PROJECT NEBE - THE NEBRASKA BEVERAGE

A TWENTIETH ANNIVERSARY OVERVIEW

By

CARL "SKIP" DABELSTEIN, KØSBV

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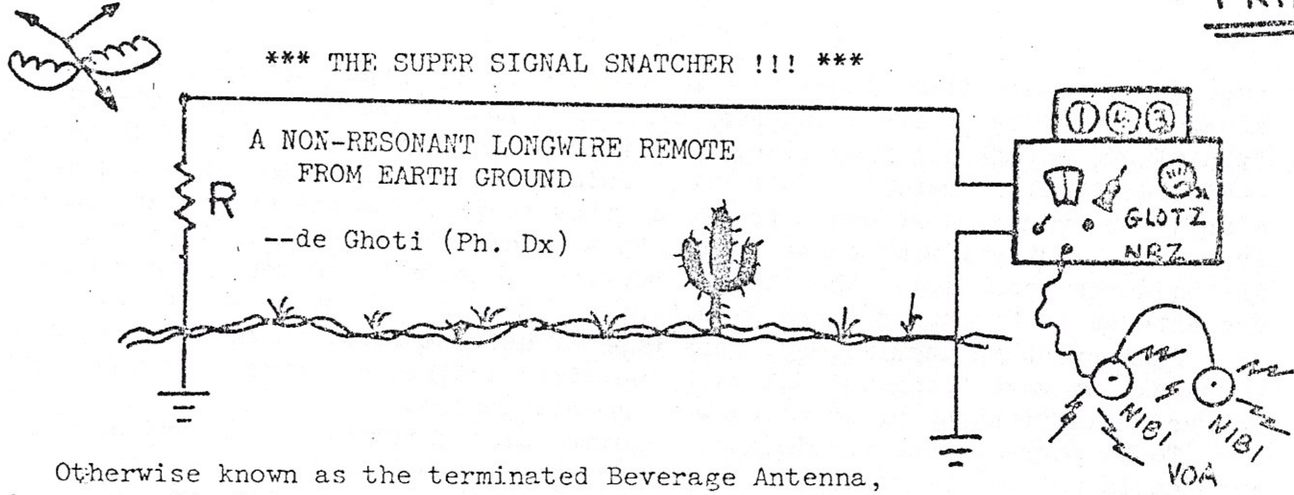
CONTENTS

*** THE SUPER SIGNAL SNATCHER !!! ***

A NON-RESONANT LONGWIRE REMOTE FROM EARTH GROUND

--de Ghoti (Ph. Dx)



Otherwise known as the terminated Beverage Antenna, this super signal snatcher can be erected with very little difficulty provided sufficient land is available. In recent years BCB DXers have used this type of antenna and their very out-of-the-ordinary receptions have been listed in both DXN and DXM.

The purpose of this article is to present a bit of the theory of operation (simplistic), to present some "paperwork" evaluations that can be made for performance extimation prior to construction and to describe one manner of construction which has proven quite practical.

The configuration for this antenna is very simple: a long long wire is erected as close as possible to a given fixed height above the ground and run as straight as possible in a given direction. Two views are shown in Figures A and B with length of wire L (feet), height above ground H (inches), wire diameter D (inches) and orientation for reception of signals from the general direction of A° azimuth.

Bidirectional operation can be had by removing the resistor R at the expense of directivity and hence gain. However, unidirectional operation is assumed here as it is most likely the desirable mode of operation.

Almost all antennas require a ground plane of high conductivity for greatest performance and belong to the huge general classification of E-field antennas-i.e., the most important component of the electromagnetic (radio) wave is the electric component. The loop antenna, on the other hand, is about the only H-field (magnetic) antenna in that, in theory, it derives its performance from the magnetic component.

Consider Figure C. A wavefront W travels in the forward direction of W (the Poynting Vector) where W = E X H, W is normal to the plane formed by E and H which are themselves normal to each other. As this wavefront passes along and above the ground (earth) plane G, E can be broken into horizontal (EH) and vertical (EV) components. The vertical component induces no currents in the antenna but EH does so that as the wavefront travels along the path of the antenna and the finite ground constants cause W to tilt more and more towards the vertical and thus E toward the horizontal (hence decreasing EV and increasing EH--desirable!), the greater the "signal" induced in the antenna. Ground with poorer electrical properties tilts the wavefront more than earth with good electrical parameters. Hence, the Beverage is expected to perform better over poorer ground--exactly the opposite of what one would naively expect!

The directional properties of the antenna can be explained in the following simple manner: In Figure C, as depicted, W is progressing from end A to end B, so if a RX is connected between B and ground (earth), the "signal" EH would appear at its antenna terminals. If the RX were replaced by a resistor R of a certain value, the "signal" energy would be almost entirely dissipated in the form of heat. Suppose now end B was not connected to either R or a RX and was left "floating"--not connected to anything--and a RX was connected at end A to earth ground. The "siganl" travelling from A to B would "run out of wire" (see an impedance discontinuity) and it would be in large part reflected back along the wire to arrive eventually at A as input to the RX. Thus, with B "floating", wavefronts travelling from A to B and from B to A arrive at the RX --bidirectional operation. To restore unidirectional operation then, RX at A, a resistor is placed at end B to ground thus suppressing the wavefronts passing from A to B but allowing those from B to A to arrive at the RX. That is, in the unidirectional mode, the antenna receives best from the general direction the antenna is "pointing"--the direction of the large arrow in Figure B.

As a point in terminology, this type of antenna is often referred to as a travelling wave (longitudinal with the wire) antenna as opposed to the much larger classification of standing-wave mode antennas.

To be correct, the termination required at the remote or far end of the antenna is not purely resistive so perfectly a network is required. However, it is not practically possible to totally terminate the wave progressing along the antenna to its remote end because the components of this termination network depend upon the distributed parameters (constants per unit length) of capacitance inductance, resistance and conductance several of which vary with frequency so that the characteristic impedance (termination required) varies somewhat with frequency. Nevertheless, for almost all BCB applications of the Beverage a simple fixed value carbon resistor will suffice quite well. (Note: there is no great practical reason why RXs-possibly in conjunction with a modified value of R-couldn't be operated on both ends of the antenna thus DXing both directions simultaneously and each in the unidirectional mode.)

The value of the terminating (carbon) resistor can be well approximated from the following simple equation (for an infinite highly conducting wire above an infinite infinitely conducting ground plane), viz:

$$R = 138 \log_{10} (4H/D) \quad \text{... ohms}$$

where H is average height above ground and D is wire diameter. Units for D and H are unimportant as long as the same measure is used for both. Several DXers have proposed the use of a carbon base potentiometer (variable resistor) at the termination to be used to "tune" the system--it is thought that this will not likely produce noticeable improvement in performance. Table I lists values for R at most BCB applications of the Beverage--standard resistors within 20-40 ohms or so of the table value should work as well.

Most likely the greatest factor of importance in the performance and construction of this antenna is that of the earth ground at each end. Here lies the dilemma: the poorer (electrically) the soil the better the expected performance of this antenna, but the more difficult it is to obtain a good, highly conductive, earth ground. However, in any case, the larger the metallic surface area in contact with the earth, the better the system ground. Multiple ground rods as well as ground screens (e.g., 1/2" wire mesh) buried under the earth are not to be overlooked!

