Here's a terrific idea that can be accomplished for very little money and can turn you instantly into a big gun (in one direction, that is).

Build The Ultimate Quagi Antenna

BY MICHAEL MARDIT*, WA2VQW

Having lived in apartment buildings for most of my life and having to "make do" with random-wires and indoor antennas, the availability of a small piece of property at my parents' summer home in the Peekskill, New York area afforded me the opportunity to experiment with the Quad and Yagi antennas. High elevations and WA2VQW never seemed to coexist together, and I discovered quite quickly that at 30 feet in a heavily wooded area the Quad was the better performer. Thus, the Quad became the antenna of choice for me.

In 1982 my wife and I relocated from New York City to the suburbs. Having been relatively inactive in amateur radio for about six years, the climbing sunspot cycle, and dreams of 15 meters blossoming again (it always has been my favorite DX band) prompted me to dig out the Quad and spend some time in the pursuit of DX. The homebrew mounting hardware for the old two-element duo-band Quad was still on hand, but the spreaders had to be done.

I found from previous Quad work that bamboo poles painted with a good-quality oil-base paint, followed when thoroughly dry by a vinyl tape wrap with 50% overlap, would be weatherproof for many years. The two-element homebrew Quad is of conventional design, so it will not be detailed here. The Quad was reassembled without extensive effort and was mounted atop a 30 foot telescoping aluminum mast by Bob, N2DVQ, who is totally undaunted hanging upside down 30 feet in the air. The duo-band Quad was used for four months and it performed well. *(If you would like a relatively quick education in Quads, I would suggest that you read Bill Orr's book Cubical Quad Antennas.* It is available from CQ's Book Shop.)

A two-element Quad, however, is at best only a 7 dBd antenna, and I was not satisfied with that. What I really wanted was to have an antenna that would be extremely competitive in one direction, but capable of a fair amount of gain in all other directions. Furthermore, it must be low in cost, be capable of working well at relatively low heights, must use materials readily available, and must not be dependent on a strong tower for support.

I looked at the survey map of my lot (fig. 1) and I noticed that the distance from the back of my house, where the Quad is situated, to the farthest point on my property was at a bearing of 337° NW. A rather

