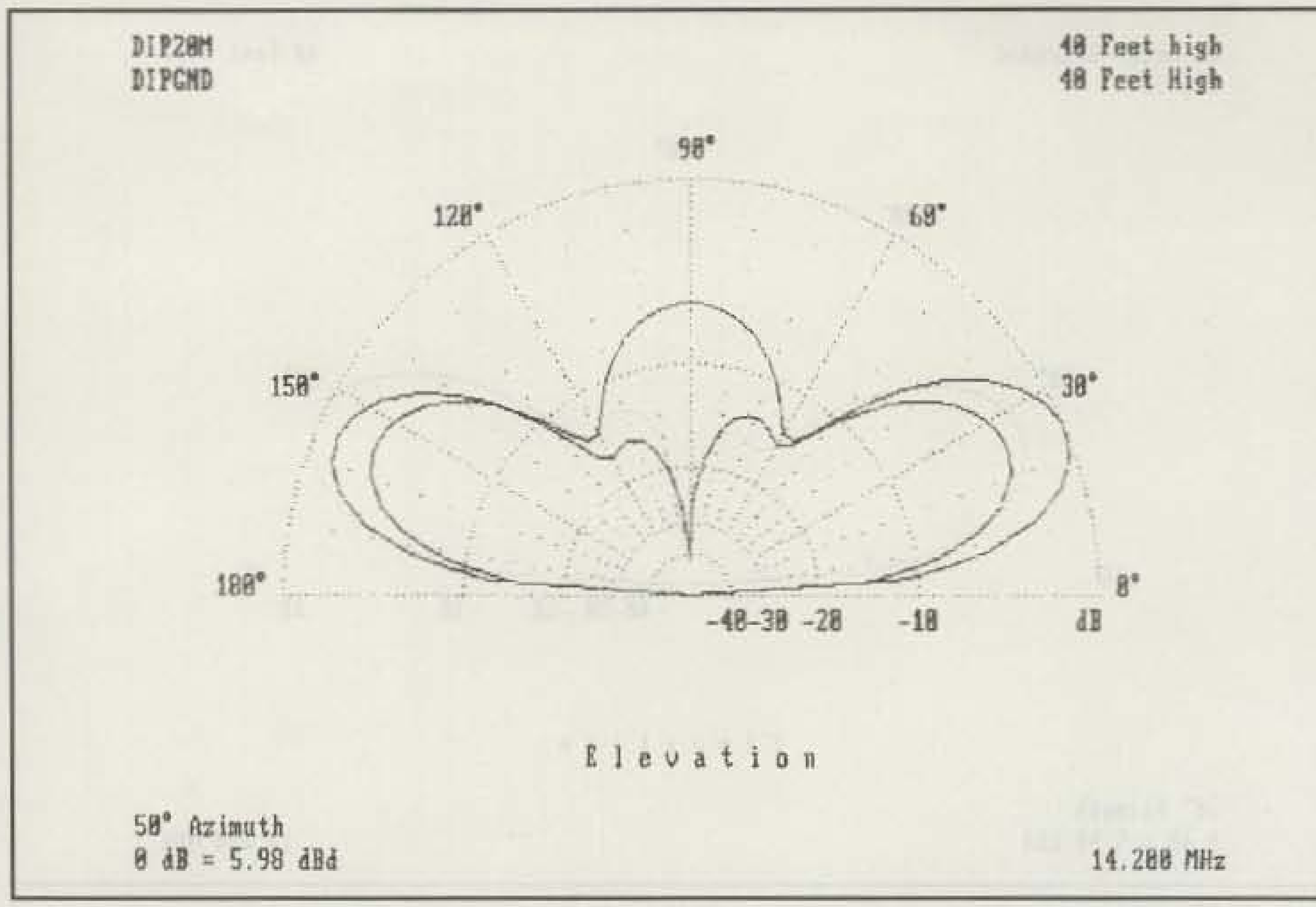

Fig. 5– Low-angle gain of full-wave dipole shows up in comparison with half-wave dipole.

