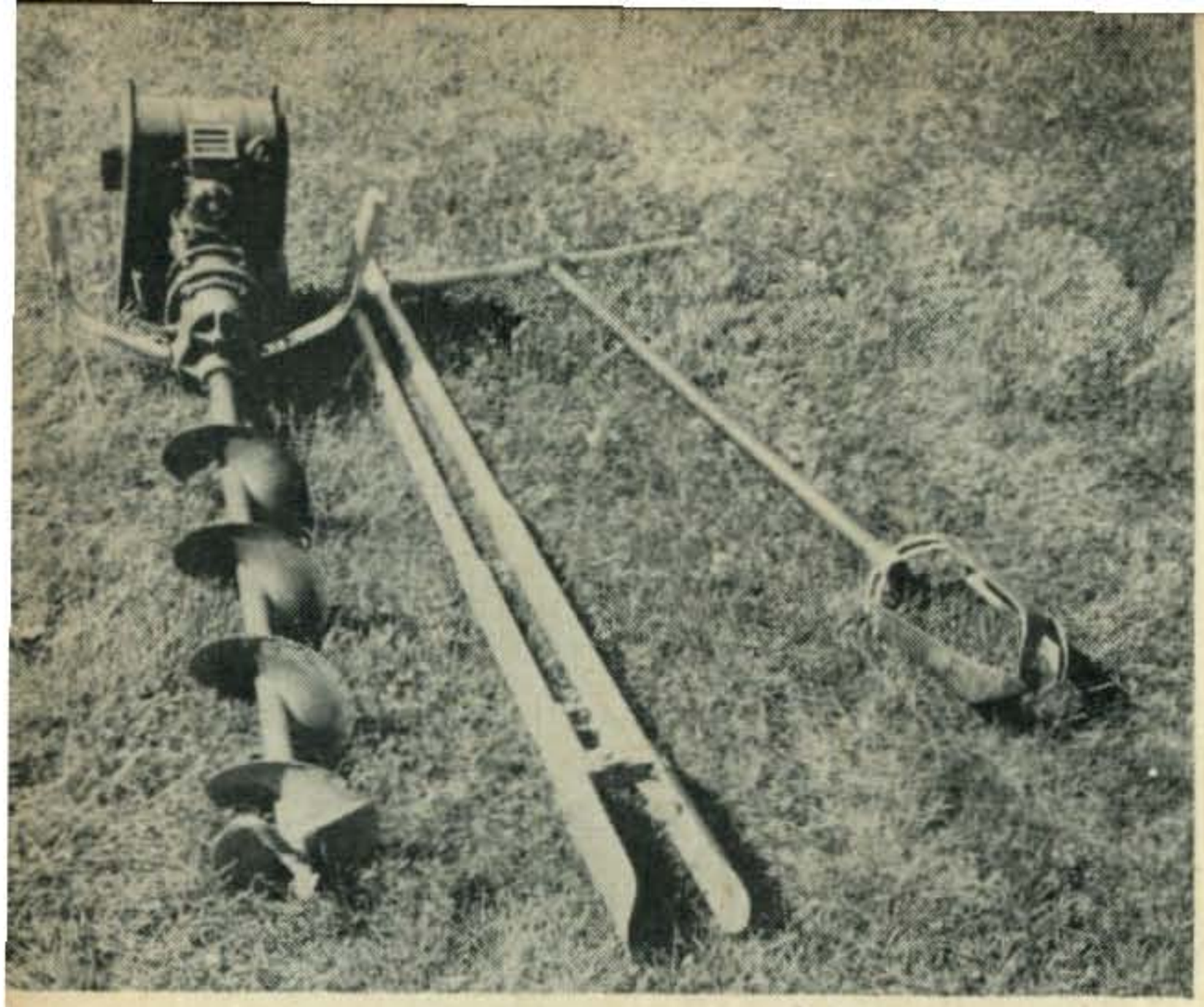

Tools for boring the hole. Left to right: Gas powered earth auger; Clamshell post hole digger; Hand powered earth auger, good in soft sand.

Beam Installation Techniques

BY MORTON WATERS*, W2JDL

LISTEN in on any of the DX bands and, if you don't already know it, you'll soon learn that the operator who snags the rare ones is using a beam. But even on short hauls, the inherent gain and directional effect of a beam can make the difference between a solid QSO and one plagued by QRM.

Deciding that you need a beam, however, is not the end of the road. You've not only got to buy or build one, but you've got to get it up there where it can go to work—which brings us to the tower. The number of types of towers is confusing and makes choice difficult. For your guidance, the following is a brief description of some of the more common varieties.

