CQ REVIEWS:

The Three-Band Big Horn Delta Loop Beams

BY LEW McCOY*, W1ICP

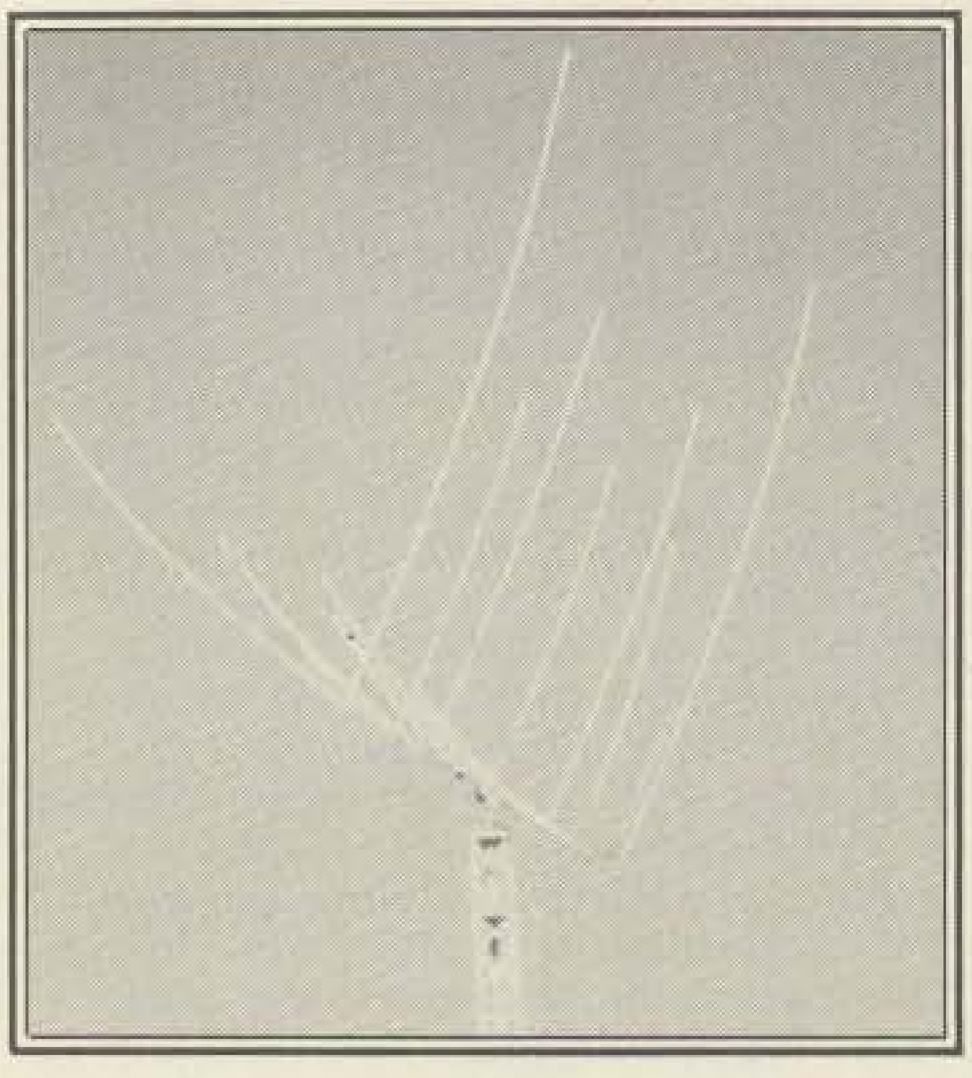
Delta Loop Antennas, Inc. recently announced a new three-band Delta Loop which I had a chance to field test and review. While the antenna technically could be called a tribander, I would avoid using the term because it gives the impression of trap beams. This is not to say that trap beams are all bad, but any antenna expert will be the first to tell you that they are "compromise" antennas when compared to monobanders.

The Delta Loop, or Big Horn, covered in this review is actually three separate beams—20, 15, and 10 meters on one boom. And, in fact, three separate feed lines are required, one for each beam. However, before going into the review, let me pass along some history and information on the Delta Loop antenna, as I was involved with its development from almost the start.