The theoretical patterns of a terminated Beverage are of interest in approximating its performance in the field. Although the discussion here is restricted to the antenna in free space (i.e., infinitely remote from a ground plane) when computing patterns, the patterns so obtained can be used with the ground plane present by accounting for certain "most likely" pattern perturbations such as elevated vertical directivity. The equation for such a terminated Beverage is given below under the assumption of a simple current distribution along the wire when the antenna is in the active (transmitting) mode and then appealing to the Reciprocity Theorem for the passive (receiving) case. It is of some musing interest to note that almost all antenna work by electromagneticmathematicians resort to this type of analysis. (GPN on loops has done the more difficult problem of passive analysis and his work is quite exceptional in the field of electromagnetics!)

$$E = K \frac{\sin(\varphi)}{1 - \cos(\varphi)} \sqrt{1 - \cos\left[L^{\circ}(1 - \cos(\varphi))\right]} \quad \text{mv/m @ M miles}$$

where K is a constant depending on parameters of little interest here, φ is the angle measured from the wire as in Figure B and L° is the length of the wire in wavelengths at the frequency of operation, viz:

$$L^{\circ} = 360\, f\, L / 984 \doteq 0.366 fL$$

where f is the frequency in mHz and L is the antenna length in feet. Since the interest here is in the relative performance of these antennas for different lengths L at various BCB frequencies f, the only factor of interest in the above equation is:

$$A = \frac{1}{C}\left(\frac{\sin(\varphi)}{1 - \cos(\varphi)}\right)\sqrt{1 - \cos\left[L^{\circ}(1-\cos(\varphi))\right]}$$

where the factor (1/C) has been added to normalize the patterns with respect to a specific chosen pattern for the purpose of comparative analysis. It is suggested that for the shortest length L and the lowest frequency f, that C=1 for the calculation of this "initial" pattern. Then in this "initial" pattern find the maximum value of A, say AM, and set C equal to this value. Then divide all values of this "initial" pattern by C so that its maximum value is now 1.0. For all subsequent patterns, C=AM. Calculations need only be made for the range $0^{\circ} \leq \varphi \leq 180^{\circ}$ since the patterns are symmetrical about the axis of the antenna wire.

An antenna pattern is inherently three-dimensional! In almost all pattern plots (save for the sterographic projections, for example) a plane is passed through the pattern and contours (pattern projections) are then plotted in that plane. The usual planes are the "horizontal" and "vertical" planes sometimes measured with respect to the earth, sometimes the antenna or whatever else is handy. Figures D and E show this procedure for a loop antenna. The three dimensional pattern of an electrically small perfect loop is a "donut" with a pinhole center. Figure D is that pattern traced on the plane passing through the plane of the loop and Figure E is that traced on the plane normal or perpendicular to the loop--the apex pattern BCB DXers strive for! The terminated Beverage has a pattern symmetrical about the antenna wire as shown in Figure F. The three dimensional pattern is that envisioned by rotating or revolving the plotted pattern about the wire axis to form "cones" of readiation/reception about the antenna.

Beverage antennas in practice actually do not assume their characteristics until the length of the wire becomes significant with respect to wavelength--even tho patterns can be calculated for any length. For this discussion we shall restrict our attention to $L^{\circ} = 0.5$ to $L^{\circ} = 4.0$ wavelengths. The wavelength W in feet for any frequency given in mHz is computed from W = 984/f. Thus, one wavelength at 540 kHz is 1822 feet while one wavelength at 1600 kHz equals 615 feet. Table II gives W in feet as a function of f and L°. A few comments can be made about Beverage patterns in general. There is a lobe (peak) for every half-wave length in the wire and if the number of half-wavelength is odd, then there will be a lobe at $\varphi = 90^{\circ}$, i.e., at right angles to the antenna. There is only one major lobe (shown as two such lobes in a planar projection) and this lobe tends to "fold" toward the wire axis as the length of the antenna is increased. The length of the wire for the lobe to fall within 10-15° of the wire axis is much to long for any practical consideration here. When $L^{\circ} = 7.0$, the major lobe has its maximum at 19°. Also it is clear when obeerving the patterns that as the wire length increases with respect to wavelentgh, the number of lobes increase and their corresponding widths decrease.

Reviewing Patterns I-VIII, hand drawn from computer evaluation of the above equation for A with φ ranging 0-180° in 1° increments, which show estimated practical performance in the horizontal plane with ground, one must remember that the pattern of the antenna changes with frequency so that as one tunes across the BCB the "big eye" keeps changing its view. For example, a 1800' Beverage assumes the basic pattern of Pattern II at 540 kHz and as one tunes to ward 1600kHz, the pattern continuously varies from Pattern II to Pattern VI. Note that the patterns plotted are taken in half-wave increments (solely for convenience here) and only 0-180° of each pattern is drawn. Also note that Mother Nature's Fundament: "Ya Can't Have Your Cake and Eat it Too" holds: viz., as the major lobe becomes more directive, so the number of side and back lobes increase! Thus, although the Beverage has tremendous "forward" gain compared to the side and back lobes (even more so when compared with a loop!!!) these minor lobes are significant when compared with, say a loop, so that one should not expect "super" suppression thereabouts. The usual BCB pests and dominants still show but stations coming in off the main lobes may well override them--they therefore do not retain their status as dominants and pests in many cases! Also note that a pattern such as Pattern II may, in practice, perform better than one such as Pattern VIII because the sidelobes are not as numerous thus allowing suppression over wider areas or arcs of azimuth although the major lobes differ significantly.

The size of wire used IS important in the sense that the larger the wire diameter, the smaller the RF resistance per unit length. RF resistance represents energy loss in the system and destroys the patterns by reducing the null depths significantly between lobes as well as distorting lobes, especially the major one--Figure H. The longer the wire the greater the RF resistance so once again Mother Nature strikes: you obtain significant increase in forward or main lobe gain/directivity at the expense of getting more side and back lobes and increased RF resistance tending to "smear" the entire "tailend" together thus allowing much BCB to leak in on the sides and back. Too, the larger the wire diameter, the more resistant the antenna is to wire breakage. For those interested in approximating the RF loss resistance, the following formula is applicable to copper wire: $RL = 1.02\ (L/D)\sqrt{f}\ /1000$ ... ohms , where as before, L is antenna length in feet, D is wire diameter in inches and f is frequency in mHz. For example, a 3200' Beverage made of 24GA copper has an RF resistance, RL, equal to 162 ohms at 1000 kHz while the same antenna made of 18GA copper has RL = 81 ohms at 1000 kHz. A measure of the RF efficiency of this antenna can be made from the following formula: $Eff = (100R)/(R + RL)$ ...% With R = 560 ohms, for example, and the 3200' Beverage above using 24GA, we have Eff = 76% while the same antenna using 18GA renders Eff = 87%. Power loss is directly proportional to the RF resistance.

Table III lists some useful statistics. L° denotes the length of the antenna in wavelengths, φ * denotes the azimuth angle at which a lobe maximum occurs, E* is the magnitude of such a lobe referenced to the maximum lobe for L° = 1.0 thus giving a comparison of these antennas as their length is increased, dB* is the corresponding power gain of such a lobe, again referenced to the maximum lobe of L°=1.0 and dBL is the amount of "suppression" the sidelobes (for fixed L°) have with respect to the major lobe for that specific pattern. Table III lists these parameters for L° = 0.5 to L° = 7.0 in increments of 0.5 wavelengths. More comments can now be made. Note, too, that if L is a multiple of an even number of half-wavelengths, then there is a null at φ = 90°. The angular compression of the lobes is clearly shown. The separations between lobes at L° = 2.0 are 39°, 29° and 32° while for L° = 7.0, they are 19°, 12°, 10°, 9°, 9°, 8°, 8°, 8°, 9°, 9°, 10°, 11°, and 15°, thus showing the "clutter" of lobes for large L°. The size of these sidelobes for large L° is also significant, e.g., for L° = 7.0 @ φ * = 86°, E* = 0.55343 or more than one=half the major lobe of L°=1.0. Thus, "ibigger" is not necessarily "better"!

