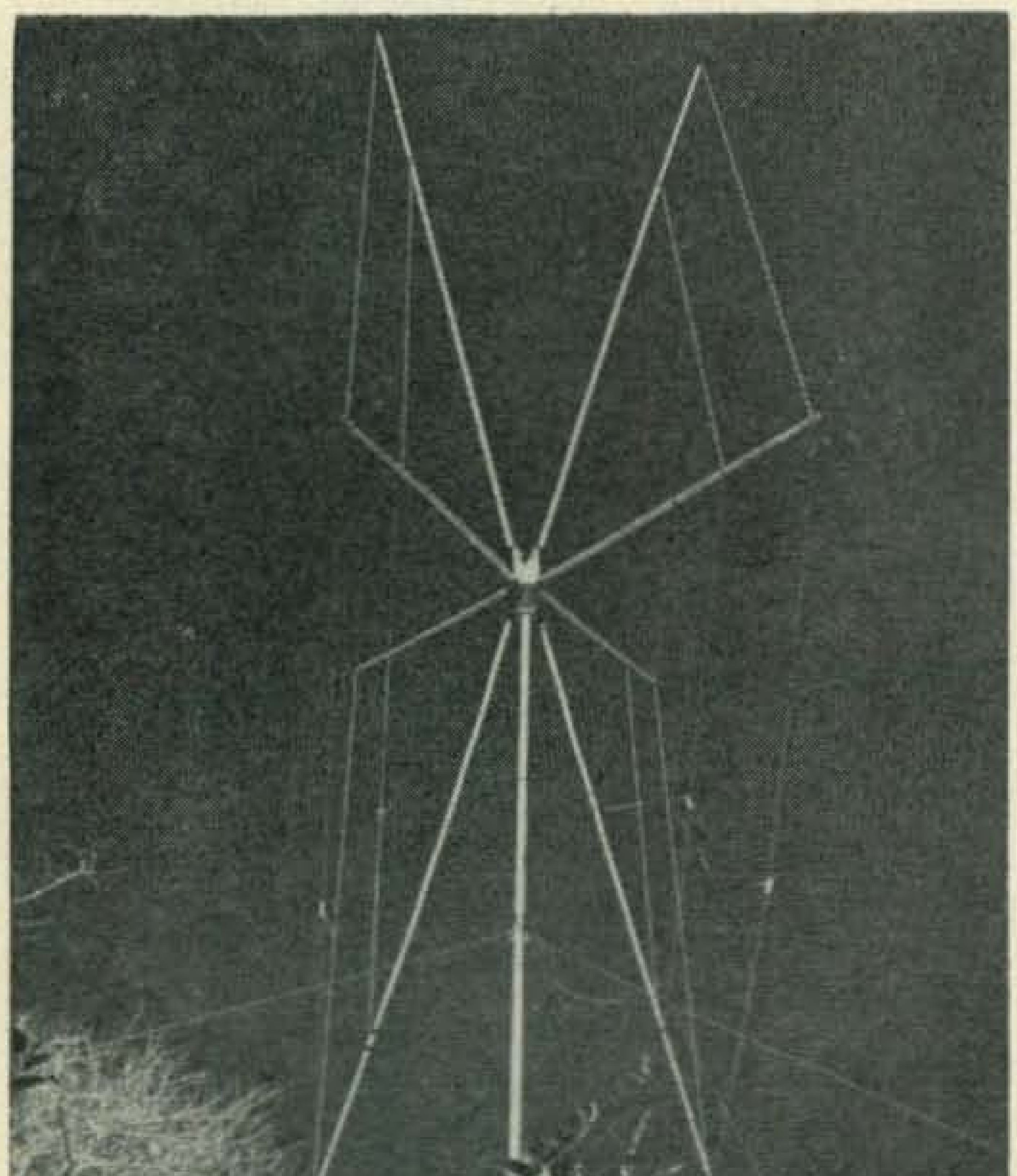
The Delta Quad

BY JOE WILLIAMS*, W6SFM

A one tenth wavelength spacing between the driven and parasitic elements is constantly maintained by the configuration of this quad. Therefore, an impedance of 50 ohms is derived for all bands. The unit is constructed for 10 and 15 meters but may be put on 20 by lengthening the bamboo poles and adding the two elements.