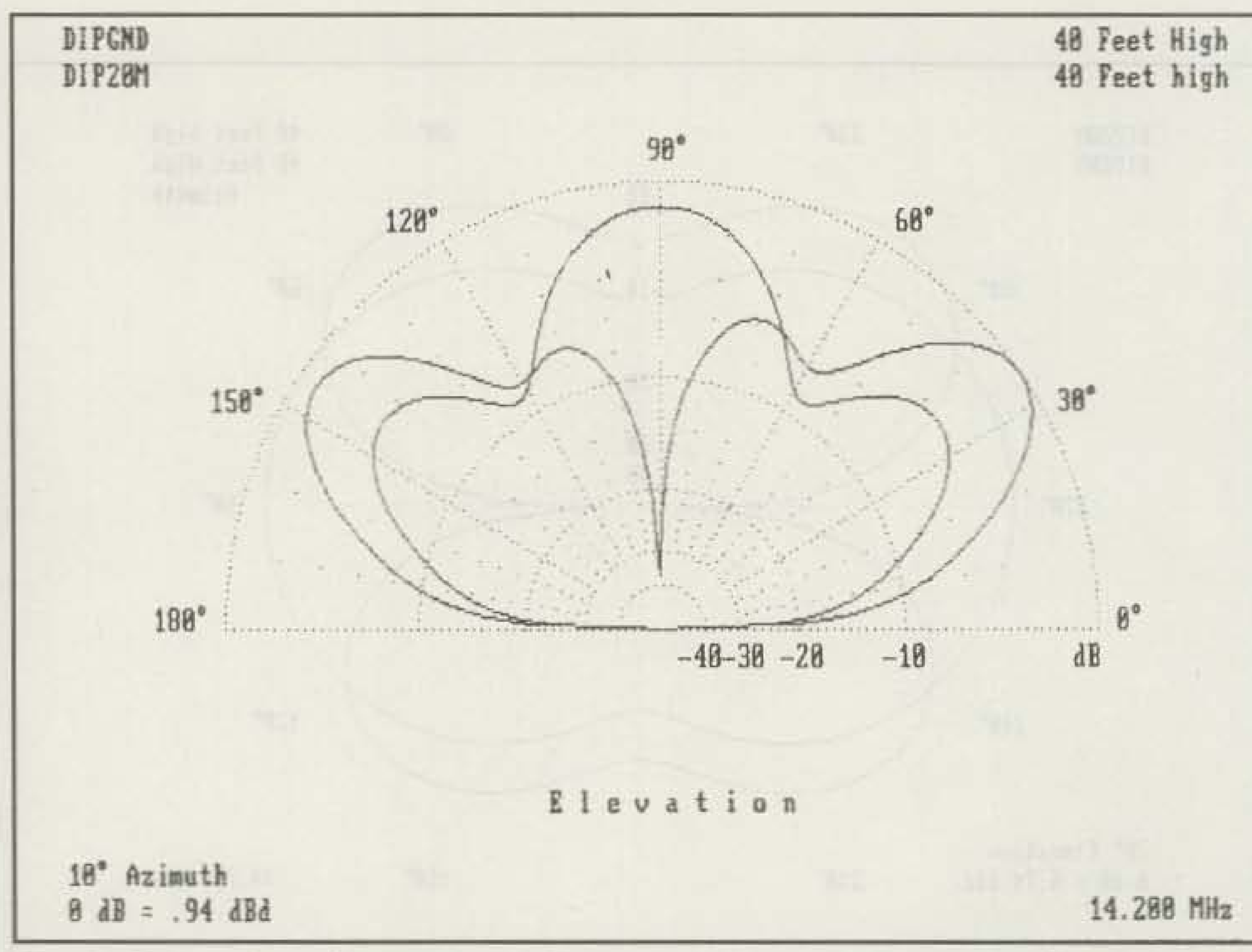

Fig. 6– End-on view of antenna plot. Note pattern improvement at take-off angles below 30 degrees.

antenna is operated off-resonance. Since every red-blooded amateur has either an auxiliary antenna tuner or a tuner built-in his transceiver, the SWR poses no problem. If you have time and various short lengths of coax, I bet you could arrive at a feedline length that would permit proper transceiver loading without a tuner! Those of you with memories like a steel trap will realize this scheme doesn't change the SWR; it merely provides an impedance that is more satisfactory to the transceiver (akin to taking a journey around the perimeter of a Smith Chart!).

Results

When I finally connected the antenna to my transceiver, I had to go outside and see if it was really up in the air. It was. With my usual luck, I had landed in the midst of a solar fade-out! I was able to get an encouraging report from an amateur crosstown who heard me with a fine signal. The band gradually came back to life, and in a short time I worked a 4X4, a UA3, and a ZP6 with good reports both ways. So it looks as if the antenna is working. Since that lucky day, I've worked a bunch of Europeans and other DX at random places around the globe. I'll keep you posted.

The Johnson-Q Antenna

All those out there who know what a Johnson-Q antenna is, raise your hand! For the majority of readers who have never heard of this famous antenna, it was one of the most popular DX antennas prior to World War II. If you didn't have a Johnson-Q, you just weren't one of the Big Guns!

This matching system was the answer to the problem of feeding a dipole antenna. Coaxial line for amateurs was not available, and the line of choice was two-wire open line, having a spacing of about 4 inches. A line of this design had a characteristic impedance of about 600 ohms depending on wire size and actual spacing. This meant that if the line was used to feed the center of a dipole, the feedpoint of which was about 70 ohms, the SWR on the line was greater than 10-to-1, leading to high line loss and tricky tuning problems at the transmitter.