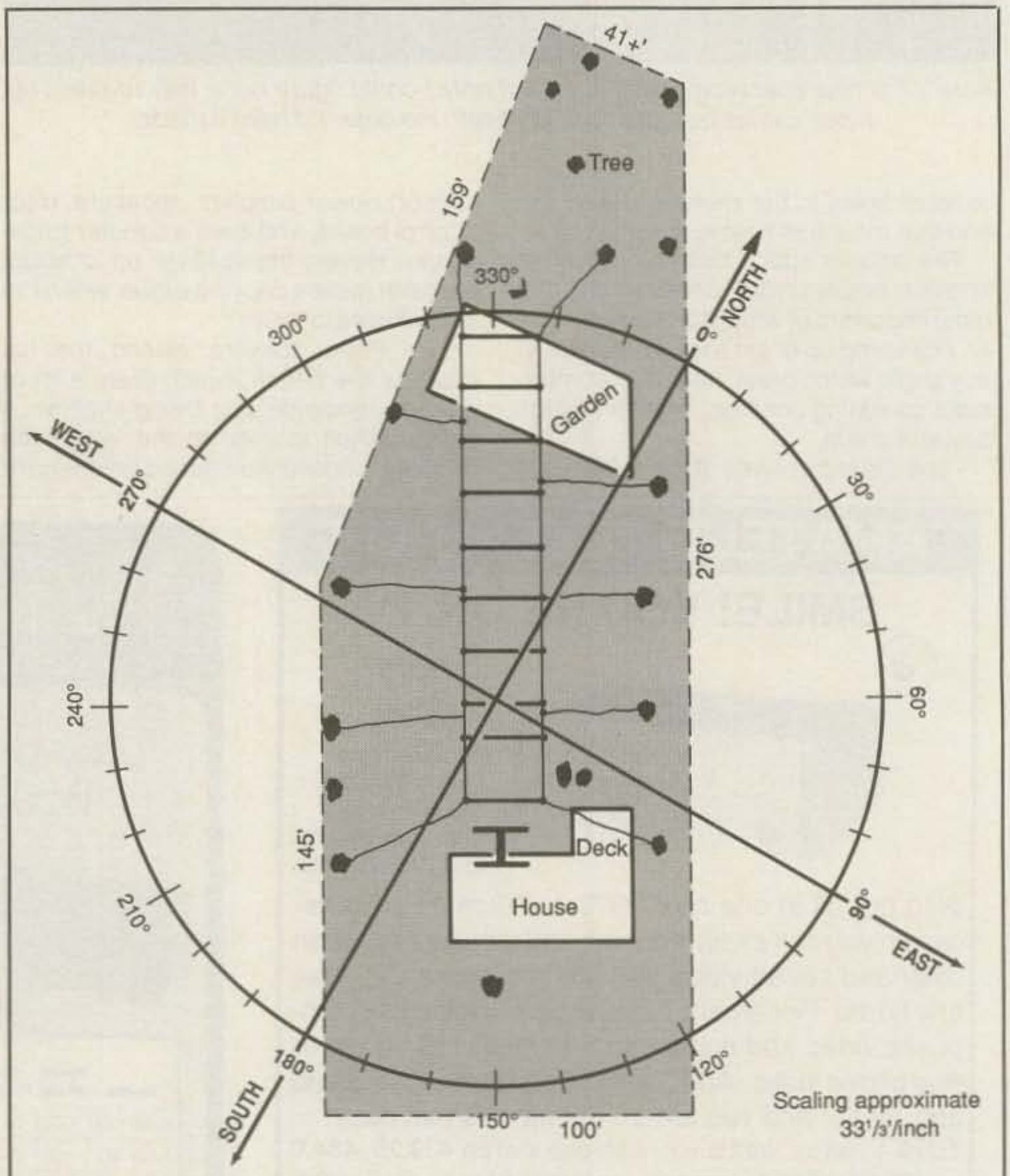

Fig. 1– Plot diagram of the author's property. The black dots represent trees.

*642 Challinor Dr., Yorktown Heights, NY 10598

Say You Saw It In CQ

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Director	Director Length	Optimum Director Spacing For 15 meter Monoband Quagi (F = 21.225 MHz)		
D1	20′10½″	QD—D1	8′11″	S1
D2	20′9″	DI—D2	18′5″	S2
D3	20′7¾″	D2—D3	9′10″	S3
D4	20′6½″	D3—D4	14′7″	S4
D5	20′5¼″	D4—D5	14′7″	S5
D6	20′4″	D5—D6	14′7″	S6
D7	20′2¾″	D6—D7	14′7″	S7
D8	20′1½″	D7—D8	14′7″	S8
D9	20′¼″	D8—D9	14′7″	S9
D10	19′11″	D9—D10	14′7″	S10

Table I– Overall dimensions for the 15 meter Quagi.

