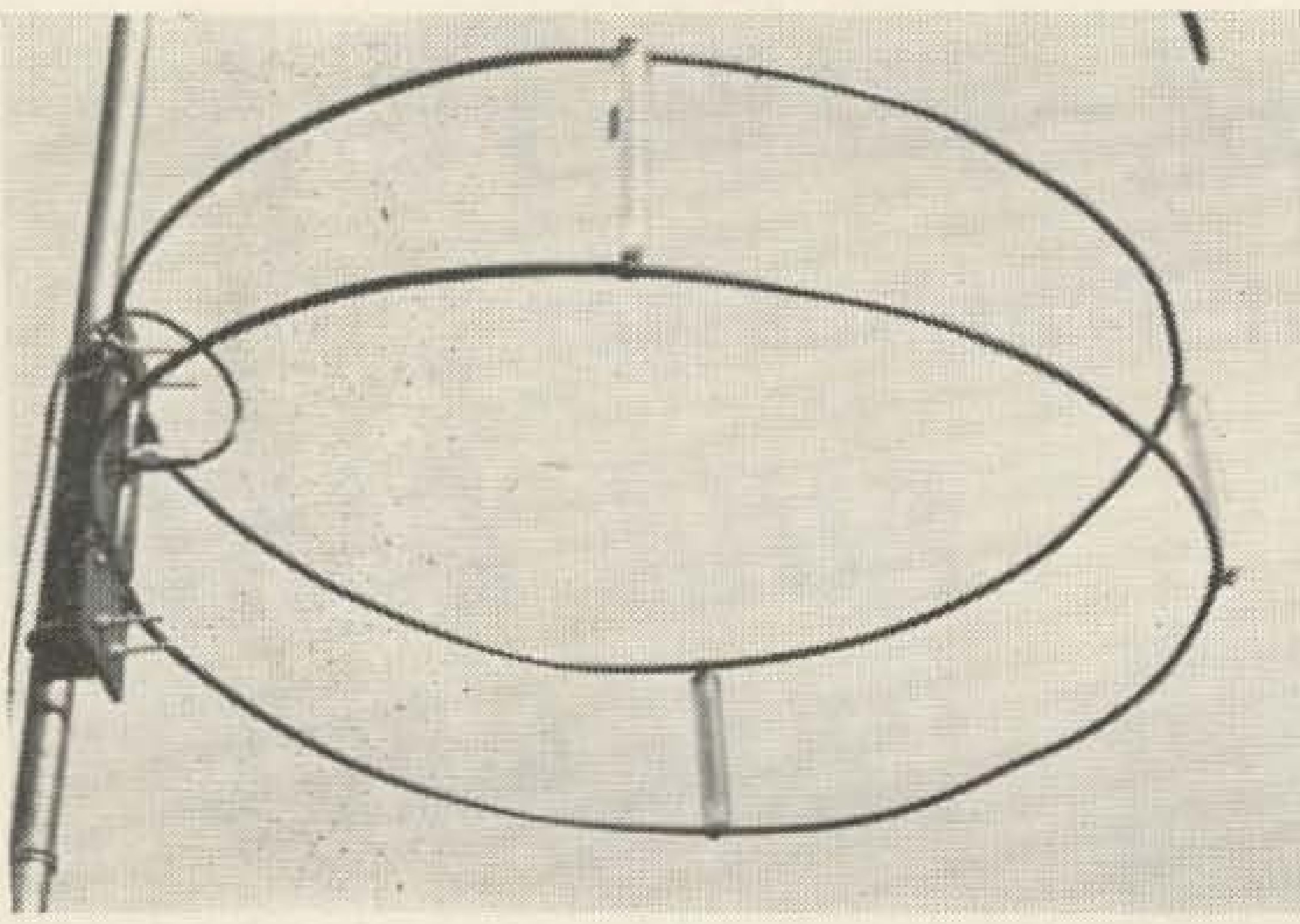

Peter A. Lovelock K2ICF/6
807 Fourth St.,
Santa Monica, Calif.