Harry Habig, K8ANV, a brilliant amateur, invented the Delta Loop back in the 1960s. Harry sent a letter to ARRL headquarters describing a full-wave antenna in a triangular configuration. Several of us in the Technical Department saw the advantage of such an antenna, and the result was a series of articles, nearly all written by me.

The name "Delta Loop" has an interesting origin. At the time, the antenna had no name and we had arguments over a "Three-Sided Quad" or a "Triangular Quad" (which are contradictions in themselves!). Then Doug De Maw, W1FB, came up with the name "Delta Loop," which was both appropriate and catchy. That's how the antenna was named. I eventually built 20, 15, and 10 meter Deltas and had tremendous success with them. Doug pioneered the use of single Delta Loops on 80 meters, which are very popular antennas today.

What makes a Delta Loop such a good antenna? In the first place, it is a full-wavelength antenna (as is a quad) rather than a half wavelength. The effective aperture (some amateurs like to use the term "capture area," but there really is no such thing) is twice that of a half wavelength. That and other factors make the gain of the antenna almost 2 dB over a half-wavelength dipole. Second is the fact (and it is a fact regardless of what you may read or hear) that the angle of radiation is slightly lower than a half-wavelength antenna.



This is the three-band Delta mounted on the 50 foot tower. As discussed in the text, the top radiating portions of the antenna are much higher—70 plus feet on 20 meters, for example.

Some years back there was a series of articles in *QST* on stacking half-wavelength antennas and the changes in angle patterns derived from stacking (also the gain derived). Jim Lawson's book *Yagi Antenna Design* also has a complete chapter on beam stacking. If you look at the configuration of a full-wave quad loop, the current points of the antenna are at the center of the bottom and the center of the top. Depending on the quad's configuration, diamond or square, the minimum current spacing point with the square configuration would be about ¼ wavelength or more. The diamond or Delta form would give greater spacing. Slightly more than half-wavelength spacing provides the greater gain, but even at one-quarter spacing the gain is there, and more important, in many cases the angle of radiation is lower. With quarter-wave spacing of the current points the angle is lowered by only a few degrees. In many cases, however, a few degrees, particularly on long-distance DX, can be the difference between working and not working a station.

Those few degrees may not be much, but it can be enough on long hops to make one big difference, even to the point of eliminating one extra hop and the resultant signal attenuation. I frankly think this is why quads (or even better, Delta Loops) "open" a band sooner and are the last to be heard when a band goes dead. Note that in the last sentence I said, "or even better, Delta Loops." Simply, the current points are farther apart (better stacking) than in a quad. The triangular configuration does that for us.

The Delta Loop is also similar to the quad in that it is a closed loop, has Low Q, and is inherently broad band. Clarence Moore, the inventor of the quad, devised the quad looking for an antenna that would not be subjected to corona problems at extremely high altitudes (Quito, Ecuador). The Low-Q closed loop did that and also offered a lower noise antenna than a half-wavelength Yagi beam.

The Delta Loop is also beneficial in that it provides us with a much higher antenna than a regular Yagi for the same tower height. Always keep in mind that one of the radiating or current points of the Delta Loop is at the center of the top. For example, in this review the tower used is a 50 footer. Actually, on 20 meters the Delta arms go up another 20-plus feet, putting our 20 meter fields at 70 feet!

The Big Horn Delta Loop that we tested is a two-element beam on 20 and 15, and three elements on 10. The company makes several versions of monobanders —two-, three-, and even four-element jobs—but the three-band antenna is one of their newer products. Let me first say a word about the Big Horn company. It is