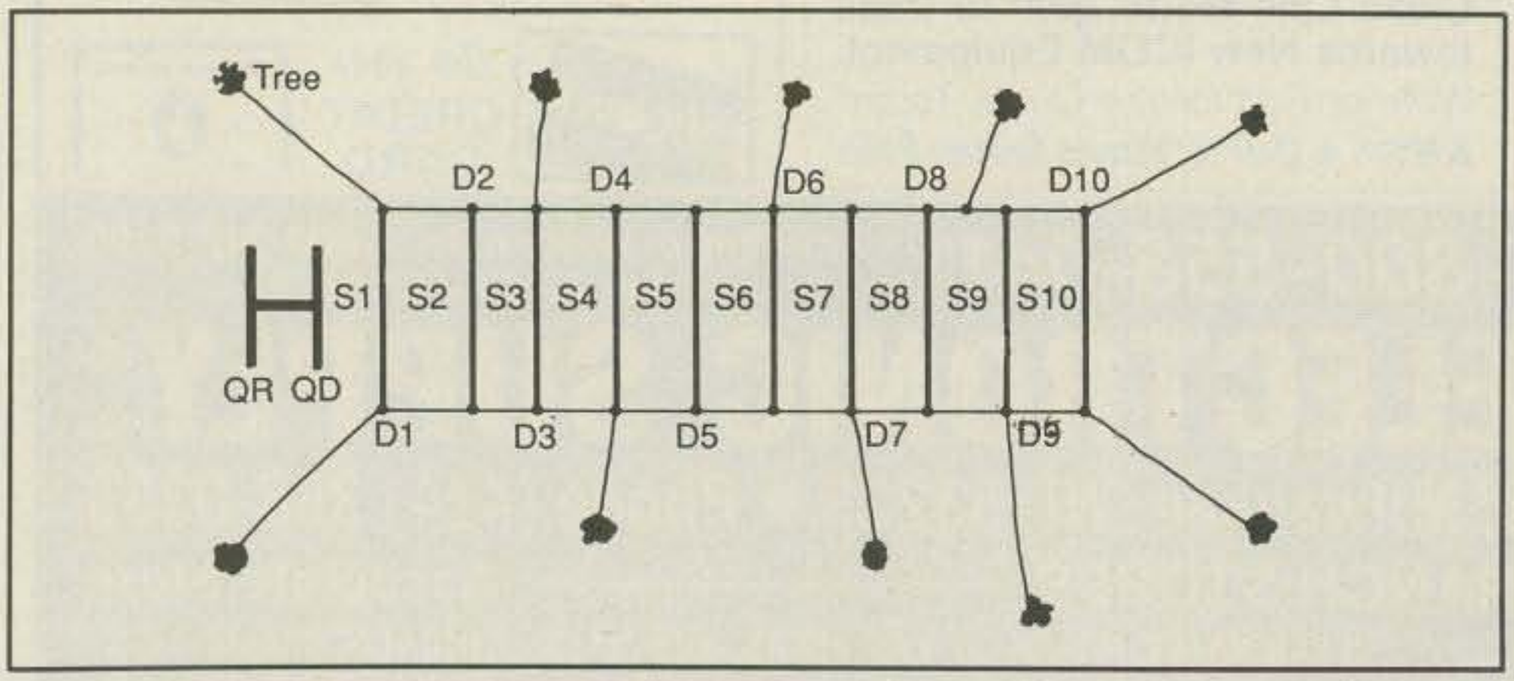


Fig. 2– The two main runner lines and side support lines are braided ¼ inch nylon solid-core rope draped over appropriately positioned tree branches as high above ground as the Quad boom is elevated.

large fixed wire beam could be erected in this direction to take full advantage of the layout of the land, but this would be a unidirectional antenna and not afford rotation. Also, what to do about the Quad?

This puzzled me for a time, but then while troubleshooting a failure in my antenna rotary switch, the idea came to me of a rotatable Quad as the "center pole" of a "rotary switch," with an "array of Quad directors" at one or more of the "peripheral poles" of the switch! It seemed an overwhelming task to try more than one set of Quad director arrays in an experimental antenna of this type, and my available time and space being somewhat limited, I decided to utilize the one direction which would be most profitable—the one at 337° NW.

Now how to implement such an idea? A walk into the backyard revealed about two dozen tall trees scattered about. They would be useful as antenna supports, but not for Quad elements. However, for supporting line ropes which in turn would support an array of Yagi directors, they would be ideal! I'd built UHF Quagis of the eight-element version for TV channels 20 and 50, and they worked admirably at relatively low heights. So suppose I positioned a number of horizontal wire elements for 15 meters in front of the 20/15 Quad and supported them with ¼ inch nylon ropes between the trees? I had room for ten directors with some space left over, so ten it would be.

Inasmuch as the directors would be made of #14 wire, the same gauge as the Quad elements (and not tubing), the lengths of the directors would have to be scaled up appropriately from the UHF design *(See "Scaling Antenna Elements," W7ITB,* Ham Radio, *July 1979, p. 58).* (See Table I.) A network of ropes between trees ensued (fig. 2), and when it was finished I had a 12-element Quagi at 30 feet supported by 10 trees bearing down on Japan, Korea, the Phillippines, and parts of China not previously frequented by the presence of my signal.

Before discussing tests, a brief discussion of element spacing is in order. When using a duo-band Quad for 20 and 15 meters, optimum spacing as calculated between the Quad driven element and first Yagi director (in a 15 meter Quagi) is not physically possible if 360° Quad rotation is desirable. In order to facilitate Quad rotation it was necessary to move the ten-element director array forward, just enough to clear the Quad's turning radius. The antenna characteristics presented here were obtained at this altered spacing.