1. **Foldover/crank down.** Consists of two or more telescopic sections with built-in winch to hoist or lower the sections. A second winch, attached to the ground support, allows the telescoped tower to tilt over, bringing the tower head within reach of the ground where antenna adjustments can be made without climbing. This type is usually hinged at a point only a few feet above ground (see photos illustrating the installation of E-Z Way's model GP-HD-40).

2. **Foldover.** Consists of a permanently mounted fixed section, usually about 20 feet high, to which a second, longer section extending above and below the top of the fixed section is attached. It pivots at the top of the fixed part. A gin pole or derrick plus some climbing is necessary to erect this kind, but once the tower is up, the tilting mechanism is used to bring the head down for antenna adjustments. Rohn Manufacturing Co., Peoria, Ill., is the maker.

3. **Trolley on tower tracks.** Here we have what is basically a fixed tower. Erecting it calls for the use of gin pole or derrick and acrobatics. After the tower is up, additional climbing is necessary to install a set of guide rails which bolt to the side of the tower. A small trolley rides up and down on the rails, carrying the antenna with it. Therefore, after the erection is done, climbing is eliminated. Known as the Hy Track, the trolley/tower combination is a product of KTV Tower and Communications Equipment Co., Sullivan, Ill.

4. **The Fixed Tower.** Usually a number of short lengths (10 to 20 feet) which bolt together. Unless the full length tower is light enough to be walked into place after being assembled on the ground, a gin pole is necessary when erecting. Must be climbed when installing or adjusting antenna.

My own tower selection was dictated by my extreme distaste for heights. Get me up, even on a footstool, and my stomach flip-flops to the rhythm my knees beat out. But—aside from any personal allergy to height—the tiltover tower has the advantage of allowing you to

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work in safety on the ground rather than atop a precarious perch. My choice was the E-Z Way model GP-HD-40, 40 feet high when fully extended.

Locating The Tower

Before starting to dig the hole for the base, survey the yard to find the best location. If you're using a foldover tower, make sure the site will give you enough clearance for the tilt. The space requirements of the GP-HD-40 are typical: six feet behind the ground post for the bottom of the tower (the part below the hinge); the top when laid down, needs at least 16 feet plus more for the antenna. Since the top of the quad is 8½ feet higher than the boom, I had to allow a minimum of 24½ feet clearance at this end. Sufficient lateral clear ance for the antenna elements must also be provided. The clearance distance will depend on the type and size of antenna.

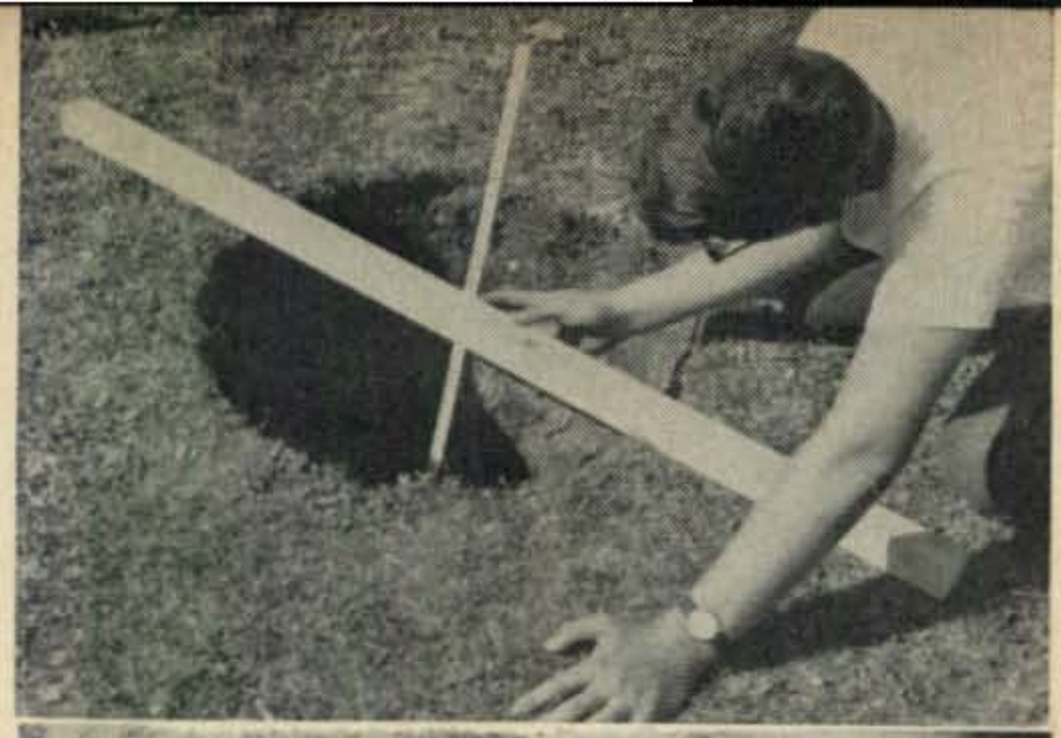
In the event the tower is to be guyed, pick a location from which guys can be extended and anchored conveniently.