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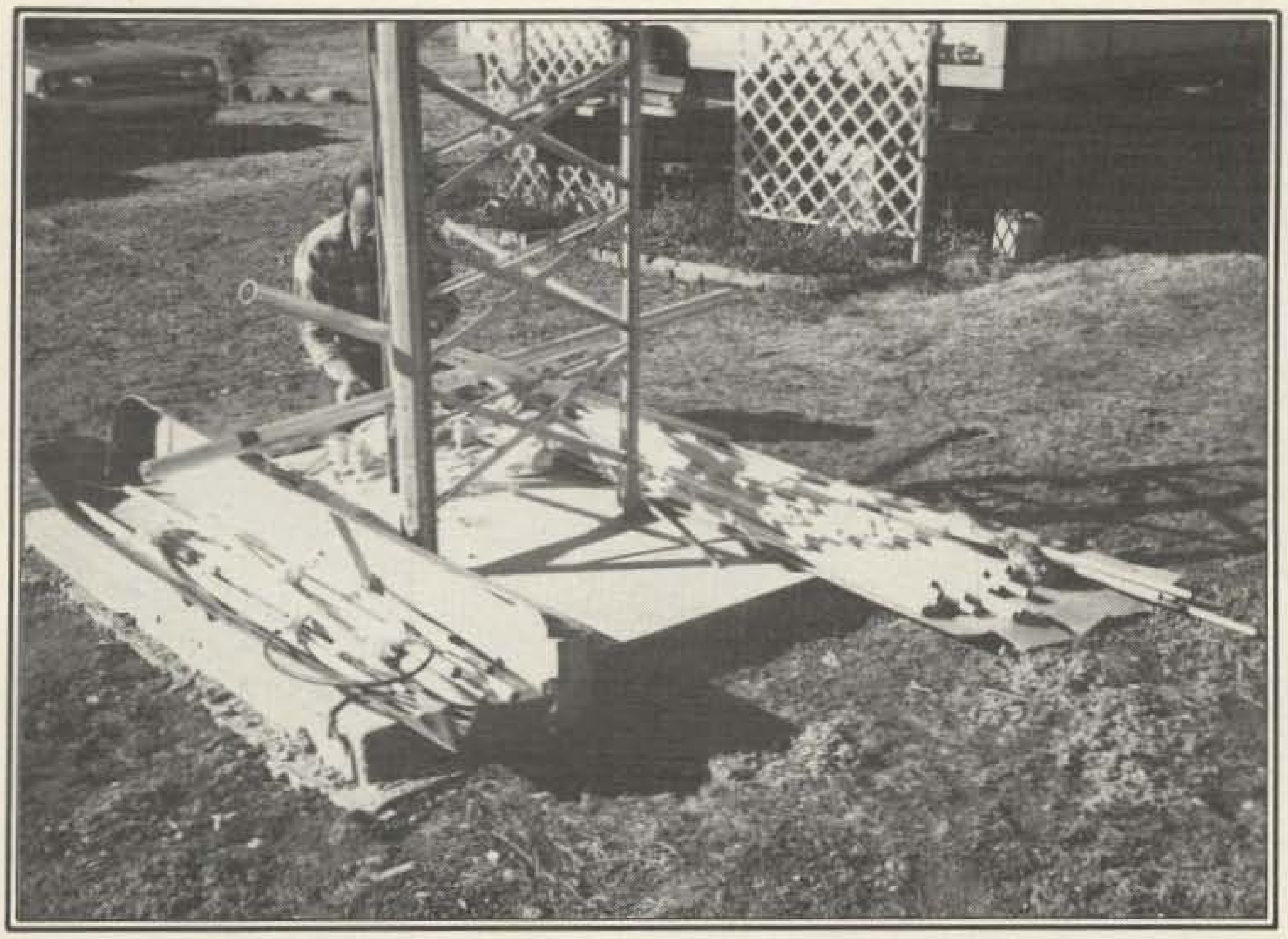


