mathematical calculations. Unless the antenna is located above salt water (bay, tidal land, or ocean), which gives a flat, low-loss surface, the real earth is usually quite different and does not meet this requirement.

Calculations for the radiation intensity at different vertical angles from an antenna are based on combining the direct radiation from the antenna at a particular wave angle with the wave reflected from the ground. Wave reflection takes place at a distance from the antenna which varies with the particular angle of elevation being studied. For a high angle the reflection area is near the antenna, but for low angles the area of reflection is more remote, and for nearzero takeoff, that area is many wavelengths from the antenna.

For vertical polarization at low angles, the absorption of energy by the earth increases with ground loss for some distance from the antenna. There is considerably less ground loss upon reflection when antenna polarization is horizontal.

In addition to the need in real life to consider the effect of ground loss, the surface of the earth is often not flat, but hilly out to a thousand feet or so from an antenna. This must be taken into consideration. If, for instance, the radiation from an antenna system fifty feet above a flat surface is desired at an angle of five degrees elevation, the earth surface involved in the reflection area is five hundred to six hundred feet away from the antenna. If the ground slopes away from the antenna, the reflection area is closer and if the ground rises, the area is further away.

In my case, near the top of a ridge with thin topsoil and shale below, slopers and phased verticals seemed always below the performance of a halfwave horizontal antenna.

Win brings up a good point. Antenna reflection drawings in handbooks and articles are comforting, but they assume a perfectly conducting ground surface. In actuality, the "lay of the land" within five hundred feet, or more, of your antenna determines the actual reflection pattern.

Many Amateurs, surrounded by other people's houses, telephone and utility wires, and television antennas, can only guess at the angle of takeoff of their signal as the reflecting ground surface is obscured. So don't take

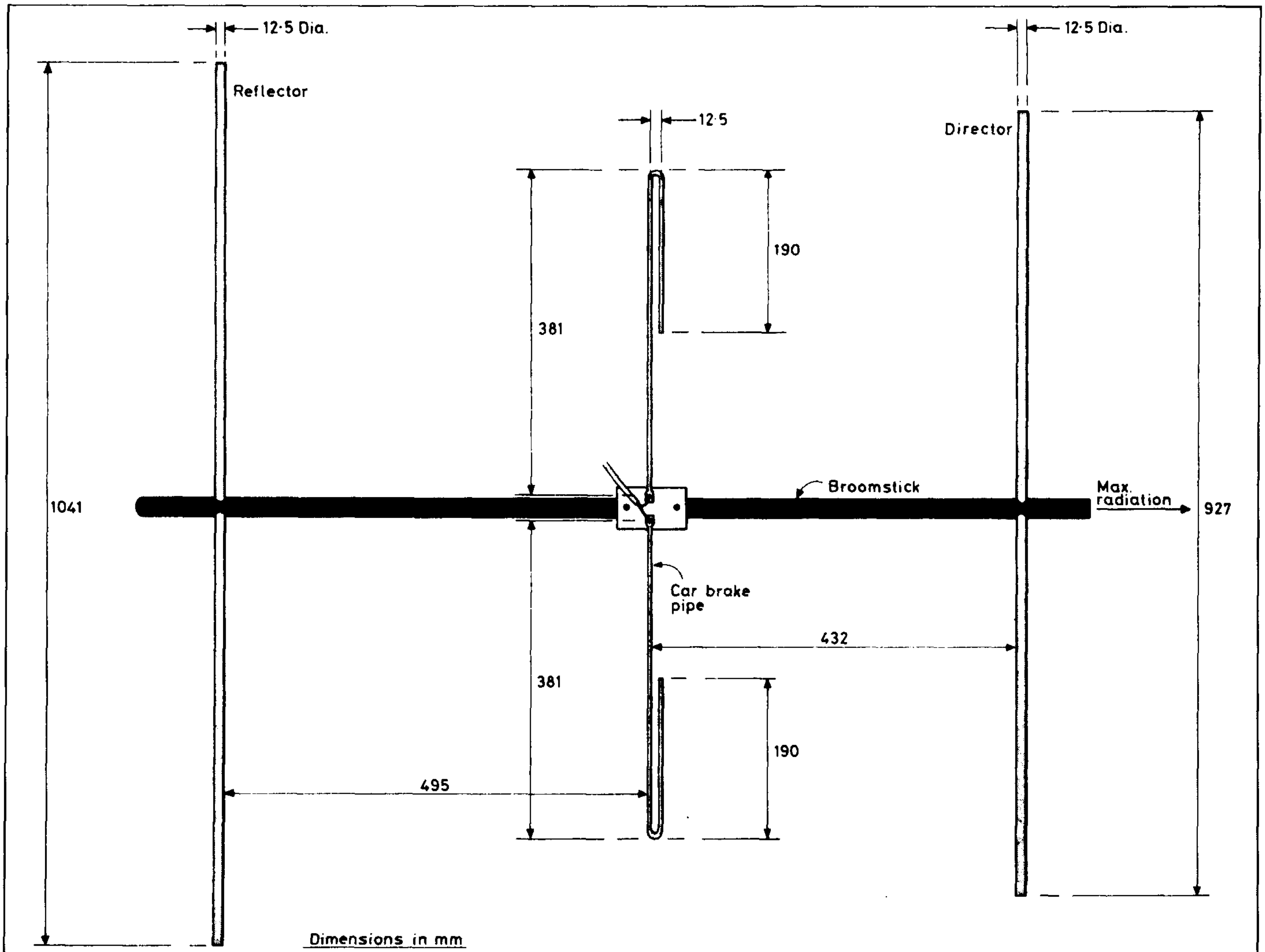

fig. 4. The unusual 2 meter Yagi beam designed by G6AFJ. Note that the driven element is folded back upon itself at the tips. Does this provide a good match for the 50 ohm transmission line? Try it and see! (Dimensions are in millimeters.) Illustration from *Practical Wireless*.