Finally, an essential point in presenting this writing is to give the BCB DXer knowledge of the general behavior of a terminated Beverage so that he can erect such an antenna attempting to orient it in such a way as to optimize its use for his purposes--e.g., alighning the "pests" and "dominants" as close as possible to the computed null areas with the understanding however that the "powerhouses" arn't likely to be "wiped out" but they can be "knocked down" considerably. The essential point to remember is that the arguments given here are an approximation to actual field performance and that Figure H should always be kept in mind!! Figure G is also important to remember because the pattern of the Beverage is three-dimensional and a "cone" about the wire axis so that reception directly "off the end" of the Beverage is to be expected tho the horizontal pattern plots show no response there! --de Fish, Ph. Dx

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Project NEBE (NEbraska BEverage) was started in October 1972 here in Nebraska with the blessing of the University of Nebraska and is carried on solely for the analysis of the Beverage on the BCB! It will eventually involve analysis of TA/TP paths through the polar cap/ring. Onesquare mile of land is dedicated for this single project for an indefinite period of time. Numerous Beverage antennas will be constructed and evaluated under my direction and the results will be given to the BCB fraternity with the hope that it be of pragmatic value for other "in-the-field" BCB DXpeditions. The initial phase of Project NEBE has been completed and results will be given to DX News in the very near future as a sequal to this writing. Good DXing!!!!

TABLE I --- Terminating Resistance, R

	H(feet) -----	5	8	10	15	20	25
Wire Size	D(inches)	R ohms					
24	0.02010	562	591	604	628	645	659
22	0.02535	548	576	590	614	631	645
20	0.03196	534	563	576	600	617	631
18	0.04030	520	549	562	586	604	617
16	0.05082	507	535	548	572	590	603
14	0.06408	493	521	534	558	576	589
12	0.08081	479	507	520	545	562	575
10	0.10190	465	493	506	531	548	561

TABLE II --- Wavelength vs. Frequency (table values in feet)

f \ L°=	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
540kHz	911	1822	2733	3644	4555	5467	6378	7289	8200	6111	10022
1600kHz	308	615	923	1230	1538	1845	2153	2460	2768	3075	3383

	L° =	6.0	6.5	7.0
f=	540kHz	10933	11844	12755
	1600 kHz	3690	3998	4305

TABLE III --- Pattern Comparisons

L°	φ*	E*	dB*	EL*	dBL
0.5	65	0.638	-3.9	1.0	0.0
1.0	48	1.000	0.0	1.0	0.0
1.0	113	0.322	-9.8	0.322	-9.8
1.5	40	1.266	2.1	1.0	0.0
1.5	87	0.528	-5.6	0.417	-7.6
1.5	127	0.246	-12.2	0.194	-14.3
2.0	35	1.486	3.4	1.0	0.0
2.0	74	0.676	-3.4	0.455	-6.8
2.0	103	0.406	-7.8	0.273	-11.3
2.0	135	0.206	-13.7	0.139	-17.1
2.5	31	1.678	4.5	1.0	0.0
2.5	65	0.798	-1.9	0.476	-6.5
2.5	89	0.521	-5.7	0.310	-10.1
2.5	113	0.341	-9.3	0.203	-13.8
2.5	140	0.181	-14.8	0.108	-19.3
3.0	28	1.849	5.3	1.0	0.0
3.0	56	0.824	-1.7	0.446	-7.0
3.0	80	0.614	-4.2	0.332	-9.6
3.0	99	0.439	-7.1	0.237	-12.5
3.0	119	0.301	-10.4	0.163	-15.7
3.0	143	0.163	-15.7	0.088	-21.1
3.5	26	2.006	6.0	1.0	0.0
3.5	54	0.997	-0.1	0.497	-6.1
3.5	73	0.696	-3.1	0.347	-9.2
3.5	90	0.516	-5.7	0.257	-11.8
3.5	106	0.387	-8.3	0.193	-14.3
3.5	124	0.272	-11.3	0.136	-17.4
3.5	146	0.150	-16.5	0.075	-22.5
4.0	25	2.151	6.6	1.0	0.0
4.0	51	1.081	0.7	0.502	-6.0
4.0	68	2.096	-2.3	0.356	-9.0
4.0	82	0.585	-4.7	0.272	-11.3
4.0	97	0.456	-6.8	0.212	-13.5
4.0	112	0.348	-9.2	0.162	-15.8
4.0	128	0.250	-12.0	0.116	-18.7
4.0	148	0.140	-17.1	0.065	-23.7
4.5	23	2.289	7.2	1.0	0.0
4.5	47	1.160	1.3	0.507	-5.9
4.5	63	0.835	-1.6	0.365	-8.8
4.5	77	0.649	-3.8	0.283	-10.9
4.5	90	0.516	-5.7	0.226	-12.9
4.5	103	0.410	-7.7	0.179	-14.9
4.5	116	0.322	-9.8	0.140	-17.0
4.5	131	0.233	-12.7	0.102	-19.8
4.5	150	0.131	-17.6	0.057	-24.8
5.0	22	2.418	7.7	1.0	0.0
5.0	45	1.239	1.9	0.512	-5.8
5.0	60	0.894	-1.0	0.370	-8.6
5.0	72	0.704	-3.1	0.291	-10.7
5.0	84	0.572	-4.8	0.237	-12.5
5.0	96	0.464	-6.7	0.192	-14.3
5.0	107	0.379	-8.4	0.157	-16.1
5.0	120	0.298	-10.5	0.123	-18.2
5.0	134	0.218	-13.2	0.090	-20.9
5.0	152	0.124	-18.1	0.051	-25.8
5.5	21	2.541	8.1	1.0	0.0
5.5	43	1.307	2.3	0.515	-5.8
5.5	57	0.951	-0.4	0.374	-8.5
5.5	68	0.752	-2.5	0.296	-10.6
5.5	79	0.619	-4.2	0.244	-12.3
5.5	90	0.516	-5.7	0.203	-13.8
5.5	100	0.429	-7.4	0.169	-15.4
5.5	111	0.353	-9.0	0.139	-17.1
5.5	123	0.280	-11.0	0.110	-19.1
5.5	136	0.207	-13.7	0.081	-21.8
5.5	153	0.118	-18.6	0.046	-26.7
6.0	20	2.660	8.5	01.0	0.0
6.0	41	1.376	2.8	0.517	-5.7
6.0	54	1.009	0.18	0.380	-8.4
6.0	66	0.781	-2.1	0.294	-10.6
6.0	75	0.664	-3.6	0.250	-12.0
6.0	85	0.562	-5.0	0.211	-13.5
6.0	95	0.472	-6.5	0.178	-15.0
6.0	104	0.399	-7.9	0.150	-16.5
6.0	114	0.330	-9.6	0.124	-18.1
6.0	125	0.264	-11.6	0.099	-20.0
6.0	138	0.196	-14.1	0.074	-22.6
6.0	154	0.113	-18.9	0.042	-27.5
6.5	19	2.770	8.8	0 1.0	0.0
6.5	39	1.439	3.2	0.520	-5.7
6.5	52	1.059	0.5	0.383	-8.3
6.5	62	0.848	-1.4	0.306	-10.3
6.5	72	0.710	-3.0	0.257	-11.8
6.5	81	0.604	-4.4	0.218	-13.2
6.5	90	0.516	-5.7	0.186	-14.6
6.5	99	0.440	-7.1	0.159	-15.9
6.5	108	0.375	-8.5	0.136	-17.4
6.5	117	0.312	-10.1	0.113	-18.9
6.5	128	0.252	-12.0	0.091	-20.8
6.5	140	0.188	-14.5	0.068	-23.4
6.5	155	0.108	-19.3	0.039	-28.2
7.0	19	2.874	9.2	1.0	0.0
7.0	38	1.498	3.5	0.521	-5.7
7.0	50	1.107	0.9	0.385	-8.2
7.0	60	0.895	-0.9	0.311	-10.1
7.0	69	0.751	-2.5	0.261	-11.7
7.0	78	0.631	-4.0	0.220	-13.2
7.0	86	0.553	-5.1	0.192	-14.3
7.0	94	0.481	-6.3	0.167	-15.3
7.0	102	0.414	-7.6	0.144	-16.8
7.0	111	0.354	-9.0	0.123	-18.1
7.0	120	0.298	-10.0	0.104	-19.7
7.0	130	0.241	-12.4	0.084	-21.5
7.0	141	0.179	-14.9	0.062	-24.0
7.0	156	0.164	-19.7	0.036	-28.8