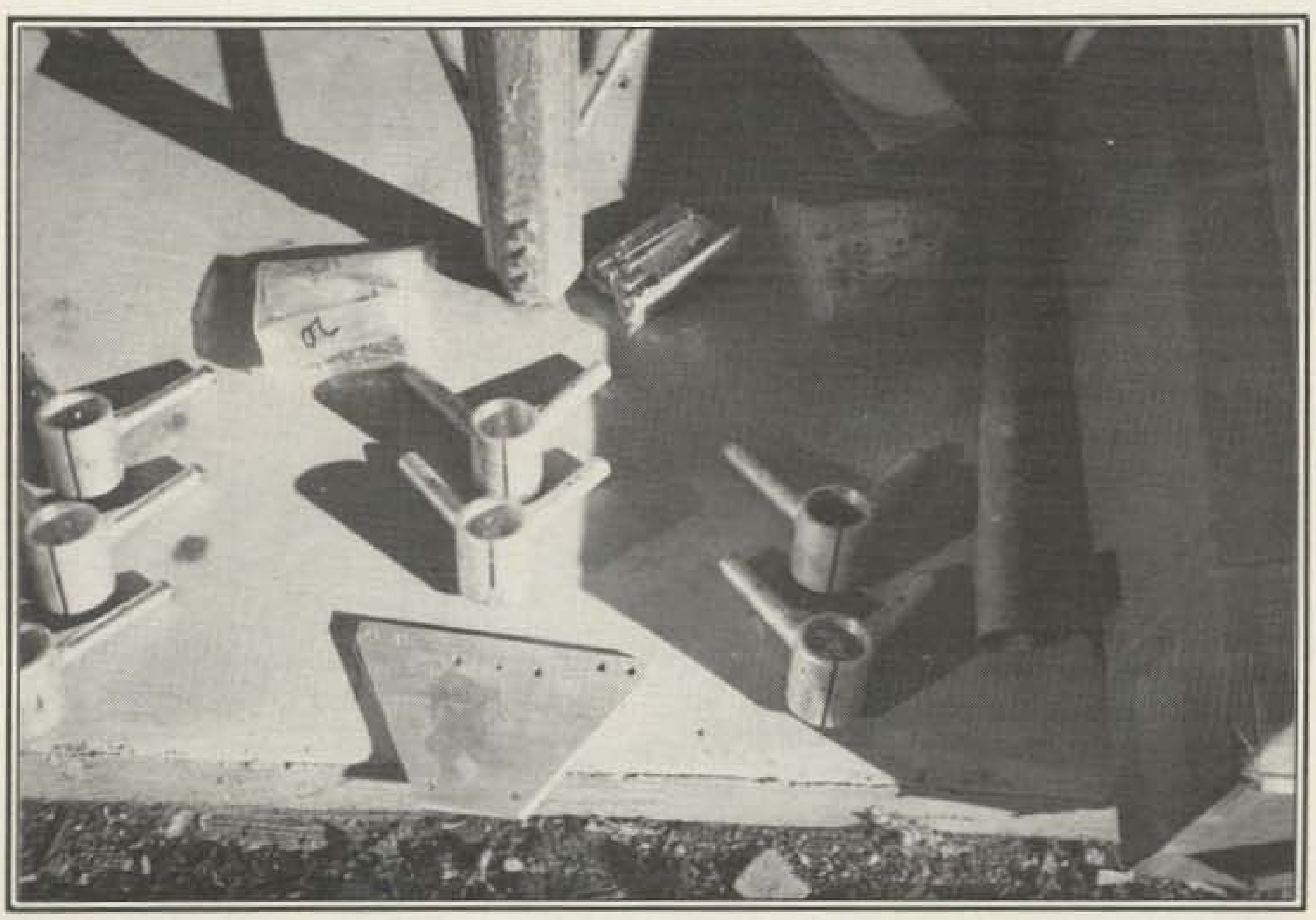
Getting ready to go to work! The antenna comes in two cartons.

Here is one of the element supports.

owned by Bob Hobert, KA1UJ, who is a very active DXer. His company manufactures aircraft and missile components, so Bob sets some pretty high mechanical standards for his products. For example, all the hardware on his antennas is stainless steel—and I do mean all *stainless*. Recently, an amateur complained to me about another antenna manufacturer who advertised stainless hardware, and most of it was. But the screws that held the elements were not, and they rusted out, causing all kinds of electrical and mechanical problems. Being aware of this fact, you can bet I examined all the hardware on this antenna. I guarantee it is all stainless. Additionally, the antenna uses solid machined parts, not castings. All aluminum tubing is AL 6061-T, which is the highest possible quality.

The antenna is shipped via UPS, and ours arrived in fine shape. We laid out the parts on the ground, and construction time (there were three of us; I read the directions while the other two guys did all the work) was 2 hours to put the antenna together and another 2 hours to raise it up the tower and install it in place. There are two triangular-shaped plates that are mounted on the mast from your tower (see photo). When the antenna is hoisted into place, bolts are slipped through this triangular fixture, making the whole system a hinged arrangement. The antenna can then be swung over to its permanent position (or swung over with the boom parallel to the tower in the event you want to work on the beams).