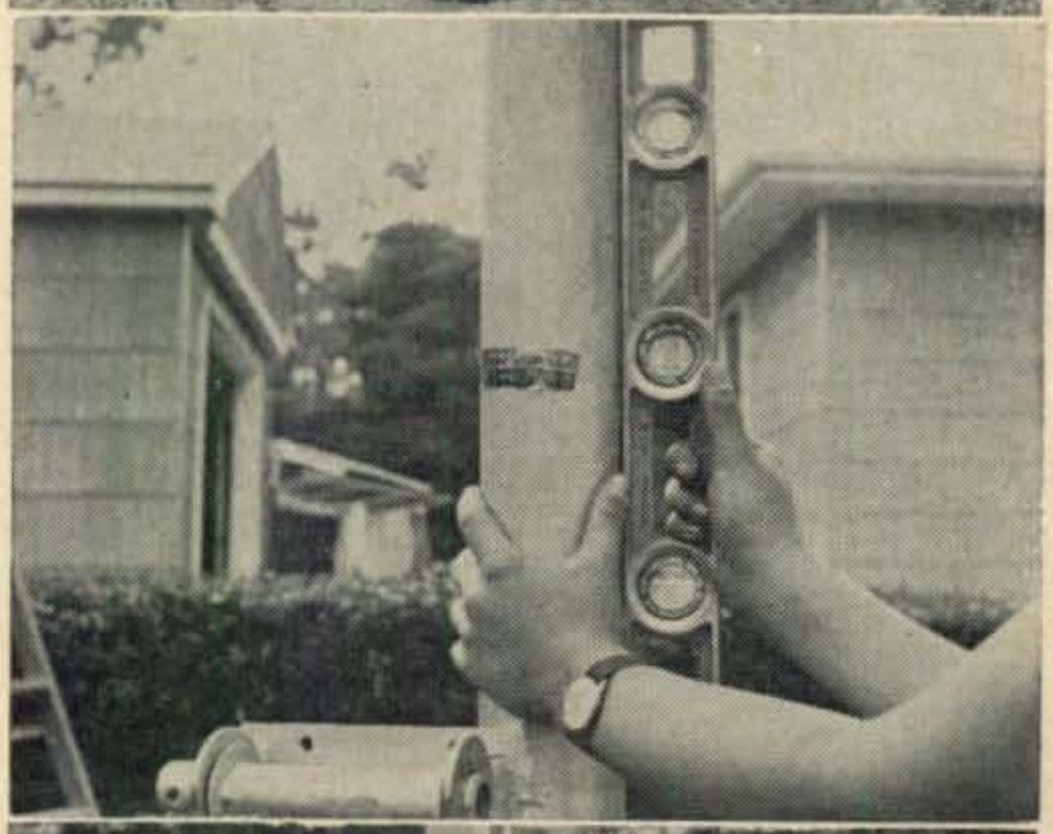
As a final consideration, be sure that the antenna will not intrude on air space above a neighbor's property. In some areas this is interpreted as trespassing.

Getting To Work

The most difficult part of the entire job is the preparation of the foundation, or, with the fancy phrases removed, digging the hole for the tower base. Make no mistake about it; when you have to dig down 4½ feet or more and place a heavy piece of steel in the hole, you've got a job on your hands.