Beverage Antenna Patterns for

L° from 0.5 to 7.0 wavelengths

FIGURE A: Side View of Antenna

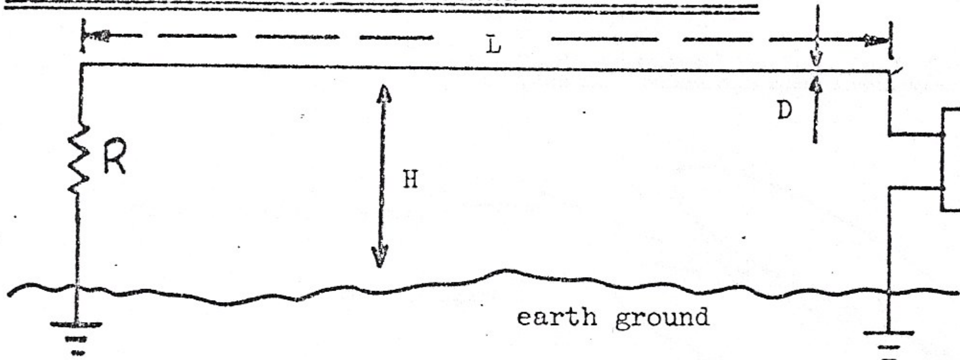


FIGURE B: Top View of Antenna

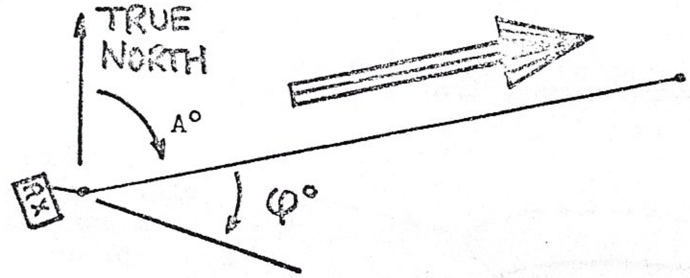


FIGURE C: Electrical Operation of Antenna

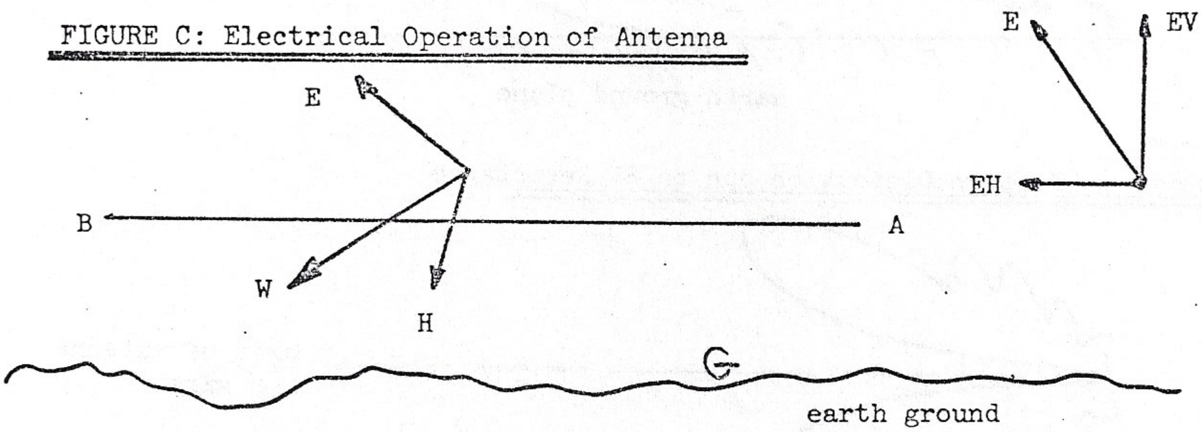


FIGURE D: Loop Pattern

Plane of Loop

FIGURE E: Loop Pattern