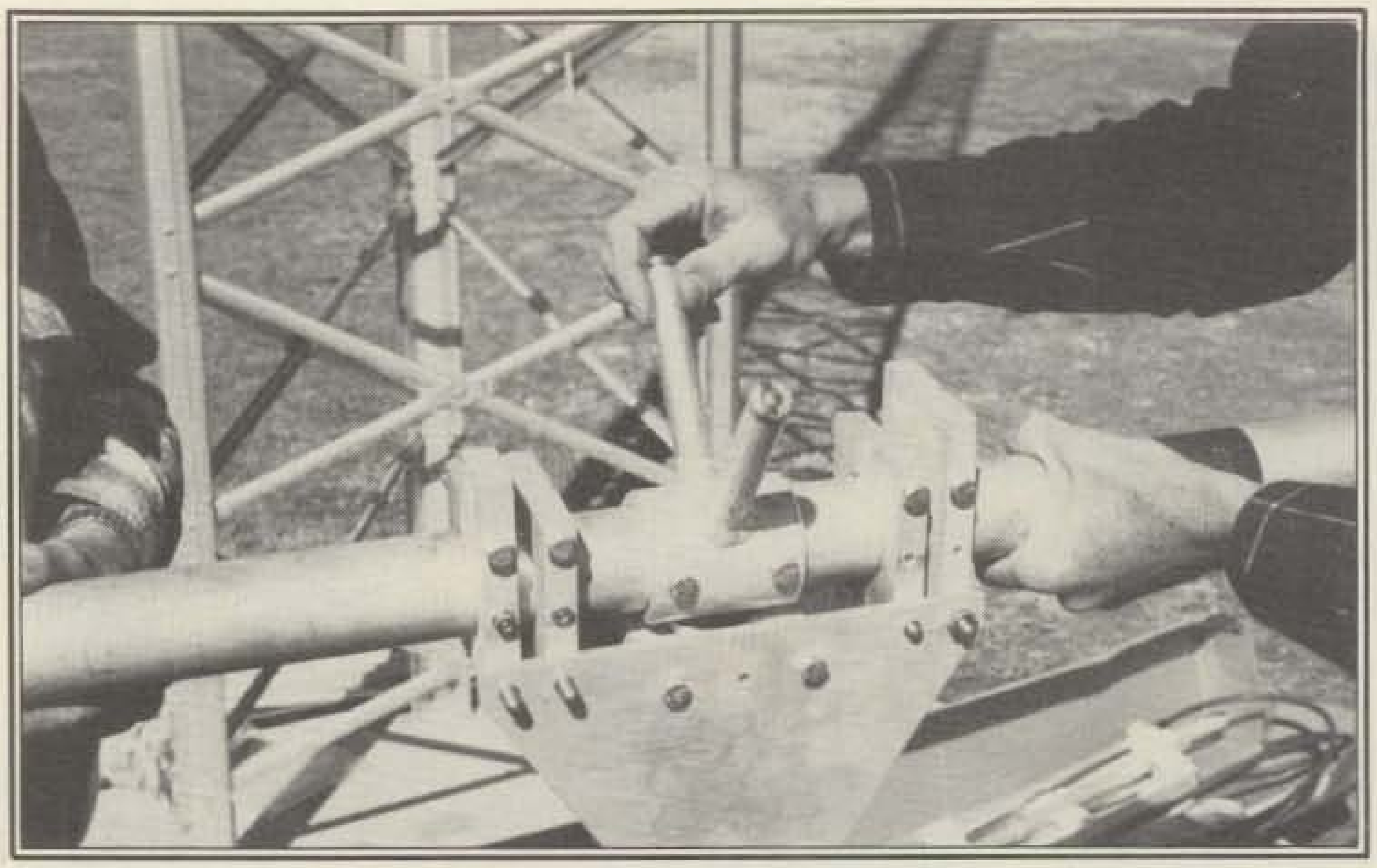
The antenna elements are color-coded for bands and for driven, reflector, or director elements, so putting them together is easy. The instruction manual is more than adequate and gives a check-off step-by-step procedure for construction. To give the reader an idea, I quote from the part about mounting the elements to the boom: "Note: Refer to the Element Assembly photograph. Observe that the elements are assembled on the boom (from the rear of the array) in the following order: (1) 20 meter reflector, (2) 10 meter reflector, (3) 15 meter reflector, (4) 10 meter driven with gamma facing outward, etc." The rest of the manual is just as easy to follow.