Fortunately for me, I was able to take the easy way out by finding a rental outfit that had a power-driven earth auger. However, if you're old fashioned—or unlucky—you can use pick and shovel. While the power auger will not actually remove all of the earth from the hole it digs, it will break up packed crusty soil faster than any other tool you can find. Once the soil is loosened by the auger, it is easily removed. In this case, I used a hand-held clamshell type post-hole digger to remove the loose earth. With the help of both tools, I was able to dig a 1 foot hole 4½ feet deep in 30 minutes. If the hole must be larger, make a series of bores in the area with the power auger, then break down the remaining solid





Hole depth can be measured accurately by laying a straight edge across the hole and reading the ruler. When deep enough, the tarred base is placed in the hole and carefully plumbed with a long level. Leverage, applied through a length of 2 × 4, can jockey post into position. Level carefully if you want a tower that doesn't look like it belongs in Pisa. When replacing the earth, tap frequently with the end of a 2 × 4. Moistening the soil lightly will help pack it down.

portions with a crowbar or shovel. Don't dig down any further than you have to. If you do so inadvertently, tamp the excess loosened soil firmly with a 2×2 or 2×4. Moisten it to help packing. Do not overwet or you'll wind up with a soupy, slurpy mess in the bottom of the hole that may take days to drain off.

Try to keep the sides of the hole as straight as possible. This will result in a stronger structure and will save labor by keeping the size of the hole to a minimum required. If the tower is to be placed in concrete, you'll probably have to dig a larger hole than is needed for the ground-post variety. The dimensions will vary, of course, with the tower but in every case the excavation *must* go below the frost line. (In the latitude of New York City, about 36″). Otherwise the tower footing may be badly heaved by alternate thawing and freezing of the ground, throwing the tower out of plumb or worse. Any local builder can tell you the frost line depth in your area. Make the hole about 6″ deeper than the tower requires and fill these 6″ with firmly tamped coarse gravel or crushed rock to provide drainage beneath the concrete.

Placing The Base

If the success or failure of this project can be said to hang on a single factor, this is it. The bottom section of the tower must be absolutely vertical. And, every step taken to insure this is a contribution towards a successful conclusion. Proceed as follows:

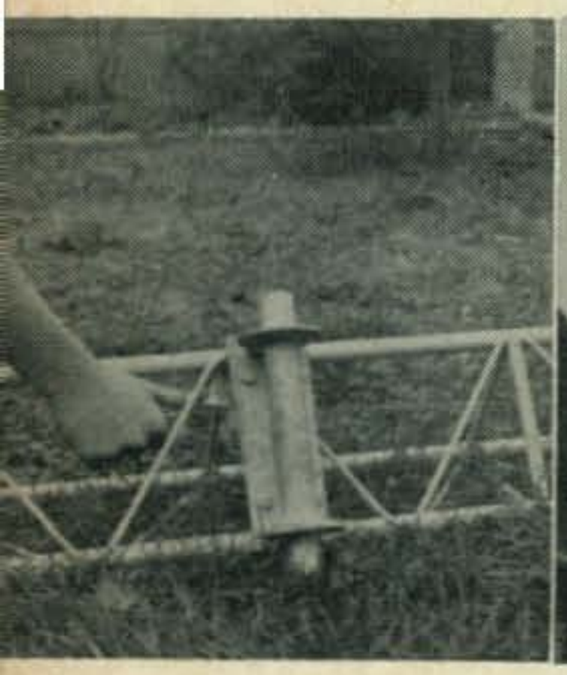
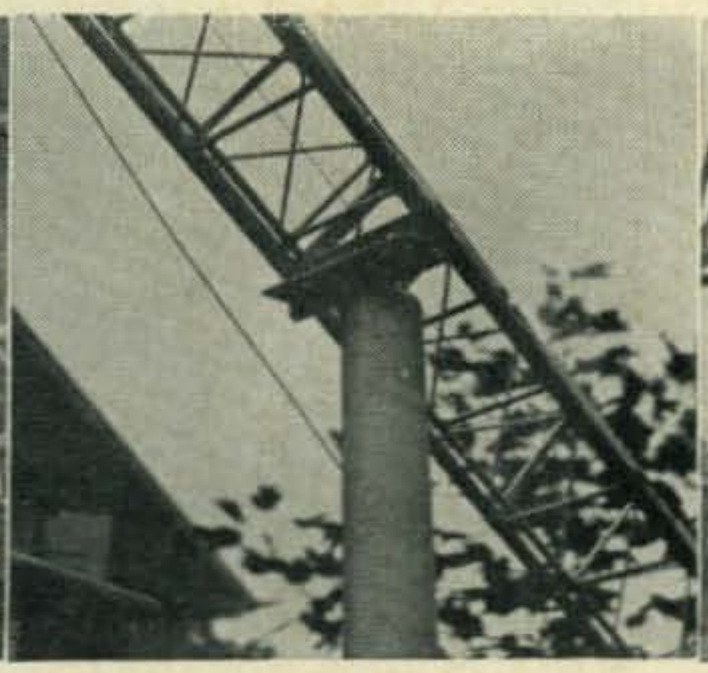
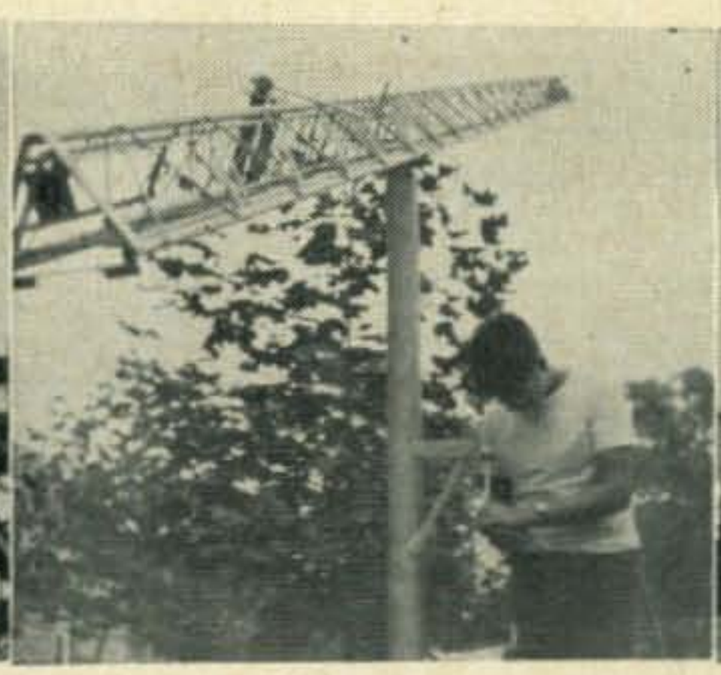
From 2×2 lumber, make four 2′ stakes with one end pointed. Notch one side of each stake 1 or 2 inches below the blunt end so that temporary rope guys will not slip off. Drive the stakes into the ground with a sledgehammer, spacing them equally around the hole about 8 feet from its edge. Next, place the tower base in the hole. (All metal which will be below grade, or covered with concrete, should first be given a coating of tar or asphalt waterproofing to prevent rust. Allow the tar to dry before proceeding.) Now, here is where the utmost care is needed. Prop the base in its approximate position temporarily and tie guy ropes from the topmost point of the base to the stakes. Get the longest carpenter's level you can find, but be sure it's at least 24″. A shorter level may cause an error which, although relatively minor at the base, may throw the top of the tower well out of plumb. Keep making adjustments to the guys, bit by bit until the base is exactly plumb. Always apply the level in two vertical planes, 90 degrees apart. Level and level again and again until those bubbles are right where they should be.