The Double Hula

Under the influence of zoning restrictions, TVI, cliff dwelling and unsympathetic landlords, many metropolitan hams have demonstrated frenzied ingenuity in contriving new designs for compact, inconspicuous antennas. Often enough, alas, paying the price of high losses, reduced capture area and low radiation efficiency, resulting in galloping frustration in trying to combat their full sized country cousins on our crowded bands.

A recent commercial innovation that offers remarkable possibilities to the huddled ham masses of suburbia and city is the 'Hula Hoop'. This new concept of radiator has already been introduced in several publications, and is known by the more conservative title of Directional Discontinuity Ring Radiator, a unique vertically polarized antenna utilizing a *horizontal* element mounted at almost zero height above its operating ground. In principle the Hula Hoop functions like a leaky waveguide.

In its originally reported form the Hula Hoop consists of a continuously circular radiating element, the circumference of which is equivalent to a quarter wave at the *highest* operating frequency. The circular element is mounted in a plane parallel to the operating ground-plane. A section of the radiator extends at 90 degrees to the plane of the circle at the driven end to form a short vertical leg, the length of which is shown as 'h' in *Fig.* 1, and the length of which is equivalent to the height above ground. The diameter of the hoop may be expressed as 28 electrical degrees at the highest operating frequency, while the vertical leg 'h' is 2.5 degrees. The radiator may be resonated downwards in frequency by increasing the series capacitance 'C' between the terminal end of the element and ground. In practice the Hula Hoop may be tuned over a 2:1 frequency range, permitting two band operation. However efficiency decreases sharply as resonance is lowered.

According to commercial tests the Hula Hoop is capable of radiating a field strength only 3 db less than a full size quarter wave vertical operating against the same ground plane. At one half the normal frequency, when resoanted by the appropriate series capacitance, field strength drops as much as 15 db from that by a quarter wave vertical. Even this is not so bad when the efficiency of some 'loaded' verticals used successfully for mobile operation are taken as a comparison.

While physically resembling it's cousin the half-wave, horizontally radiating 'Halo', beloved of six meter mobile enthusiasts, the Hula Hoop's functional characteristics are far from similar. The quarter-wave loop, in close physical and electrical relationship to a ground-plane, results in complete cancellation of a horizontally polarized field. The discontinuity effect of the radiating elements circular con-

guration causes it to act as a leaky wave-
uide' with a highly efficient vertically polar-
ed field.

One published construction article[3] de-
ribes the application of the Hula Hoop for
obile operation on ten meters or CB band,
ilizing the car roof as an effective ground
ane. This Hula Hoop is only 27 inches in
ameter with height above roof (h) being a
ere 3 inches. It is claimed to have outper-
rmed a quarter wave whip mounted on the
me vehicle.

For the suburbanite the Hula Hoop brings
e opportunity of low-frequency operation on
e current 75 and 40 meter DX bands, with-
ut having to erect a vertical radiator, the
ight and appearance of which will unleash
e wrath of neighbors and local officialdom.
enough real estate is available to accom-
odate a Hoop diameter of from nine to eigh-
en feet, supported one to two feet above
ound, the surrounding community may not
en be aware he has an antenna. Or if they
e, will conclude it to be the supporting
ructure for a plastic swimming pool.

For the compact crowd, the Hula Hoop may
ell be exploited on the higher frequencies,
*oviding an adequate groundplane is avail-
ble.* Even at 20 meters the hoop diameter is
ly a paltry 54 inches.

The author's own experiments with a car-
p, ten meter prototype were extremely con-
ncing. Half a dozen stations worked on
ound-wave reported no discernible differ-
ice on their S-meters between the hula and
comparison mobile whip. The darn thing
orks.

But what of the city-dweller without a con-
enient ground-plane to hook his hula to. Or
en his country cousin who wishes to hoist the
la to dizzy heights without compromising
; compact qualities with bulky ground-plane
ements. And let it be understood, on the
ound, or in the air, the Hula Hoop requires
highly effective ground-plane, so cast out
ose slender ground rods and roll out the
icken wire, you low-frequency DX'ers.