Normal Loop Plane

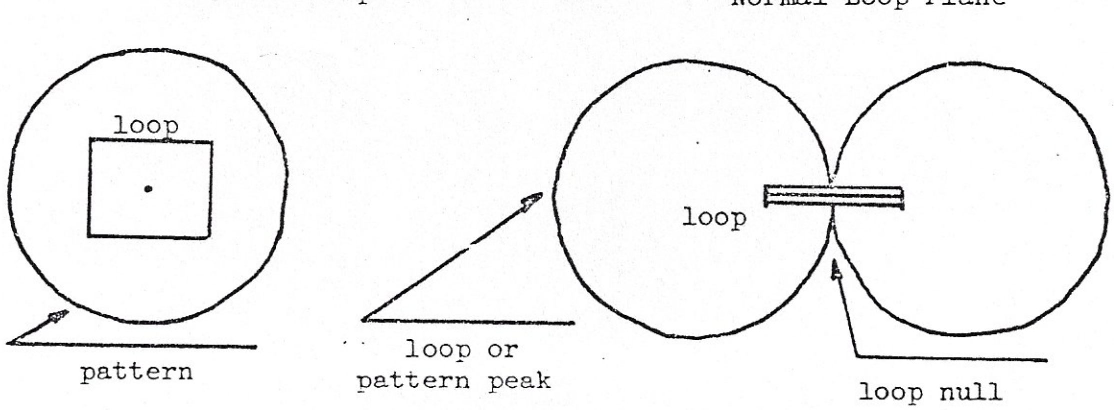


FIGURE F: Typical Terminated Beverage Pattern

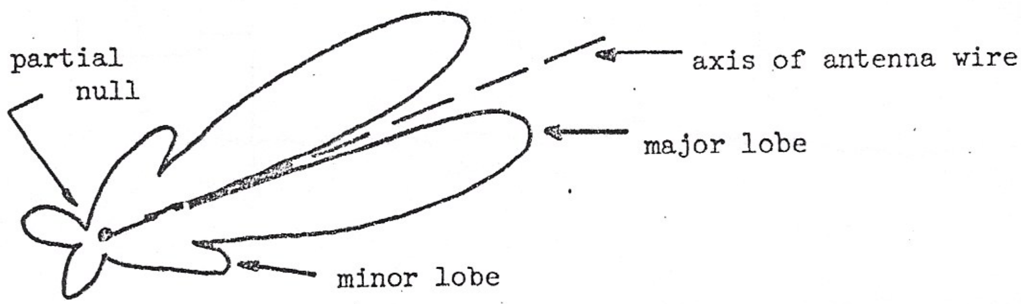


FIGURE G: Effects of Ground Plane on Vertical Pattern

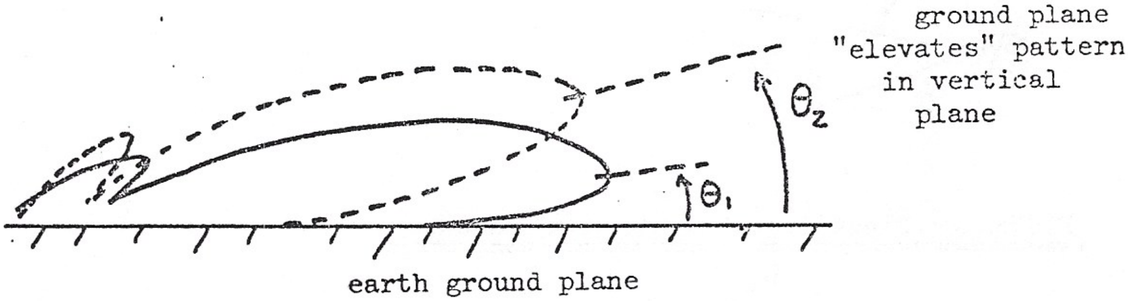
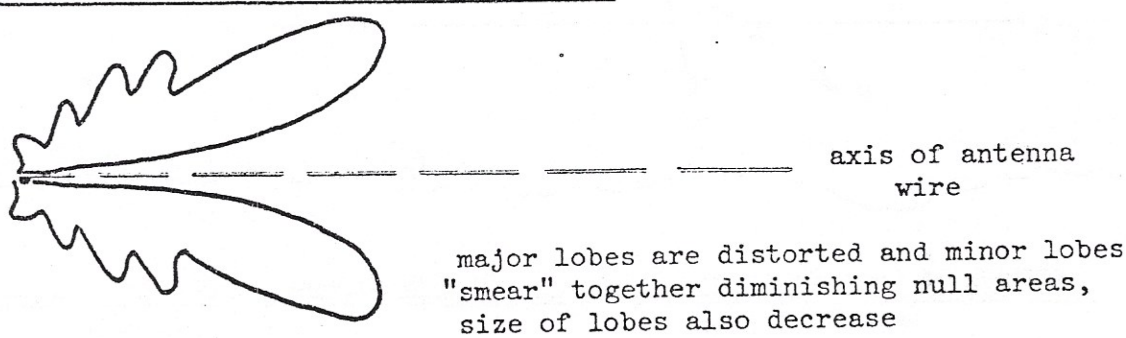
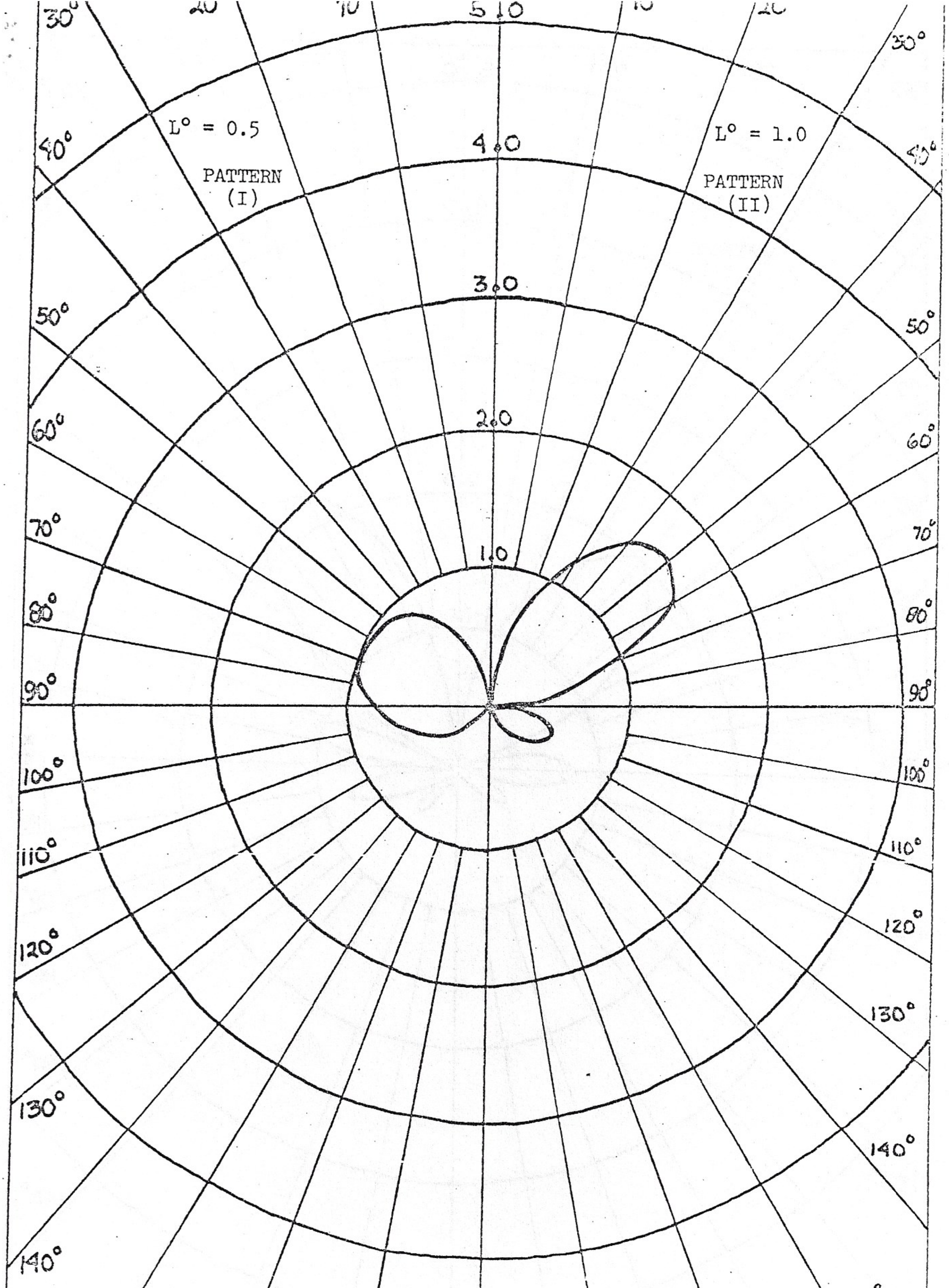
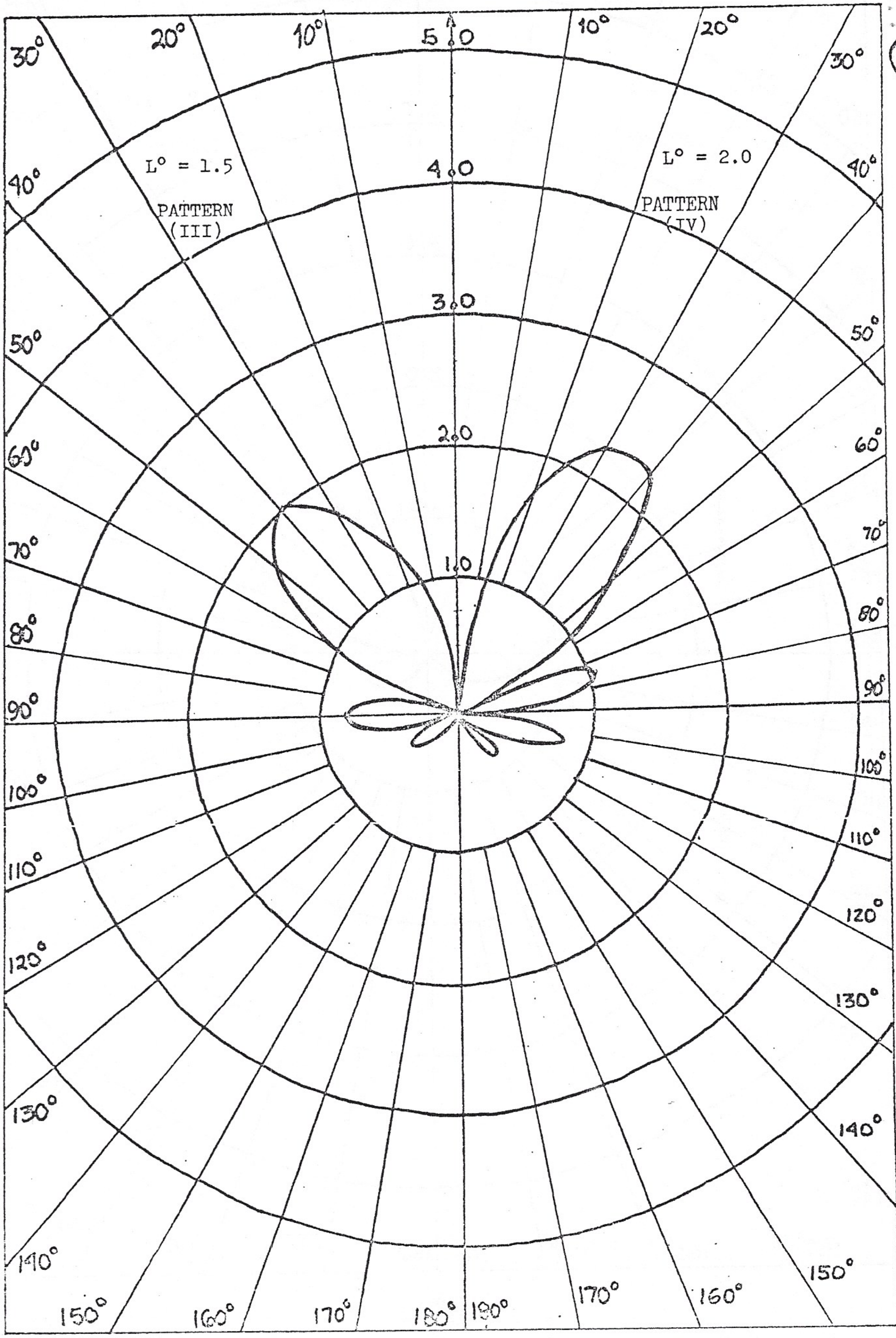