THE quad antenna has gained world wide popularity and this popularity has sound basis. The amateur operator using a quad has several good things going for him at the same time. A most obvious advantage is the fact that a quad is a two element parasitic array and will deliver almost an "S" unit of just plain gain. The top and bottom wires become phased to make a form of colinear antenna. The spacing from top to bottom creates a diversity effect and the low angle of radiation makes it a favorite with DX operators.



Overall view of the "Delta Quad". Single coax feedline handles both the 10 and 15 meter antennas. Parasitic elements are tuned by *LC* components but stubs may be used as listed in the construction data. Photo by Robert Jensen, W6VGQ.

*4150 Beck Avenue, North Hollywood, California

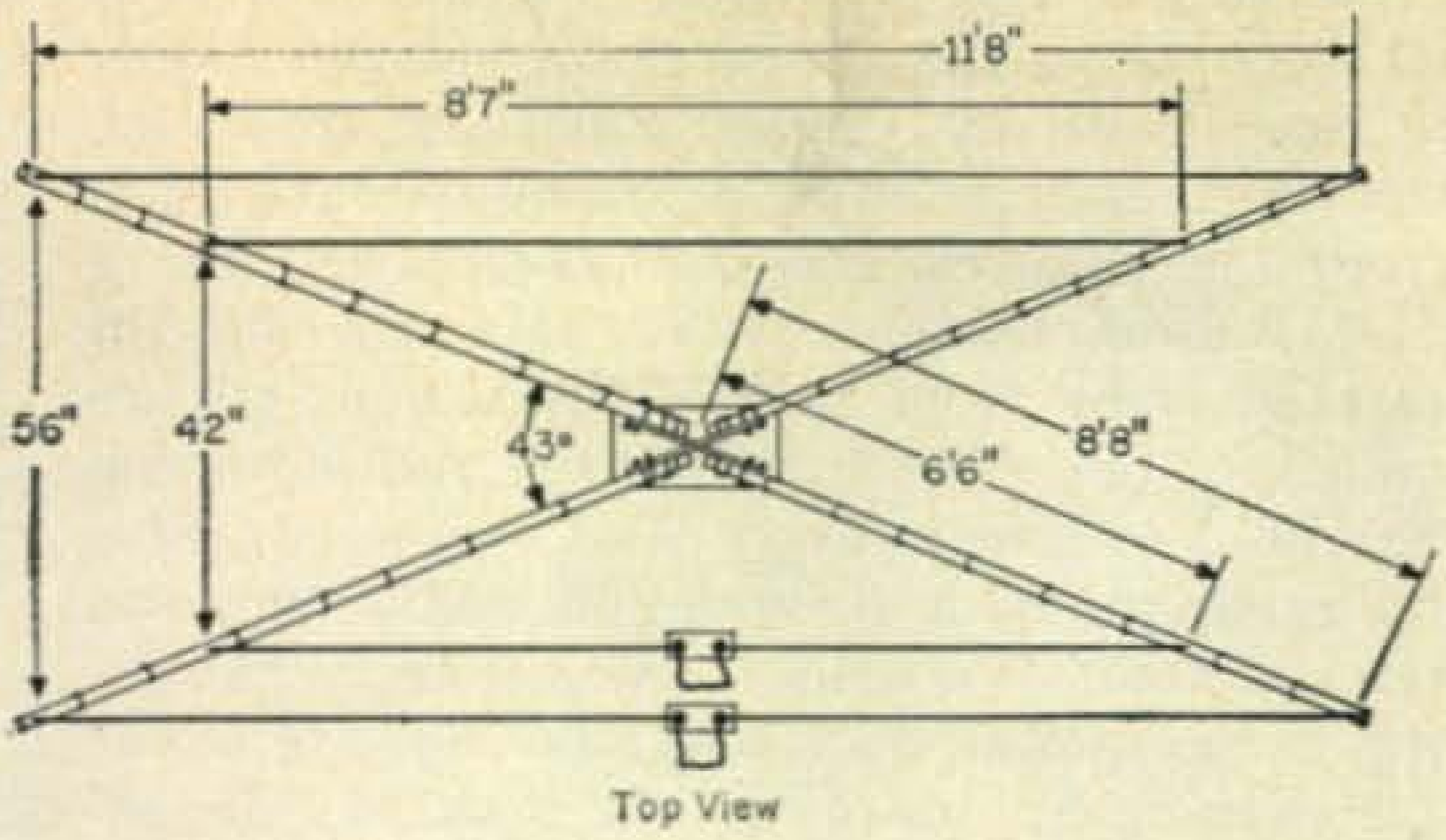
When a ham goes to the trouble of flying a batch of bamboo, he likes to get the maximum use from it. Mechanically, it figures that once a quad has been built for a lower frequency, say 14 megacycles, there remains wasted space that may be used for higher frequencies. So, we have the multiband quad. But, there is one persistent bug-a-boo which attends conventional cubical quad multiband design. It is the differences of radiation resistance of the respective driven elements. The Delta quad, based upon a configuration suggested by K6JT (ex W2OA), seems one solution to that problem.