But wait, there is a solution. At K2ICF fixed
cation, where it was desired to take the ad-
intage of height for ten meter RACES oper-
ion over hilly terrain, top-of-the-mast oper-
ion was the dilemma. Then came the blind-
g inspiration for a ground-planeless Hula-
oop and the Double Hula came into being.
Since the conventional Hula-Hoop perched
i its vertical leg at height 'h' above the
ound-plane sees a mirror-image of itself in
e ground from which it derives its phase-
g characteristics, why not replace the mirror

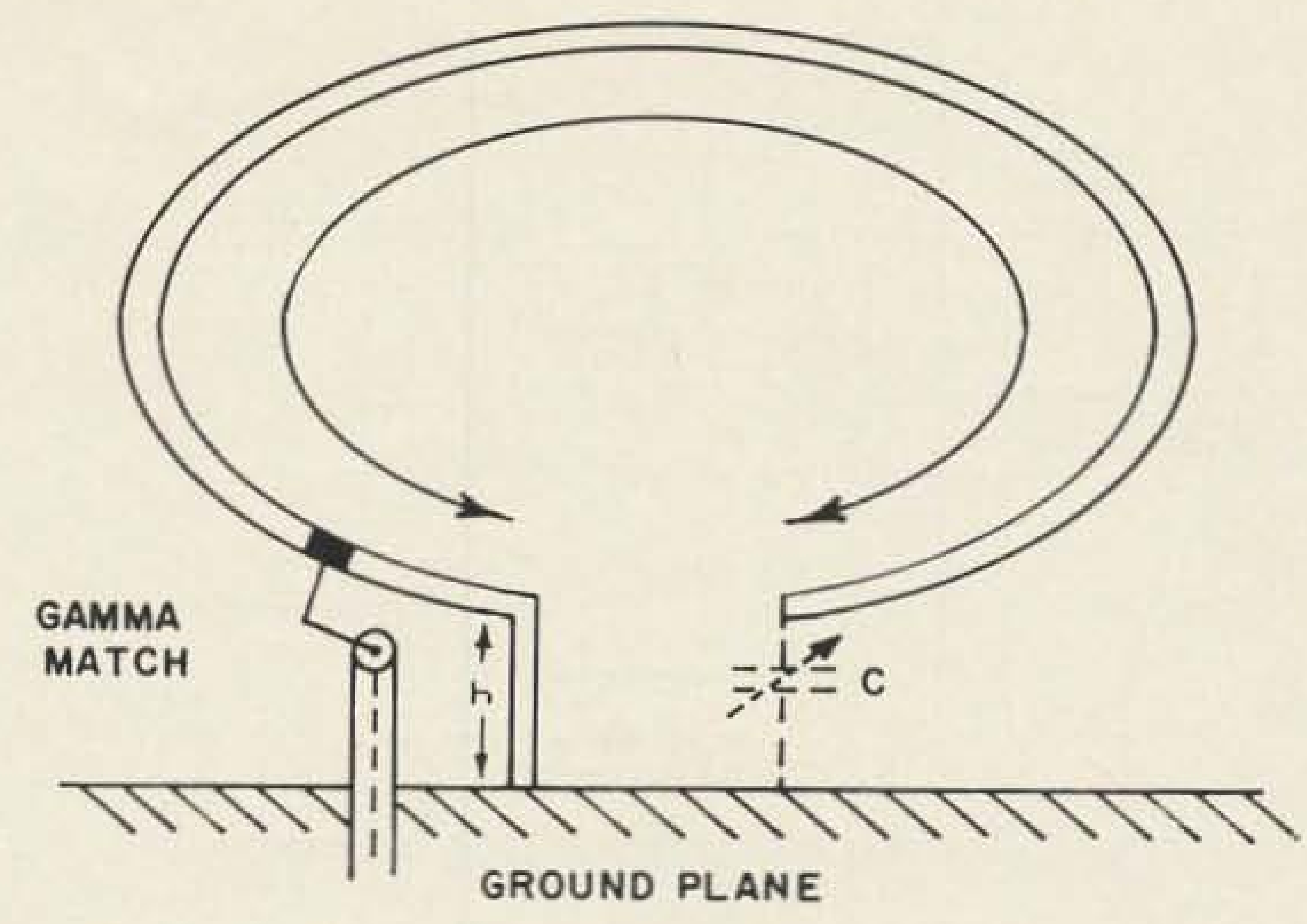

Fig. 1. Total radiator length $L + h = 1/4$ wave at highest frequency. C = added resonating capacitor to lower frequency.

image with a physical twin. Why not, in fact, furnish a second Hula Hoop spaced 2h below the primary element and electrically connected by a common vertical leg. A doublet Hula?