Once you are sure the base is plumb, you can start backfilling the hole. Replace a few inches of fill at a time, stopping frequently to tamp it down firmly and to check again with the level. Once the hole is about half full you can work more rapidly, for the base will have taken a set that will be difficult to change. A sprinkle of water on the loose fill will help it to pack down better, but, as has been said, don't overdo it. Wet mud is no good; damp earth packs best.

When using concrete for fill, pour about a foot at a time. Then work a small spade or scrap of wood up and down in the fresh concrete. This is called puddling and will remove air bubbles before the concrete gets a chance to trap them. Add concrete until the pour is at grade level. Stake some scrap boards around the opening and add a few more inches of concrete. When it starts to set, round off the top or trowel a slope into it so that rain will drain off.

After the concrete work is done, allow a couple of days before removing the temporary guys. During this period, wet down the concrete lightly once or twice each day to keep it from drying too rapidly. The longer the drying takes, the stronger the concrete will be. If there is danger of a freeze, cover the concrete with several layers of straw and burlap.

When the base post is set, the tower may be assembled. The winch for raising the mast section is shown being bolted in place. The tower is then mounted on the base and bolted to the hinge. After installing the base pulley and threading the pulley and winch, the tower may be cranked erect; a big moment.


In the event of a heavy rainfall while the concrete is still quite wet, cover the exposed surface with a piece of canvas to keep the rain from washing the concrete away.

Erecting The Tower

With the base finished, it's tower time. If the tower is of the telescoping variety, lay it on the ground and see if the sections move in and out freely. Now is the time to relieve any binds, not when the tower is up in the air.

Each type of tower needs different handling. Follow the manufacturer's assembly and erecting instructions and if, as part of the job, you must climb the tower, observe these rules:

1. Be careful.
2. Wear a safety belt, or tie a loop of heavy rope around your waist and around the tower.
3. Be careful.
4. Don't climb on a windy day or when it's not light enough for full vision.
5. Be careful.
6. Hold on.
7. Be careful.