Having completed the assembly, and the positioning of the array at the scaled distances from the Quad, the SWR of the hybrid beam was checked. The SWR changed when the Quad was rotated into the array of directors, and returned to its nominal value when the Quad was ro-

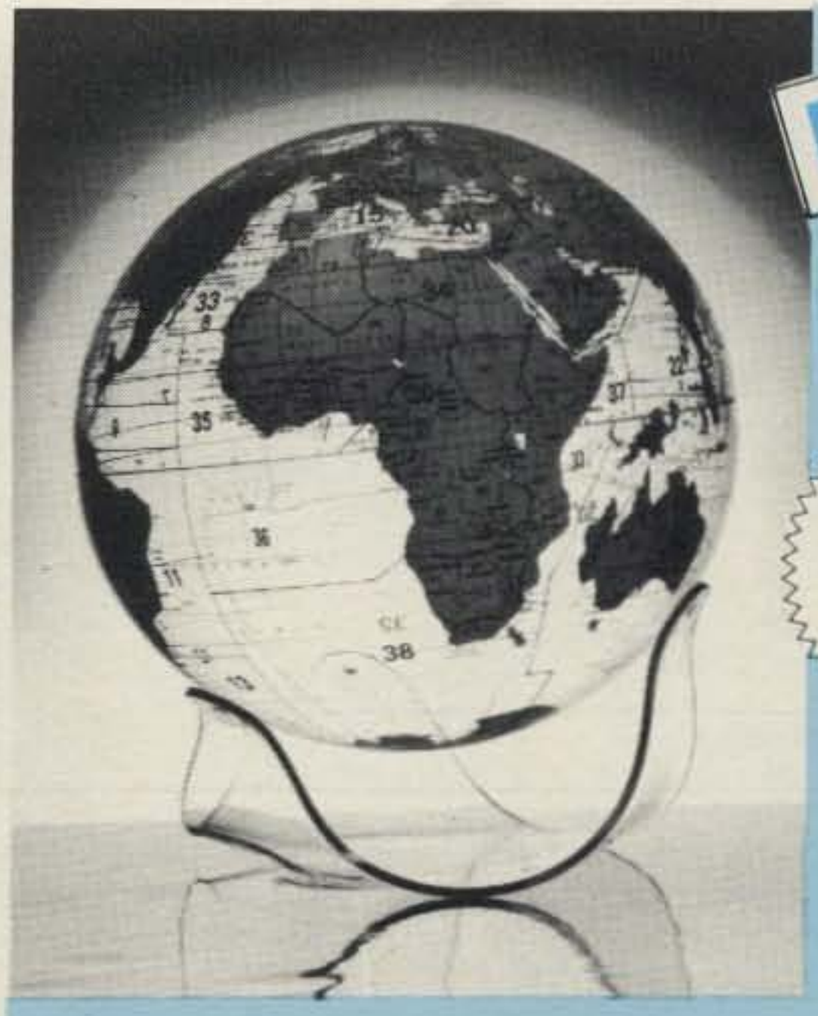
tated out of the array of directors. The calculated impedance out of the array is 60 ohms, SWR = 1.2:1; and into the array, 45 ohms, SWR = 1.6:1.

My system is set up for RG 11/u coax, with a sleeve balun for matching. The gain performance of the original two-element Quad does not appear to be degraded in other directions, but is magnificently enhanced to JA/HL and YB. The estimated gain of the 12-element Quagi approaches 14 dBd, and the SWR never exceeds 2:1 at any point on the band at my installation. This estimation was arrived at by the following. **On Transmit:** Output power and antenna data were collected from over 150 stations along the beam path of the Quagi antenna, 337° ±20° referenced on Yorktown Heights, New York. Using this data, the approximate Effective Radiated power of the transmitting station was calculated. The signal reports sent and received were compared. The difference was compared with the ERP at WA2VQW. The apparent Quagi gain along the beam path was determined. **On Receive:** Many signals that were received at S4 level on a quiet band with the Quagi were just barely discernible with my drooping ground plane the feed point of which is at 42 feet.

The total length of the antenna from the back of the Quad reflector to the most distant director is 150 feet. The beamwidth appears to be near 40° for greatest effectiveness.