The Johnson-Q used a linear matching transformer to drop the SWR on the open-wire line close to unity. The matching transformer was a quarter-wavelength long and was composed of two 1/2 inch diameter aluminum tubes, spaced about 1 1/2 inches, center to center. Fig. 7 shows the general construction.

The problem with the Johnson Q was the weight of the center insulator and the aluminum Q bars. In spite of the nifty idea, it was virually impossible to put enough tension on the flat-top to pull the antenna into a horizontal position. Some operators supported the aluminum tubes with a short pole placed beneath the antenna.

The antenna, in any event, worked well. The irony is that the massive and weighty Q-section could have been replaced with a compact and light-weight L-network made up of a single capacitor and two small inductors! Apparently no one thought of that.

The Johnson-Q faded into limbo after World War II with the introduction of inexpensive 50 ohm coax. Old timers remember the Johnson-Q antenna as a piece of nostalgia. If you had one, you were to be envied, as it was very expensive. The 20 meter version cost an astronomical $6.00! That was a lot of money at the depths of the Great Depression! It just shows that an avid DXer will not let any cost stand in the way of a super-antenna!

A New Type-N Connector!

Anyone who has gone through the frustrating task of putting a type N connector (UG-21) on a piece of coax knows what a nasty job that is. It is very easy to damage the little rubber gasket, and then you are in Deep Kimchii. I hate the little demons.

Finally, 50 years after the UG-21 hit the market, an improved version is at hand. It goes together much in the manner as the PL-259 (fig. 8). Here's the way you do the job:

1. Cut the end of the coax even. Strip the jacket, shield, and dielectric back 1/2 inch. Don't nick the center conductor!

2. Cut the outer jacket back an additional 3/8 inch. Tin the braid. Don't overheat.

3. Screw the plug subassembly on the cable. Solder assembly to braid through solder holes, making a good bond between braid and shell. Solder center conductor to center pin. Don't overheat. *Note:* Solder must seal holes for connector to be waterproof.

4. After assembly cools, screw shell onto assembly. Tighten until assembly bottoms on hex structure.

There! It wasn't hard, was it?

You can get this new connector for less than $4.00. Two distributors that carry it are: The Wireman (N8UG), 261 Pittman Rd., Landrum, SC 29356 (803-895-4195), part number 7354; and Cable X-perts, Inc. (KC9VW), 113 McHen-