The V-shaped pieces are the boom mounting units that support the elements. The triangular piece is one of the units for supporting the boom to the mast.

Big Horn doesn't go into gain figures in any detail in the manual, and I can't help but admire Bob, KA1UJ, who tells me he wants to avoid gain arguments. However, from my own experience with antennas I am not reluctant to do so. The 20 meter and 15 meter beams, two elements each, consisting of a reflector and a director should easily produce an honest 7.0 dB gain plus as measured against a half-wave dipole. On 10 meters, with three elements, you can count on over 9 dB. Both theory and previous range measurements have verified these figures.

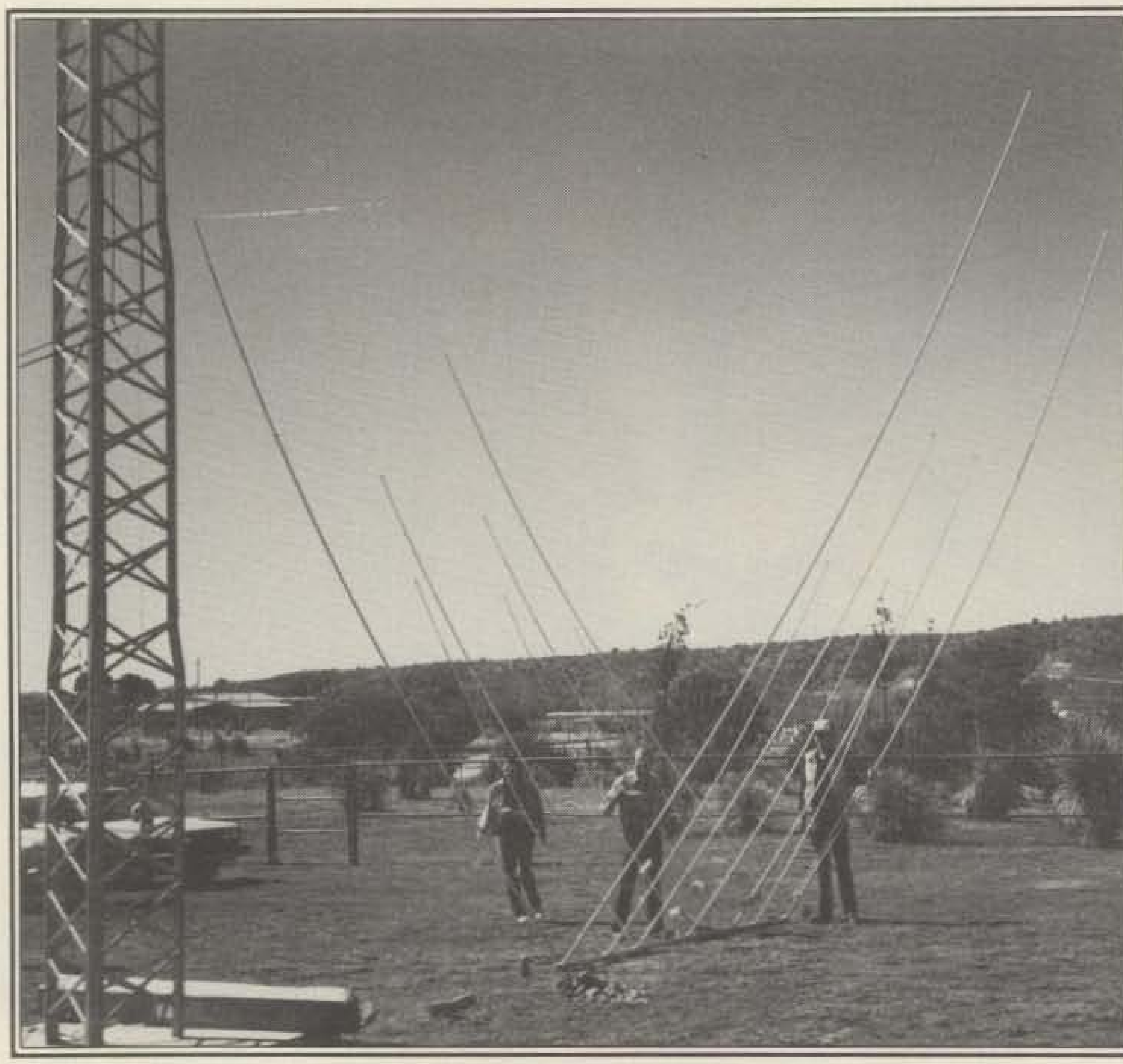
In front-to-back measurements more arguments exist than in anything else. The front-to-back attenuation will depend on the angle of the signal being received. In some cases F/B could be zilch, and in other cases (same antenna) it can be un-