The Beam

Your selection of the beam—the signal squirter—will, like the tower, depend on your personal preference and what your friends have told you. By and large, the gain and F/B ratios do not vary greatly from one type or brand to another—until you get up into the Rolls-Royce category. For this writer, the reputation and low cost of a 3 band quad made it the front runner. Another important factor was that it would allow me to use a light duty—and therefore lower priced tower—because of the antenna's minimum weight (under 30 lbs.). I was able to use a tower which, while low priced, could support the quad at 40 feet in 60 m.p.h. winds or 100 m.p.h. at 20 feet without guys. Note, however, that guying *is* recommended by the E-Z Way people if your area is subject to the unusual stresses and strains of ice or snow storms. The quad's light weight also permitted me to use a small, inexpensive rotator—the Cornell Dubilier AR-22, which has proved well able to handle the quad without excessive windmilling. On this tower, the rotator mounts above the tower top, clamping to a short length of pipe. In towers with larger cross-sections, the rotator is usually installed inside the tower head.

Assembling The Quad

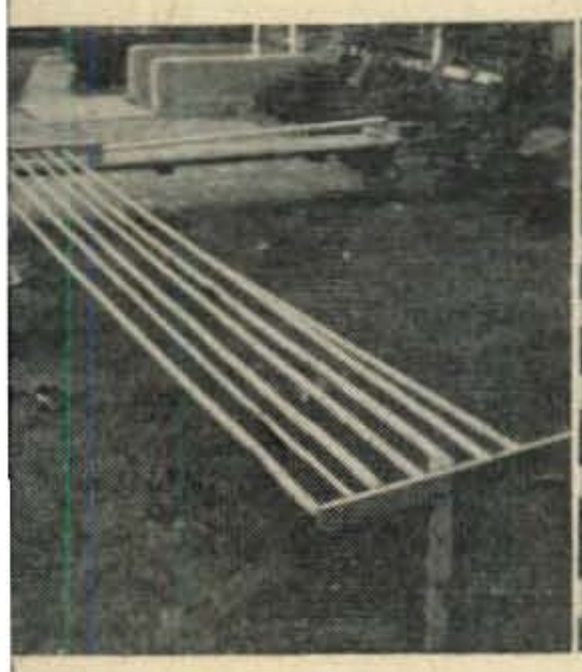
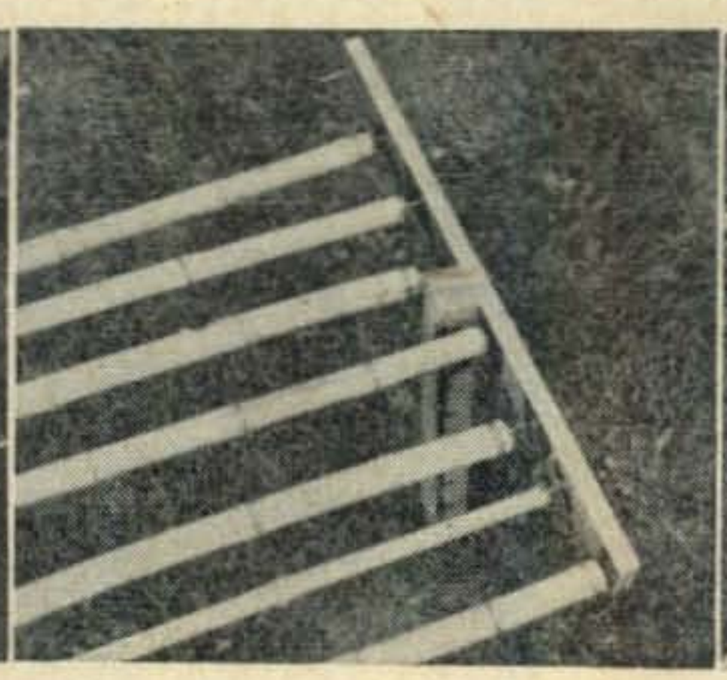
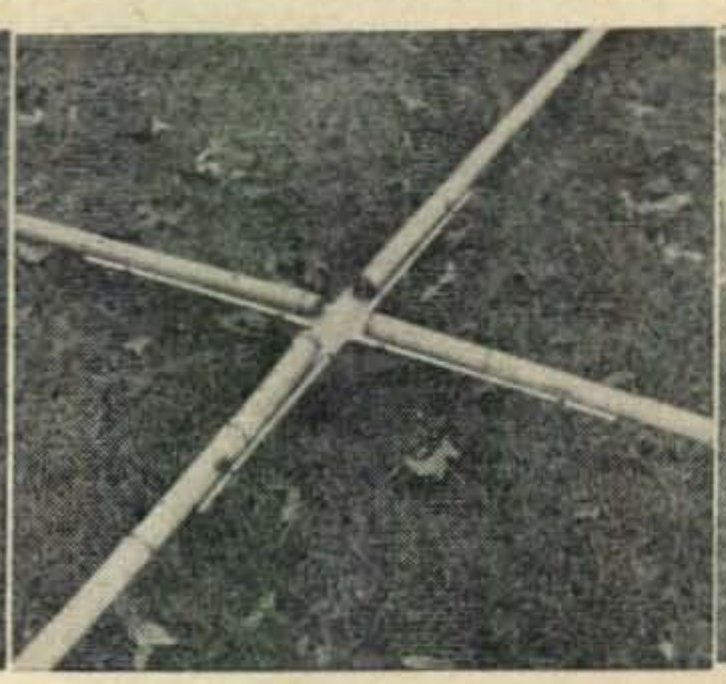
Whether you build a quad or buy a kit, the problems you face are identical, but with the kit, some of the work is done for you. Skylane's quad (seen here) as well as other brands, can be had in several degrees of cost and completeness. Basic (and cheapest) is a set of aluminum end spiders and boom support. You supply the rest. At the top of the line is the complete kit—wire, hardware and all—with either bamboo or, for about $40 more, fiberglass spreaders. The latter require no weatherproofing and have tremendous strength with inherent flexibility. The bamboo spreaders will also do the job but unless carefully treated will quickly dry out and crack. With the proper measures, the bamboos will last two or three years.