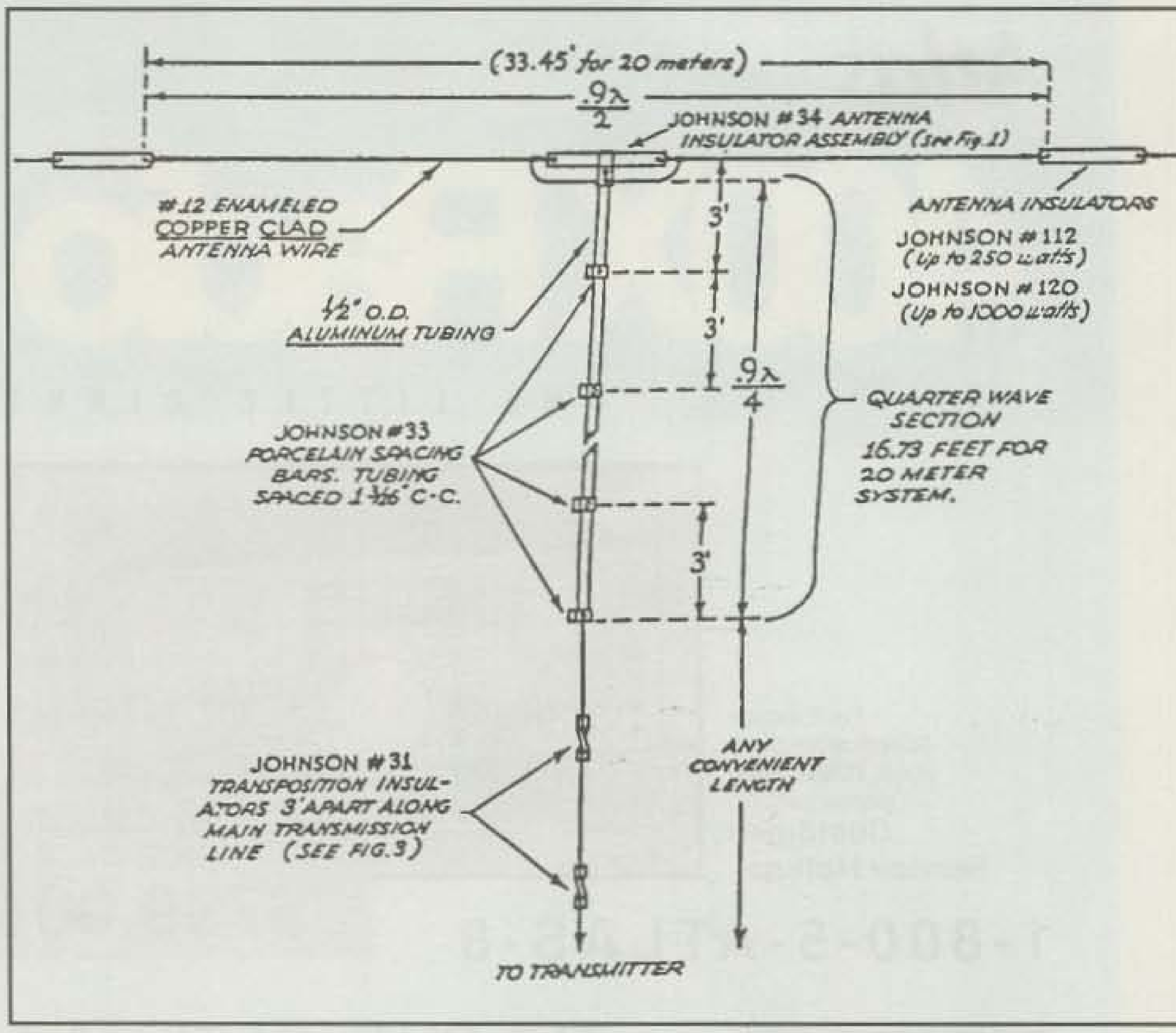

Fig. 7– The famous Johnson-Q antenna sold in kit form by E.F. Johnson Co.

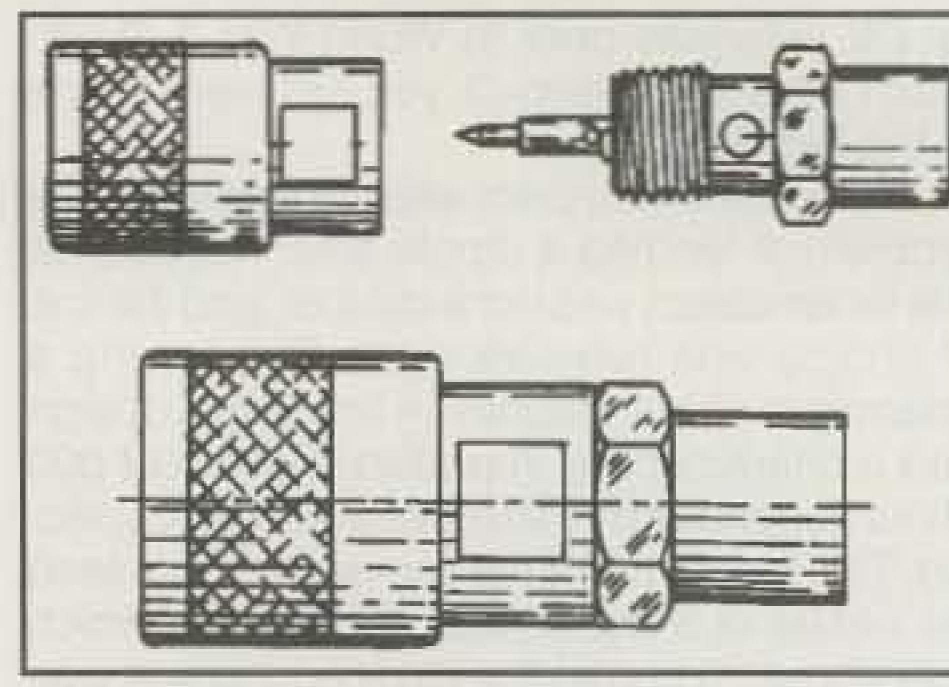

Fig. 8– Illustration from the Cable X-perts catalog shows how the new type-N coax connector goes together

ry Rd., Suite 240, Buffalo Grove, IL 60089 (708-506-1886), part number 6633S.

And Thank You Very Much!

My appreciation to the following readers who have written me in the past weeks. I enjoyed hearing from all of you!

Don Wiggins, W4EHV; Bruce Kelley, W2ICE; Don Leslie, W6FMX; Hu McClain, K6SPK; Bob Hickman, AA5WE; Darrell Penrod, KB4UX; John Boles, KA6LWC; George Goldstone, W8AP; Bill Wildenheim, W8YFB; Steve Barnes, KH6SB/Ø; Louis Cronenberger, K4BGZ; and Dick Rollema, PAØSE.

73, Bill, W6SAI