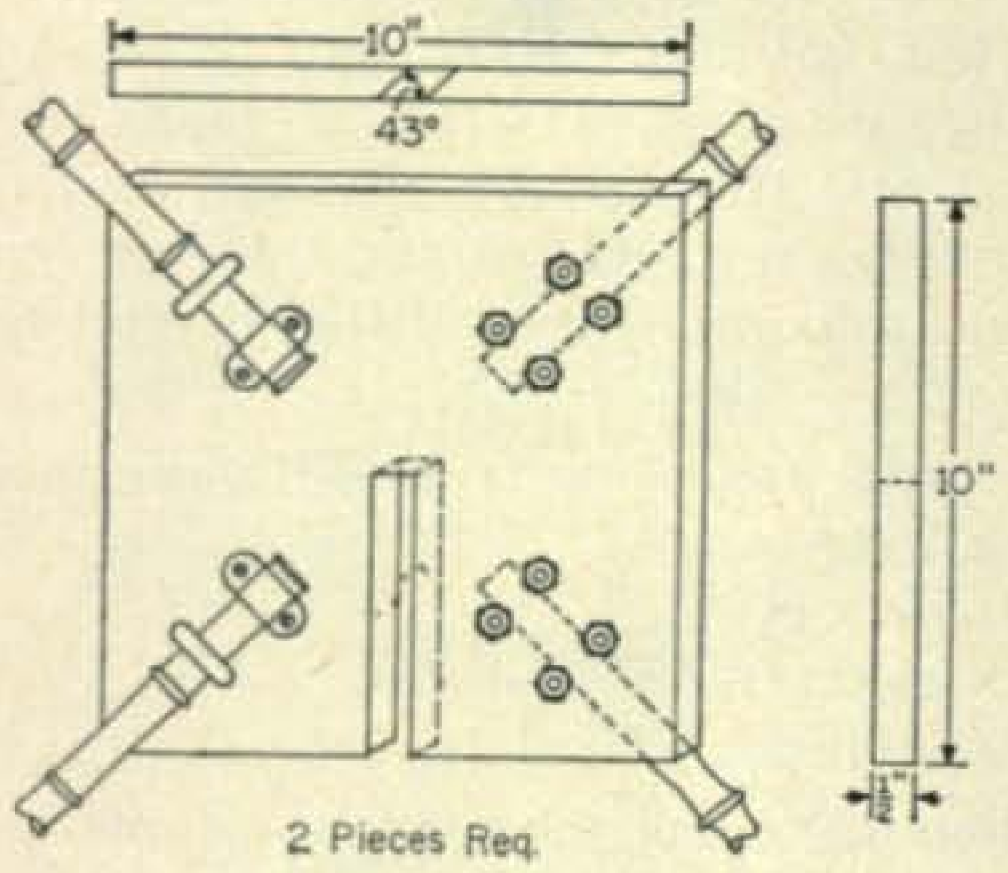
In addition to the 90 degree angular pattern familiar to the cubical quad, this antenna has an "X" shape when viewed from above. The supporting bamboo poles (9 feet long) which form the antenna-reflector relationships are mounted in a manner which produces a one-tenth wavelength spacing for each frequency band element pair. The lower frequency limit is determined by the lengths of the poles. (For a 3 band antenna covering 20, the poles would have to be 13′ 3″ long.)