This is the boom/mast support. By removing three bolts, the boom can be swung over on the fourth bolt. We tested this on the tower and it worked FB.

believable. I have made many tests on all three bands using the S meters of three different popular modern transceivers. Some signals that were S9 or more off the front were actually not readable or inaudible off the back. In other cases the F/B might have been only a couple of S units. But I should pause here and state that there were *no* instances of less than two S units on any signal or any band. What I am really saying is that it is impossible to put a hard and fast front-to-back ratio on any beam. In the best cases these beams showed as much as 40 to 50 dB F/B, and probably 10 dB for worst case.

What I just said should have been said a long time ago simply because antenna manufacturers are put into an impossible



All together, ready to go up.

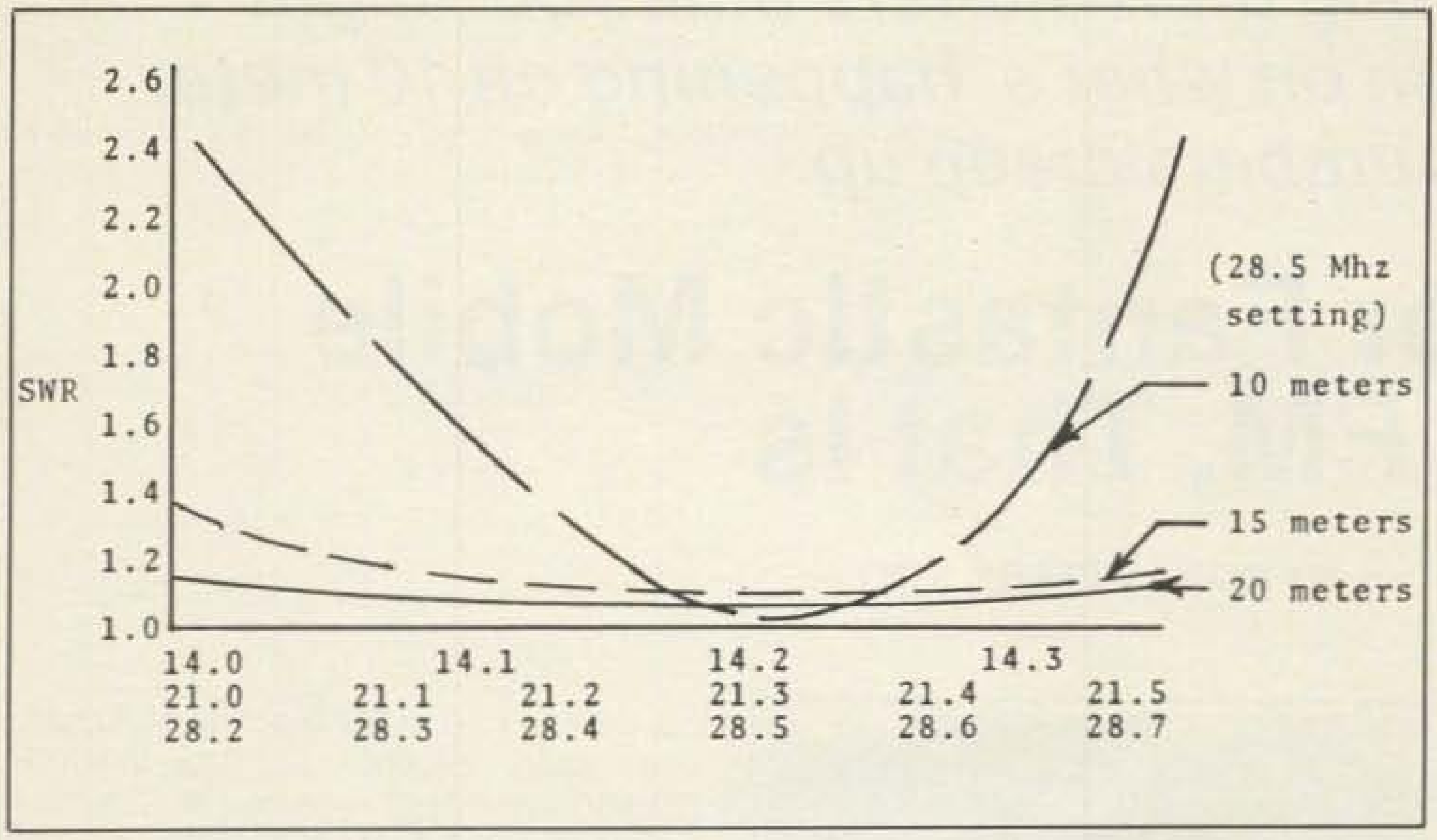


Fig. 1– Manufacturer SWR curves. We found them to be identical in most respects in our tests.

position by amateurs. The amateurs want to know what the front-to-back is, and the manufacturer is faced with providing an honest answer that is impossible to give.

This is also true of standing-wave-ratio figures. It is impossible to manufacture an antenna that will provide a perfect matched condition for *all* locations (unless the antenna is a dummy load!). A manufacturer makes an antenna, his engineers design a matching system, they test the antenna at 50 feet, for example (a popular height), and they set the match for this height. However, what many amateurs fail to realize is that the impedance of an antenna is primarily determined by its height above ground, a good conducting ground, plus the proximity of the antenna to nearby objects. No two installations are identical, and of course this puts the manufacturer in a bind. It is really a catch 22 situation. Well, I got that off my chest. Like I said, the front-to-back on a Delta Loop beam, as with any beam, can be outstanding on some signals and not so good on others.

When we got the antenna up and feed lines connected, my natural inclination was to go looking for DX. I hadn't listened with a Delta Loop for nearly 20 years, and I had forgotten how "quiet" the antenna was. We did the usual thing of switching bands, turning the antenna to see about the front-to-back, and so on. There was no doubt in my mind that here was a really impressive antenna.