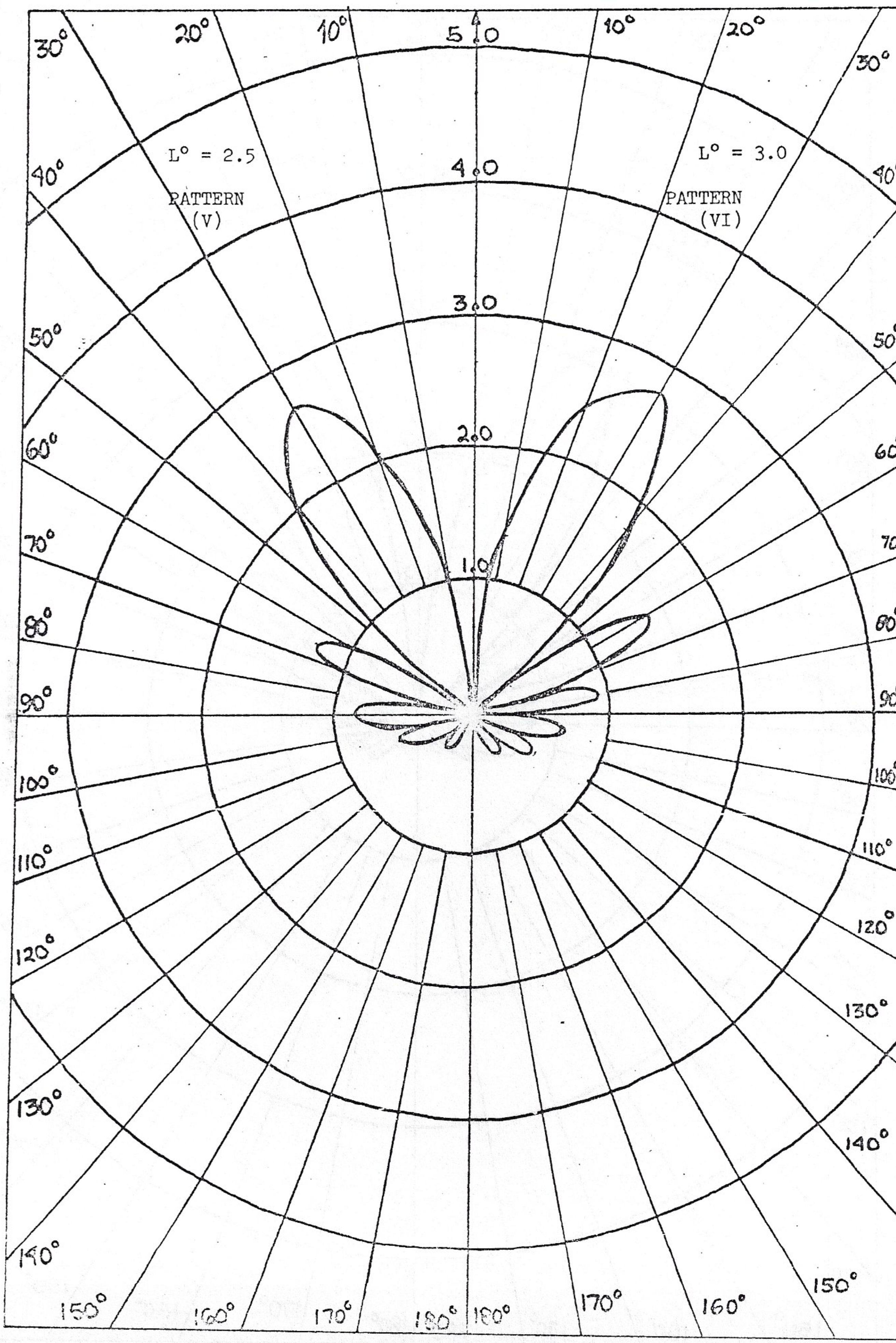
FIGURE H: Pattern Distortion due to RF Resistance




L° = 0.5
PATTERN
(I)
L° = 1.0
PATTERN
(II)
5.0
4.0
3.0
2.0
1.0
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°



10
L° = 1.5
PATTERN (III)
L° = 2.0
PATTERN (IV)
5.0
4.0
3.0
2.0
1.0
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°