No time was lost in acquiring a roll of automotive copper tubing ⅜ inch in diameter, and retiring to the basement to pound this into two parallel hoops spaced 6 inches apart by polystyrene rods. The mounting assembly shown in *Fig. 2*, was fabricated from a 10" × × „9 ¼" masonite board, to which the common vertical leg and hoop end were rigidly mounted with clamps made from ½" copper strip. Variable capacitance was added to the terminal end of each hoop by 3" lengths of copper strip extended from the mounting clamps adjacent to the vertical leg. The shell of a female coax connector was sweated to the mid-point of the vertical leg, and the center conductor connected by a short length of #14 gauge wire to a copper clamp spaced approximately 4" along the upper hoop, to provide the required gamma match for the coaxial feedline.

The entire assembly was then wrestled to the roof of the station building (known to other family members as house) and was mounted with the traditional U-clamps to the mid-point of a rugged 12 foot mast that also supports the family TV antenna as shown in the photo.

As was expected the massive bulk of the TV antenna directly above the Double Hula had undesirable results on its radiation pattern, as apparently did the vertical mast extending both above and below the hoops, in the place of radiation. However this initial mounting did permit tune-up and matching adjustments, and close up photographing.

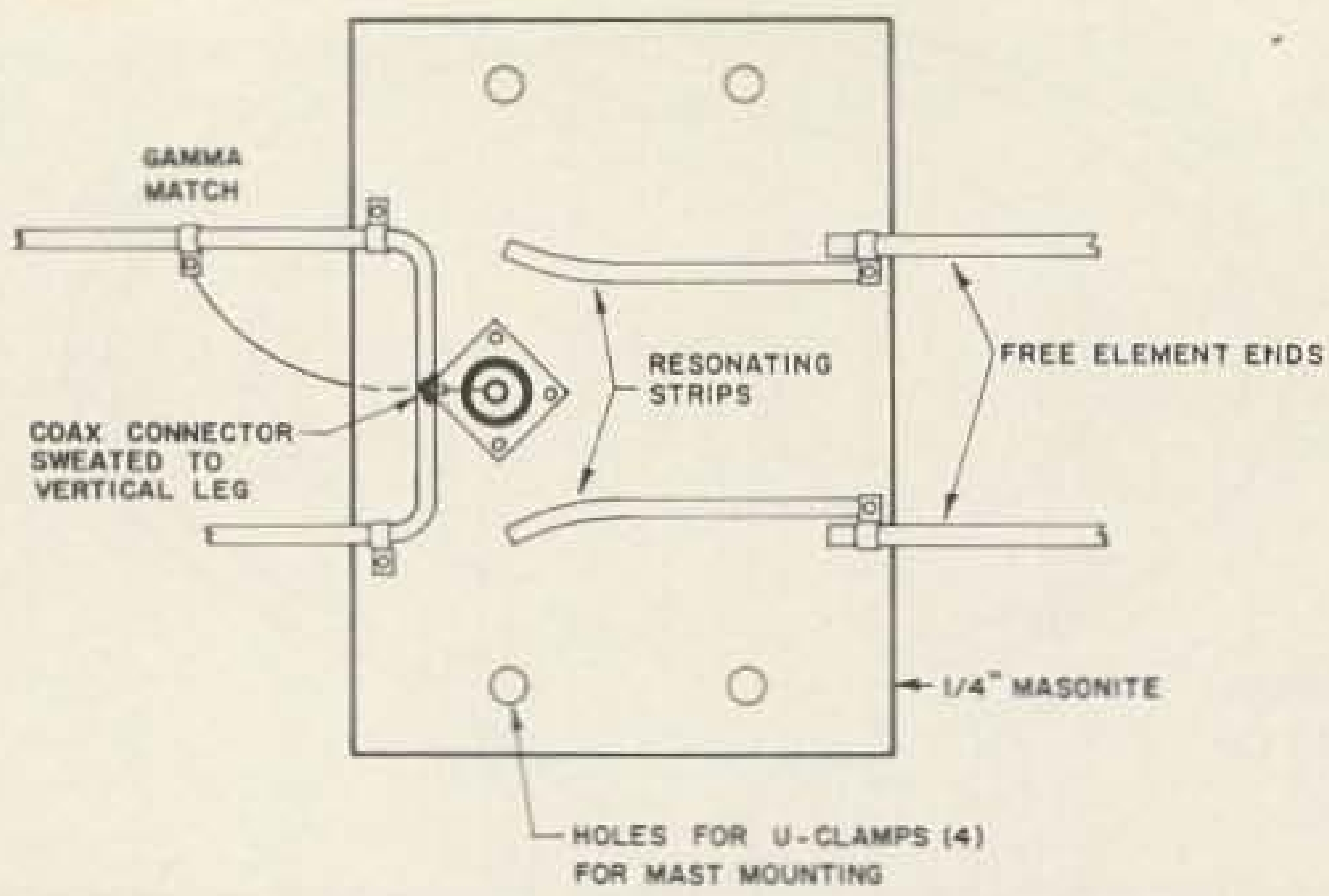

Fig. 2 Doubla Hula mounting assembly.

The assembly was resonated with a grid-dip meter by varying the proximity of the copper tuning strips to the vertical leg. Final pruning was accomplished by touching up the copper strips, using a long fibreglass rod, to obtain minimum standing wave ratio at the operating frequency of 28.7 mc. When this was accomplished the Gamma Match was adjusted to bring the swr close to 1:1.

Since initial tests indicated the Double Hula wasn't doing so well under its TV umbrella, it was then raised on an auxiliary mast section to a position located some 4 feet *above* the TV antenna. A recheck showed no significant change in resonance or swr.

But now ground wave signals were heard from New York City and Long Island some 35 miles away, as were strong skip signals from South America. Excellent contacts were had with mobiles at distances up to 40 miles using a ten watt transmitter, and locals reported improvement in signal strength over a commercial tri-band trap vertical mounted on the roof peak.