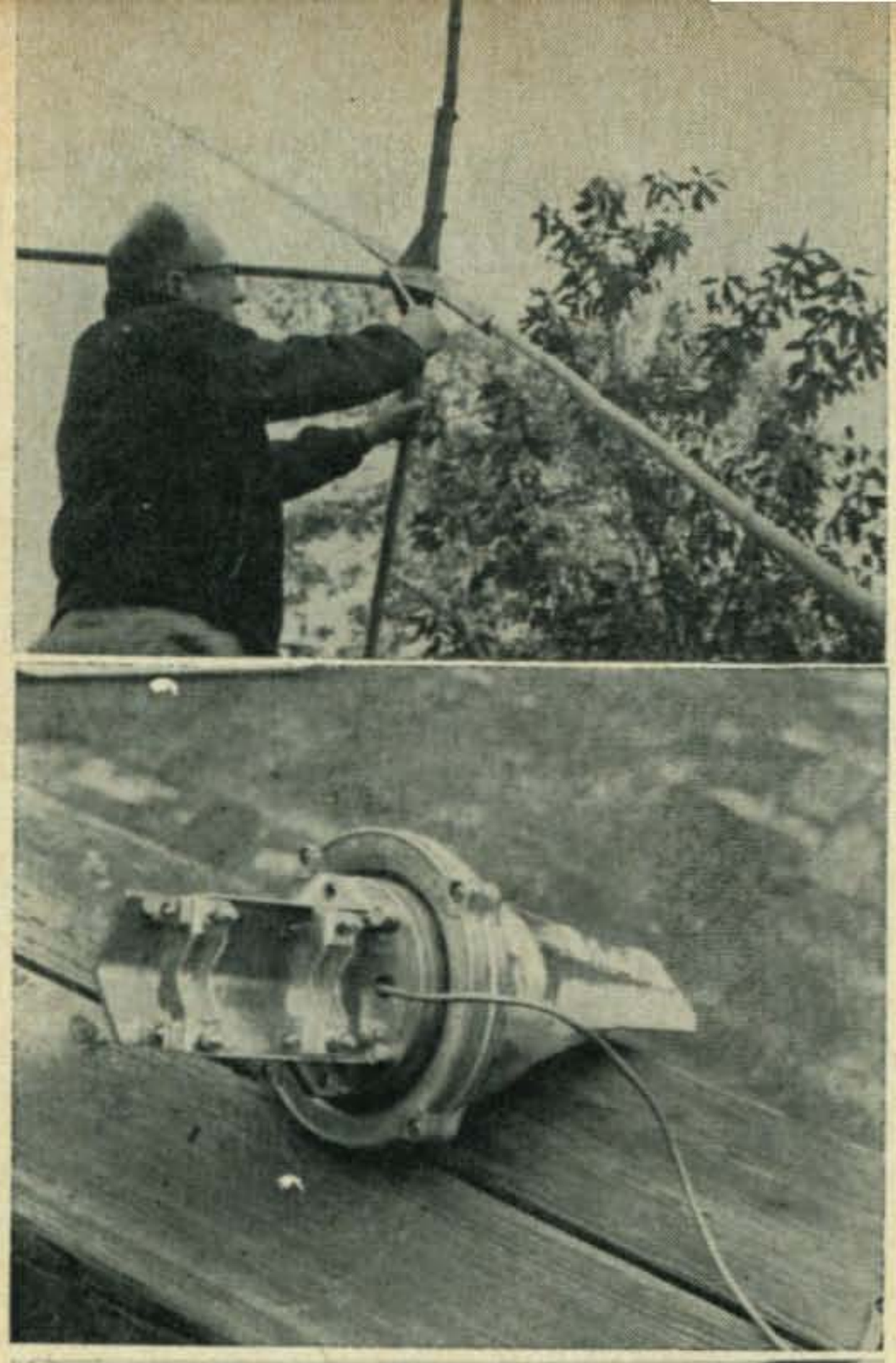
Treating the bamboo is easily done. Use a good grade of exterior synthetic enamel or epoxy varnish. In either case, apply at least two coats, more if you have the time. Allow sufficient drying time between coats.