One-tenth wavelength spacing in a quad antenna results in a radiation resistance of about 50 ohms if the array is situated ½ wavelength or more above the ground. Thus it will be seen that each antenna in such an arranged multiband combination should exhibit the same radiation resistance (50 ohms) if the family of antennas is high enough to provide ½ wavelength separation from ground at the *lowest* frequency concerned.

Once the shape of the Delta was realized, a close inspection of the literature[1] led to the

[1] Orr, W.I., "All About Quad Antennas," *Radio Publications*, Wilton Conn.
Jones, A.K., "Antennafax,", *CQ* July, 1960, Page 32.
Hess, M.G., "Single Line Feed for Tri-Band Quads," *QST*, August, 1959, page 20.
Adolph, E.H., "Three Band Quad for Field Day," *QST*, April, 1961, page 30.





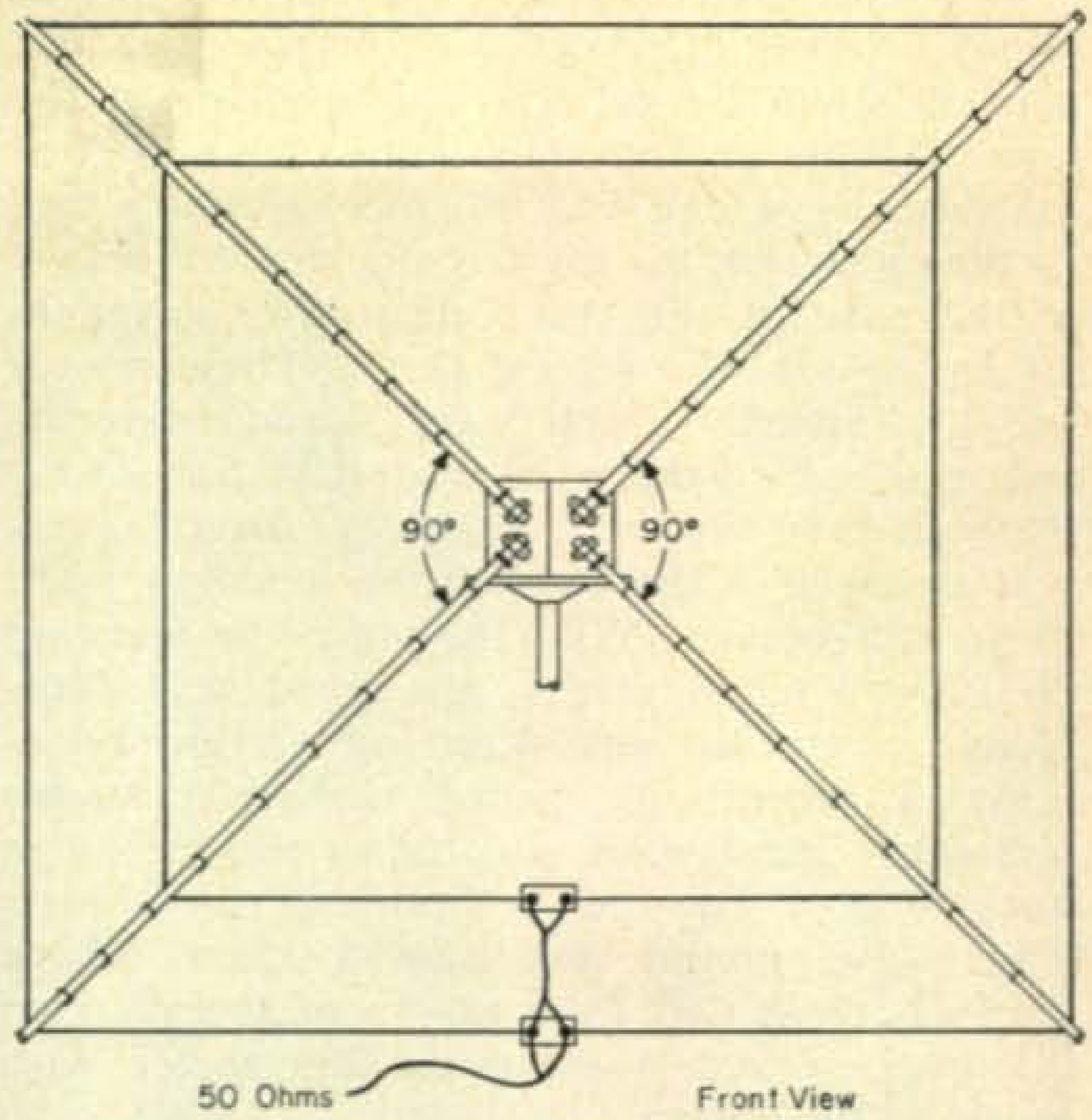


Fig. 1—Construction data for the "Delta Quad". A horizontal angle of 43°, as shown, will provide a one tenth wavelength spacing. The vertical angle should be 90°. A sketch of the support is shown and is elaborated on in the text. The stubs may be replaced by lumped *LC* constants. The rear bay is not shown as it is directly in line with the front bay.

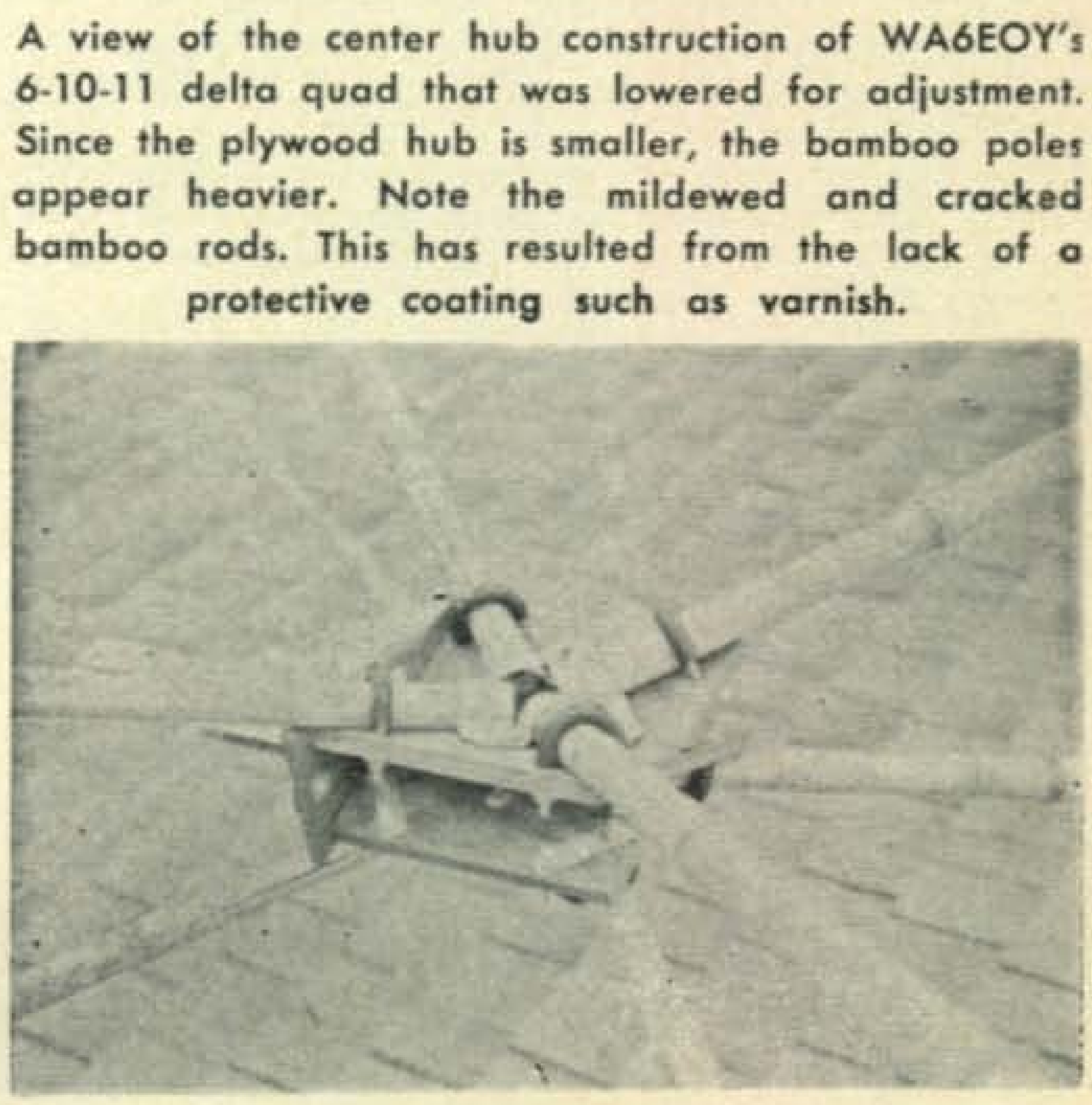
conclusion that simpler multiband quads could be devised. In order to employ the existing low pass filter and coaxial transmission lines, the radiation resistance of 50 to 52 ohms was the design hinge.