About this time, came a second blinding flash. If the Double Hula was functioning like a vertical half wave, would it work as a horizontal dipole if its plane was rotated 90 degrees, like a wheel on edge. After a struggle this new orientation was effected. Still no change in resonance or swr, and what's more it worked. Now we had the effect of a 16 ft. horizontal dipole packed into a compact wheel configuration only 27″ high and 6″ in length. At a pinch it could be made to work on 20 meters. But the equivalent of a 35 foot doublet would only be 54″ high and 1 ft. 'long.'

Now suppose we mounted another Doubl Hula spaced 0.2 wavelengths behind the first could this be phased to act as a parasitic re flector. Visions of a full efficiency 20 mete beam comprising of three sets of 'ear-rings with a turning radius limited only by boon length danced through my mind. Unfortunate ly at this juncture the author ran out of time and with none foreseeable in the reason able future, decided to turn the whole concep over to those of the fraternity who have th freedom of hours to run amuck on roof-tops At least it had been proved that vertical o horizontal the Double Hula works and offer lots of opportunity for the experimentall minded, as well as practical joy for those wh are underprivileged in space.

A few words of caution. Excepting for th basic dimensions of the 10 meter hulas, th author has not attempted to determine exac dimensions for other frequencies, and thes should not be critical considering the capa bility of series capacitance resonance. How ever length of the circular elements shoul not exceed a quarter wave at the highest oper ating frequency desired, or capacitive res onance will not be possible. Height of th vertical leg (h) is approximately 3 inches fo 10 and 11 meters and may be multiplied di rectly for lower ham bands. The Q of th hula is high, and thus the bandwidth some what narrow. The Double Hula displayed broader bandwidth, and when resonant a 28.7 mc, could be operated from 28.5 t 29.3 with less than 2:1 swr. The mechanicall minded may contrive ways of tuning such an tennas remotely for wide frequency coverage

The ⅜ inch copper tubing used for con structing my Double Hula was found to b reasonably adequate in mechanical strengt for several weeks. However there is som doubt to its survival in high winds or ice storms. More rugged material is suggested fo permanent use and especially for lower fre quency versions. . . . K2IC

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