the patterns seriously. In most cases, the higher the antenna, the better the DX results. And that's probably due less to the reflection angle of takeoff than to elevating the antenna above nearby conducting structures!

the G6AFJ beam antenna for 2 meters

Is someone pulling my leg? Or does it really work? (See **fig.4.**) This is reproduced from the February issue of *Practical Wireless,* a well-known British publication. (Antenna dimensions are given in millimeters.) The noteworthy aspect of this three-element Yagi for 144 MHz is the unusual driven element, with its tips folded back upon themselves, presumably to provide a match to the 50-ohm line. G6AFJ says "the antenna can be tuned by altering the position of the bends in the folded elements to vary the gap."

The driven element is made of "car brake pipe," a substance that is unknown to me, but I would assume that it is thin-wall copper tubing. It appears to be about 3/16 of an inch (5 mm) in diameter.

In any event, the antenna is simple to make, and if any readers try out the idea, I'd like to hear about the results.

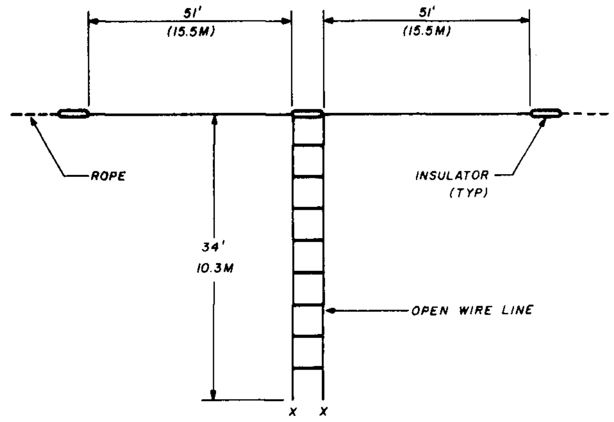

fig. 5. The G5RV multiband antenna. This simple device has been operated on all Amateur bands between 160 and 2 meters! One version of the antenna connects a 50 ohm coaxial line at points X-X and uses an antenna matching unit at the station to reduce the SWR on the line to a low value suitable for the transmitter. Another version extends the open wire line to the transmitter and uses a balanced antenna tuner to match to the transmitters coaxial output.

inexpensive station clock

Would you like a small, accurate station clock that you can set to WWV and buy for less than $15.00? I found one at my local hardware store. (I also found the same item for sale in several drug stores.) I am talking about the Timex model 5204-412 digital clock that sells for $9 to $14. This compact clock has a large red LED display of hours and minutes, plus an indicator of "a.m." and "p.m." It also has an alarm which is handy for keeping to schedules.

The instruction manual tells everything about the clock except how to set it to WWV, so the "minute" LED advances exactly on the proper WWV time-tick. Once you know how to do it (and I found out by experimentation), it is easy to lock the clock within a second of WWV. Here's the trick. Advancement of time as shown on the "minute" LED is performed when the clock is turned *on.* For some obscure reason (don't ask me why) there is a built-in 30 second time-shift in the clock. The trick is to plug the clock into your power receptacle exactly 30 seconds *after* a WWV minute tone. If you do this, then when you set the clock to WWV the LED will advance exactly on the minute tone of WWV. Once you accomplish this simple feat, the little clock runs right along with WWV UCT time.

the G5RV "all band" antenna

Have you ever noticed the antenna description on an overseas QSL card was the "G5RV antenna?" Little-known in W-land, the G5RV is a popular multiband wire antenna used by many overseas operators. Popularized by Louis Varney, G5RV, the basic antenna is shown in **fig. 5**.

A 102 foot long flat-top is used, fed at the center with a length of open wire transmission line. The antenna operates as a shortened dipole on 80 meters, an extended dipole on 40 meters, nearly three 1/2 wavelengths on 20 meters, and as a center-fed long wire on 15 and 10 meters.

There are many methods of feeding the G5RV antenna. The original design uses an open wire stub plus a length of coaxial line. An antenna tuning unit is used in the station, as the SWR on the coaxial line can be quite high at certain frequencies.

A second feed system is to extend the open wire line directly into the station, and use a balanced antenna tuner at this point.

The G5RV feeders can be connected in parallel at the bottom of the stub and the antenna operated against ground as a top-loaded vertical on 160 meters. Some hams have even used it on 6 and 2 meters by using a VHF antenna matching unit at the station!

My preference is to run open wire line from the antenna directly to an antenna tuner in the station. (Saxton makes heavy-duty open wire line, I believe.) For low power (a hundred watts or so), TV-type twin lead may be substituted for the open wire line.

moonbounce revisited

The popular brochure "All You Want to Know About Moonbounce (EME) Transmission" has been reprinted and is once again available. If you wish a copy, send four 20¢ stamps, or four IRCs, to me at the following address: Eimac Division of Varian, 301 Industrial Way, San Carlos, California 94070.

ham radio