A practical Delta for 15 and 10 meters was built at W6SFM and is in current use. This compact beam has no boom, is very light, has excellent mechanical balance, requires little adjustment, uses an inexpensive mast and is fed with a single transmission line of RG-58A/U which is connected directly to the driven elements. A forward gain of 5 db is assumed. The measured front to back ratio of the 15 meter section is 24 db. The front to side ratio is 30 db. The angles of radiation should be 26 degrees at 21 mc and 18 degrees at 28 mc.

Construction

A support to provide the required 43 degree angles was made from plywood. Two 10" squares of ½ inch ply were slotted to permit the construction of an "X". Another small piece of the same material was used as a bottom plate for the "X". Weldwood glue and long wood screws were used to join these pieces. The "X" provides four flat surfaces for the attachment of the eight poles. "U" bolts (1½") and "U" straps (1") were used to do this. Short pieces of rubber windshield wiper hose were slipped on each "U" bolt to prevent bamboo cracks. The "U" straps were attached with wood screws. A reinforced heavy duty TV mast clamp was bolted (¼" galvanized) to the bottom plate of the "X" support. The bamboos were carefully measured and trimmed so that a knuckle ring remained at the base end of each pole. This ring was sanded flat on one side down to the level of the body of the pole. This made a better fit on the support and discourages rotation of the pole. The wire holes were pre-drilled (⅛") parallel to the sanded flat on each pole. The base segment of each bamboo was wrapped with friction tape to help prevent splitting. Where necessary, a build up of friction tape was used under the "U" strap at the base of the bamboo to insure a snug fit. The pole tips were plugged with plastic wood and bound with a few turns of plastic tape. The bamboos and the plywood "X" were each given three coats of spar varnish.

A view of the center hub construction of WA6EOY's 6-10-11 delta quad that was lowered for adjustment. Since the plywood hub is smaller, the bamboo poles appear heavier. Note the mildewed and cracked bamboo rods. This has resulted from the lack of a protective coating such as varnish.



The mast consists of 3 ten foot sections of thin wall steel (1¼" O.D.) TV masting. The mast is manually rotated and is guyed at the nine and the twenty foot levels. Supported at the base by a ball bearing race assembly and its pipe pedestal, the mast is slip sleeve clamped to the eave of the shack. It is wire guyed at 20' by the use of a second sleeve. These sleeves are 1½" pieces which were sawed from the swedged end[2] of the bottom mast section. Other methods may suggest themselves. An 18" slack was arranged in the coax at the wire guy point to permit rotation. With the aid of an assistant and two kitchen chairs, the quad was completely assembled and wired on the ground.