L° = 2.5
PATTERN
(V)
L° = 3.0
PATTERN
(VI)
5.0
4.0
3.0
2.0
1.0
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
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130°
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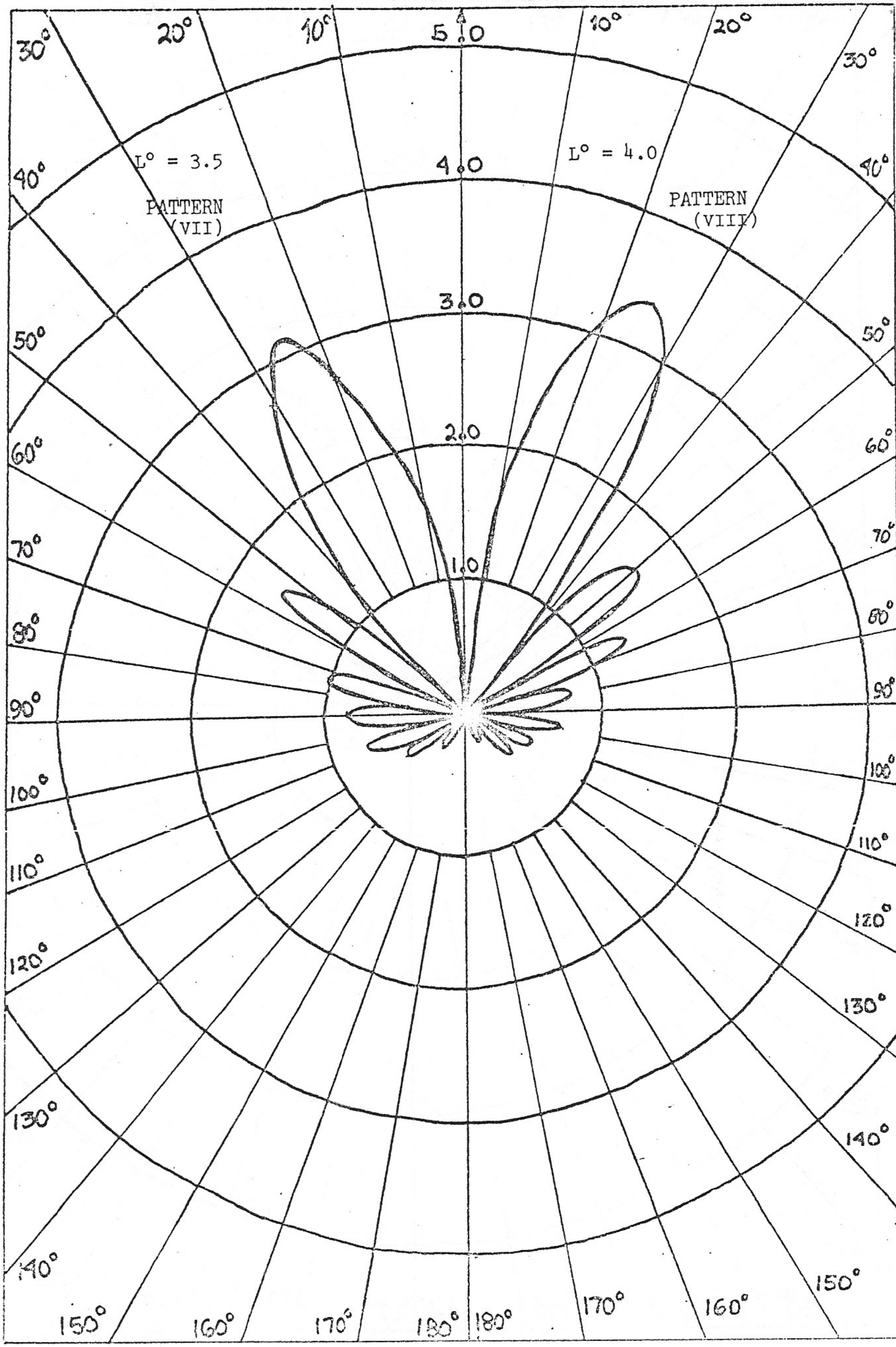
150°
160°
170°
180°


L° = 3.5
PATTERN (VII)
L° = 4.0
PATTERN (VIII)
1.0
2.0
3.0
4.0
5.0
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20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°

12

MORE DOMINANTS: 1270 KHz

-Day: WLBR Pa. Night: WXYZ-Mich. and WSPR-Mass. (Alster)
-Day & Night: Local WSPR. AN: WXYZ. MM: CJCB. (Caldwell)
-Day: WEIC Charleston, Ill. or WHBF-Ill. (Eddie)
-Day: WTID. SSS: WMPM Night: WXYZ/WUOK (Frcho)
-CHWK/KBAM days, KBAM/KAJO/KCOK/KTFI/CHWK/CHAT SSS, usually CHWK Eves w/CHAT, KTFI/KCOK under. On stong aurcral nights CHWK is gone, KCOK dominates. CHWK dominates AN. MM's: KFJZ u/CHWK's OC. (Portzer)
-Nothing days, CHAT usually very strong at night. (Sorensen)
WHLD days, WXYZ nights; KFJZ AN if WXYZ off (Whatmough)
-Clear days, KSCB/WHBF/KDML/KFJZ SSS, WHBF/KDML/KFJZ eves, KFJZ AN and MM. (Ed.)

So, that does it for this time. Thanks to all reporters. Next dominants will be 560, 1430, and 1590. Send dem reports on in by the end of December, and Happy Holidays! 73 de EWL.

ADDENDA TO FISCHER'S BEVERAGE ARTICLE

* Gordon P. Nelson

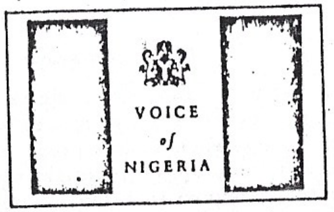
The mind does boggle... Ghoti's great article arrived this morning while yours truly was busily slaving over a hot slide rule on the kitchen table busily solving the Beverage antenna equations - presto, he's done it for us.[1,2]

I think the only important point to be added is to reemphasize an important point that Dave has already stressed: that his curves are based on the assumption that the antenna is so far above real ground that earth effects can be neglected. Real world ground is not only covered with Kleenex and beer cans, it's also nonuniform and has both a finite conductivity and dielectric constant. The effects of nonideal ground conductivity and dielectric properties are twofold: (1) The equations get mucked up almost as badly as the loop equations do when you include real ground,[3] and (2) The split in the center of the main pattern lobe(s) tends to vanish. Otherwise the front-to-back and side-lobe properties remain essentially unchanged. But the front lobe-splitting is definitely an artifact due to the ground assumptions.

In actual practice the value of that terminating impedance out there at the far end tends to vary somewhat with time due to a variety of ground effects ordinarily neglected in the theoretical treatments: in particular the action of temperature and moisture on the connection between the earth and the termination ground connection. Ground-rods, radial wires buried in the ground, old radiators thrown in the frog pond - all of these are metallic electrodes in contact with the chemically complex and variable trash pile known as the surface of the Earth.[4] Changes in the temperature, chemical composition, and moisture content of the contact area between the termination electrodes and the soil there will change the effective termination from hour-to-hour and day-to-day. In practice this means that no matter how carefully you have set the termination resistor to null out the back lobe, within a few hours or a few days

(continued page 39)

580 *WYYZ Jasper,Ga 1/1/73
590 * Clayton,NC 8/9
* Alexander City,Al 9/1
600 +WRBN Warner Robins,Ga 5/3
+WAAM Ann Arbor,Mi (4/5)
*WMST Milton,WVa 8/25



(cont. from p. 37)

the electrode chemistry in the ground will have altered the value enough to require a significant change. Thus in actual practice it's necessary to be able to control the value of the termination resistor if you're going to maintain the advantage of the back-lobe terminator. The people who deal with these effects on a daily basis have developed elaborate techniques for "tweaking" the value of the termination remotely to compensate for these secular changes; unfortunately these techniques are not available to the amateur. Either one of us will come up with a simple remote technique to modify the value of the terminator or some poor soul will have to spend a long cold night out there in the swamp at the far end riding the terminator potentiometer on request from the receiver site people via CB...