One aspect of the antenna which is noticed immediately is how quiet the receiver becomes when the quad is rotated parallel (coupled into) the director array. The stateside signals, especially the high-angle signals on short skip, tend to disappear into oblivion. The front-to-side ratio is noticeably higher than the front-to-back ratio, but these parameters are difficult to measure accurately here, because one is comparing the two-element Quad part of the antenna in all other directions to the whole Quagi array. This data is subject to errors and anomalies caused by "over-the-pole" and excellent north/south propagation due to my choice of antenna orientation. An estimate using my old Swan 500 transceiver (my current station exciter) shows at times a F/S ratio of 24 dB and a F/B ratio of 20 dB, but varies considerably up and down from morning to evening—with changes in propagation. It also appears to be dependent upon the wave angle and level of absorption at the time.

It is not uncommon for me to receive calls from South America when my array is on Japan and north/south propagation is good. Patricia, LU1FIY, has called me several times with the Quagi pointing to Japan when I am calling for DX without specifying a direction. Signal strengths, however, are markedly reduced. In another situation Tad, JH1MTO, gave me 5/9 + 10 and after turning the Quad re-



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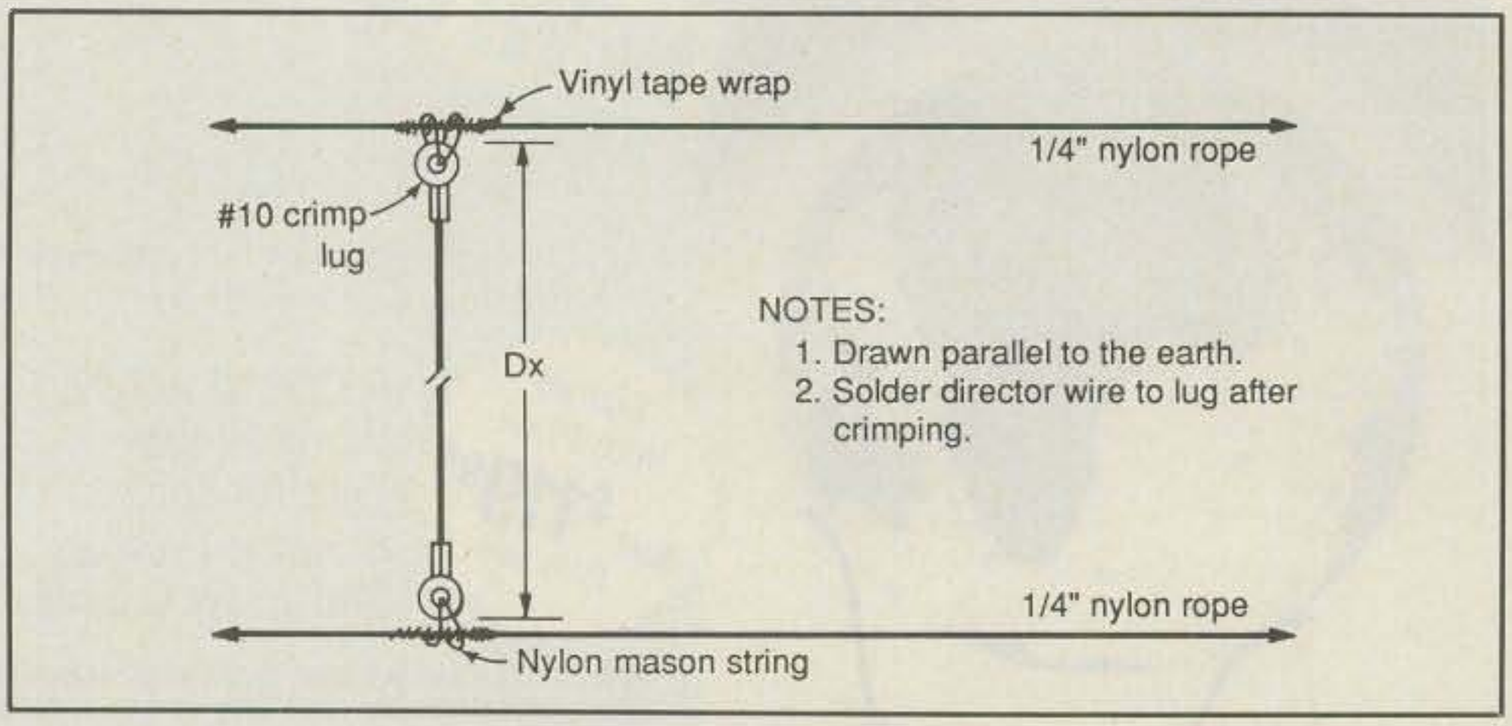

Fig. 3– The director wires are #14 stranded, insulated, the same wire as I used for the two-element Quad. The method of attachment of the directors to the ropes is as shown.

flector to him only 5 and 1.