Painting bamboos 12½ feet long can get to be rather bothersome and sloppy unless you build a little jig. As shown in the photos, the jig consists of two boards with 3 inch nails driven through them. The bamboos are loosely impaled on the nail points, like the centers of a lathe. You dip your brush and apply it with one hand, while spinning the spreader with the other. Using this jig, a coat of varnish can be applied to all eight spreaders in 20 minutes.

When the paint is dry, lay one spider face down on the ground and position four bamboos

Assembly of the beam begins with weatherproofing the bamboo poles. The Rube Goldberg jig to support the bamboo for varnishing looks like nothing but works like great. Close up shows protruding nails. Place the bamboos on the spider to check hole alignment. If the fit is okay, turn the spider over and secure bamboos from underneath to prevent sag. To be sure of maintaining right angles, stake spreaders as explained in the text.

on it. Use galvanized hardware to fasten each bamboo to its respective spider arm. Be careful not to draw the nuts up too tightly, or the bamboo may crack. Dab tar or asphalt roofing compound on and around the hardware for corrosion and water-proofing.

Before beginning to string the elements, make sure that the spreaders are at right angles to each other. Use a large carpenter's square or the old 3-4-5 right triangle trick. Measure 3 feet on one spreader, 4 feet on an adjacent one. The distance between these points is 5 feet if the arms form a perfect right angle. Drive pegs or stakes into the ground to hold the arms in their correct positions.

The radiator and reflector elements of the Skylane quad use #14 solid enameled wire, and the power handling capacity is 1 kw. If your quad is to be a 3 bander with a single coax feed line, wire the 15 meter element in place first. Draw the wire tight enough to keep slack to a minimum but avoid bowing the spreaders. Although formulas vary somewhat, the one used here calls for 140 inches per side for a resonant frequency of 21.3 mc. The other elements, 102 inches per side for 10 meters and 204 inches for 20 meters, resonate at 28.6 mc and 14.2 mc respectively. All three radiators are tide together to a common female coax connector at the midpoint of the bottom of the quad.

Reflector lengths are identical, but each reflector is independent of the others. A small loading coil is soldered into each of the three at the midpoint of the bottom of the quad. These coils are close wound on one inch forms, using #14 enameled wire:

10 meters—6 turns
15 meters—4 turns
20 meters—5 turns

When the wiring is finished, examine the bamboos once more. Apply waterproofing to each piece of spreader hardware. Seal the hollow ends of each bamboo with caulking compound of the non-hardening type. Wrap each bamboo with plastic electrician's tape at every point where the elements are fastened to them.

If you haven't already done so, fasten the boom to the rotor. Finally, mount the quad on the boom, attach the RG-8/U coax, hoist the tower on high, tune up the rig and go to it—you're in the big league now! ■

After assembling the spreaders, the reflectors and directors are strung and the assemblies are clamped to the boom. The rotator, an AR-22, is shown ready to go with the control cable attached and the bottom plate on. The rotor is clamped to a short length of pipe above the tower and the boom support is clamped into the rotor. The boom is then clamped to its support T. Attach the coax feed line and up goes the tower, 40 feet, with the antenna pointed in the direction of DX.