As a protection against canyon draughts and other local wind conditions, the spreaders were braced by the addition of cross-guys. Thirty five pound test monofilament fishing line was cross tied from the front spreaders to the back spreaders using the ten meter wire holes as tie points.

The top section of the mast, with its guy wire rig attached, then was securely clamped into the "U" bolt of the TV mast fixture on the bottom of the "X" support. The quad was then stood up and walked to the mast site. After we added the middle mast section, the assembly was hand over handed onto the waiting bottom mast section. From a scratch start the material cost of this beam, including mast and coax, should run to about $23.

Adjustment

The reflectors should require little or no adjustment if the suggested dimensions are used and good geometry prevails. These antennas were cut for the c.w. portion of each band. For higher frequencies within the bands all parameters become smaller if optimum performance is to be realized. The builder should consult the book if such construction is planned. If front to back ratio improvement is found to be necessary, the quad can be lowered by removing the center mast section and stub adjustments can then be made.

Stub adjustments are most easily made by setting the antenna for optimum front to back ratio. In this case the quad is oriented so that its *back* is to the transmitting station. Using a lamp cord "S" meter extension from the station receiver or using a headphone extension from the receiver, the stub is adjusted for a *null*. Variations in forward gain are difficult to read while front to back measurements are quite obvious. The transmitting station should be 500' or more away and *must* be using horizontal antenna polarization. (My check station is about 1½ miles away-airline. When using stubs, back-to-back alligator clips are handy for clipping up and down the stub. My dimensions include a stub length which is calculated to be adequate to the 'bottom' of each band. After the optimum F/B spot is found with the alligator clips, a strap is soldered across the stub and the surplus (if any) is removed. Incidentally, in a quad of good design; optimum F/B and maximum forward gain tend to coincide.

The stubs are made from 3" wide open wire and the lengths are:

20 meters: 38"
15 meters: 22"
10 meters: 17"

In lieu of stubs, lumped constants may be used. The basic idea is to use an *LC* combination which will cause the reflector to resonate at a frequency which is about 5% lower than that of its associated driven element.

These 'stub-substitute' coils are made of #12 enameled wire. Each coil is made by winding on a form which is 1⅛ inches in diameter. The coils have an *inside* diameter of 1⅛". The coils are wound with minimal (close) spacing and in that condition have maximum inductance. Increasing the spacing (by pulling apart) decreases the inductance. Adjustment is accomplished by extending or compressing the coil while measuring the F/B ration (as described above). A small insulator (like the little eggs used to break up guys) is situated inside the coil to take the suspension strain. The coil data is as follows:

20 meters: 9 turns
15 meters: 7 turns
10 meters:6 turns

Wire hole locations for additional frequencies may be determined by Pythagorean means. ■

[2] The swedged ends of the masts were designed for interlocking and have an inside diameter of 1¼". If other mast types are used an alternate method of guying must be employed.

Mars Bulletins

Air Force Mars Eastern Technical Net

Sundays 2—		4PM EDST 3295kc, 7540kc, 15,715kc
Sept.	10th	Business Meeting.
Sept.	17th	**Doing the Job with Photoelectrics.** Mr. John J. Larew, Mgr., Specialty Control Dept., General Electric Company.
Sept.	24th	**Communications Receiver Design Considerations.** Mr. Frank Roberts, Chief Eng., National Radio Company, Inc.
Oct.	1st	**Progress Report: Electric Power Generation in the Atomic Age.** Mr. 'Bud' Pratt, Ch. Eng., Niagara-Mohawk Power Co.
Oct.	8th	**SSB—Superiority and Specifications.** Mr. Al Robertson, Mgr. and Mr. Joe Shafer, Sr. Amateur Radio Development Engr., Heath Company
Oct.	15th	**SSB—Operating Techinques.** Mr. William Kaufmann, Martin Co.