Tests conducted with Jay, NE2Q, using his six-element mono-band Yagi at 100 feet, running the same output power, antenna pointing to Japan, show his received signal to be equal to mine with the Quagi. With Jay's mono-bander at 40 feet his signal is about one S-unit stronger. Jay's elevation above sea level is 750 feet compared to mine of 500 feet. No doubt ground reflection reinforcement of his signal at the 40 feet level is occurring here.

The on-the-air results of this hybrid antenna have been most rewarding from the very first contact. After completing the final positioning and tensioning of the ropes, it was almost time for the evening meal. I made my first CQ DX NW call hurriedly on an active 15 meter band where only Europe and South America were being heard. WB5LBJ/DU6 answered me from Iloilo in the Philippines for a new country!

A few evenings later I called again and the flood gates to Japan opened up. You'd think I was on Palmyra! It didn't stop for over two hours! Many JA's told me that they didn't know the band was open to W2 because they were not hearing East Coast signals at all!

Over the last several months I've spent about 60 hours using this antenna, and I've worked over 400 stations in Japan and over three dozen total in Indonesia, the Philippines, and Korea. Many of the rarer DX stations stop by to see who's under the pileup and drop their calls for me to answer. I've "stood by" to listen for stations outside of Japan who might be calling me and have been called by BV2FA, BY1QH, BY4SZ, many HL's, and others along the beam window. When polar propagation is really good, I've been called by rare stations outside the window such as 9N1MM and 8Q7AC. This antenna has been responsible for originating real pile-ups, and then I turn over the frequency to the DX and QSY to do it all over again. My signal reports have been running 5/7–5/9 from Japan, when conditions are good, about 2 to 2½ S-units greater than their signals are received here. The average JA station runs 100 watts output, and from 4 to 6 elements at 45 feet. My output power to the antenna is about 600 watts average.

Subsequent comparison reports with several other local stations running equivalent power to large mono-band Yagis at 50–75 feet show their signal to be equal to or weaker than the Quagi in signal strength in the JA direction—a good part of the time. The Quagi's stateside rejection when pointed to JA is markedly better than the competition on receive, though, and it has enabled me to have real QSOs of 30 to 45 minutes along the beam path. All this from a roll of #14 wire nylon rope and a basic two-element Quad at low height!

I will point out that it is not mandatory that ten directors be used. I used ten because I wished to maximize the available space, and many natural supports were also available to assist me. As few as two directors would show a worthwhile improvement over the Quad alone. Also, there is no reason why the 15 meter Quagi could not further be scaled up to 20 or even 40 meters.

The next phase of the experiment will be to place a wide mesh screen behind the Quad reflector to hopefully improve the F/B ratio.

I would be interested in hearing about your results with this configuration, but if your direction of choice is through the northeast corridor, there is no need to write to me. I'll know! See you on 15 . . . CQ DX NW beaming JA, HL, and BY.

I would like to thank all the stations too numerous to mention who assisted me by giving me data on their station's components and reports on the Quagi. Special thanks and appreciation are due Bob, N2DVQ, for his time, effort, and encouragement, without which the Quagi would still be on the ground.

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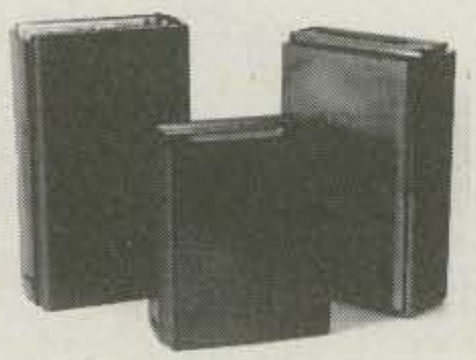

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