The next step was to check out the match. The Big Horn uses individual gamma matches, and we quickly went through the three bands and found that we matched the manufacturer's curve (fig. 1). It was late in the afternoon New Mexico time and we found that all three bands were open. I tried 15 first, aiming the beam at the Pacific and called "CQ DX, Pacific," signing W1ICP/Portable, New Mexico. Yeh. You guessed it, a whole slew of East Coast USA amateurs called me! So much for front-to-back. However, I did pick out a ZL and then a VK who called. They were not reluctant to have me test the beam, and in both cases they gave me 5/9 off the front and inaudible off the back. What did I say about F/B? I then moved the beam around and worked a bunch of JAs. Incidentally, I was running about 100 watts. I got the usual "You are the loudest station from the States" from one JA. Next, we moved to 10 and worked a bunch of South Americans, and then up to 20 to do likewise.

Here are some more vital statistics. The turning radius is 14 feet, and the boom length 13 feet 6 inches. The element arm lengths are: 12 feet on 10, 16 feet on 15, and 24 feet on 20. On a 50 foot tower with the boom at the top of the tower, the top of the antenna (20 meters) is at 70 feet plus. The weight of the antenna is 81 pounds. Just a few days after installing the antenna we had winds of 60 miles per hour (not unusual here at 6500 feet on the Continental Divide). The antenna rode the storm as if there was no wind at all. (Nothing like an aircraft manufacturer to make an antenna!) Power rating on the beams is 2 KW PEP, but I see nothing that wouldn't take more power if we could run that much. If the FCC is reading this I am only joking, but the antenna is very rugged. One last feature if I failed to mention it earlier is that the Delta Loop is not as likely to receive rain and snow static because it is a closed Low Q loop.

The price class for the three-bander is $769.00. It is manufactured by Delta Loops Antennas, 44 Old State Rd. Unit #18, New Milford, CT 06776 (phone 800-223-3718 or 203-355-3718). A catalog is available on request. CQ