The noise-cancelling properties of the Beverage have been mentioned in passing elsewhere this issue. In conjunction with Dave's NEBE project, a related effort is underway at HQ. Within a few days we hope to activate our 11wavelength Beverage (6600 ft.) in N.H. Beamed on Central Asia and the Far East, it's erected over solid Conway Granite and terminated in swamps... Pattern center is due North and hopefully we'll be able to get through on some of the midwinter Far East Asian paths discussed at the NRC Miami Convention.

Since we're heavy on footnote/reference numbers this week, we'll append (with apologies) to Ghoti:

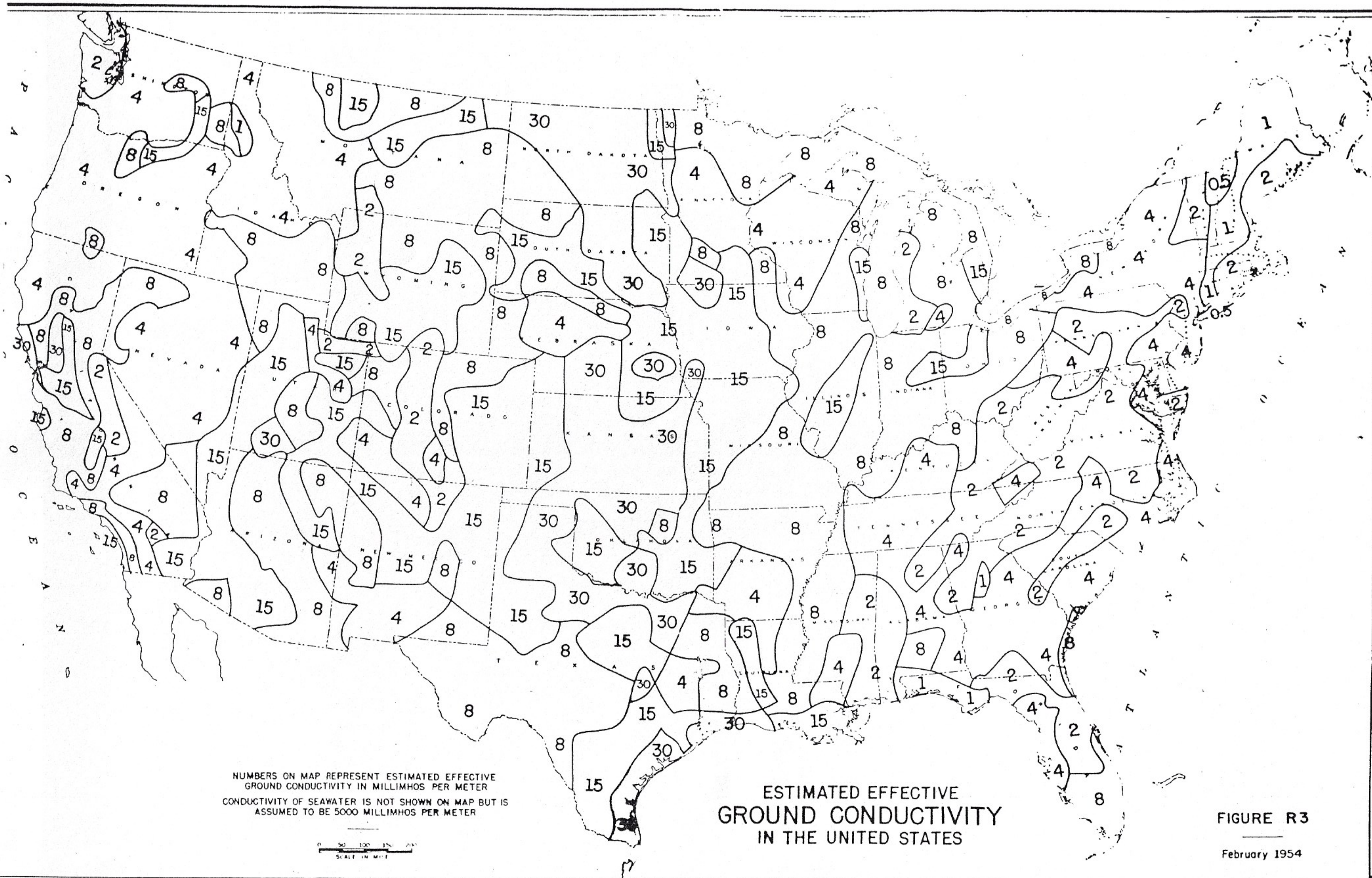
(1) "The wave antenna - a new type of highly directive antenna", H.H. Beverage, et al., Transactions of the AIEE, Vol. 42, p. 215, 1923. Available an an NRC reprint from HQ; most definitely both the first and (almost) the last word on this ultimate MW antenna!

(2) "The BCB DX'ERS BEVERAGE", G. Nelson, DX NEWS, 2/28/71.

(3) "Analysis of the electrostatically perturbed loop antenna over real lossy ground", G. Nelson, available as an NRC Monograph from HQ, 45 pages of solid equations, not for the faint of heart.

(4) "Reference electrodes - theory and practice", D. Ives & G. Janz, Academic Press, N.Y., 1961. Interesting and relevant work on on this subject was done as early as WWII; unfortunately all of the relevant files were yanked from the FCC/FBIS public archives when they were transferred to the National Intellegence Authority in August of 1946. See "Preliminary inventories of the national archives; No. 93, records of the federal communications commission", Washington, 1956, for the shadows of the missing research bodies...

*GPN



NUMBERS ON MAP REPRESENT ESTIMATED EFFECTIVE GROUND CONDUCTIVITY IN MILLIMHOS PER METER

CONDUCTIVITY OF SEAWATER IS NOT SHOWN ON MAP BUT IS ASSUMED TO BE 5000 MILLIMHOS PER METER

ESTIMATED EFFECTIVE
GROUND CONDUCTIVITY
IN THE UNITED STATES

FIGURE R3

February 1954

TO: Prof. Allen R. Edison
Department of Electrical Engineering
University of Nebraska, Lincoln
FM: B.C. Macholan, C.W. Dabelstein, R.D. Mitchell, D. Fisher
DATE: September 1972
RE: Project NEBE (NEbraska BEverage)

The following is only a brief sketch of this Project and not all investigations are necessarily discussed.

It is proposed in Project NEBE that two Beverage antennas be erected at the University of Nebraska Field Laboratory near Mead, Nebraska for the purpose of:

(a) recording propagation phenomena in the Medium Wave frequency spectrum-viz: the Standard AM Broadcast Band, 525-1625 kHz;
(b) determining relative reception properties of the Beverages with respect to short electrical and magnetic dipoles;
(c) determining unidirectional and beamwidth properties of the Beverages as well as bidirectional performance
(d) investigation of the effectiveness of these antennas to provide data for determination of the extent of the auroral polar cap

Basic details of the proposed Project are:

(i) Erection of two Beverage antennas each approximately 3200 feet in length constructed from #24 gauge copper wire held above ground level at a nominal height of 4 feet by wooden supports placed approximately at 50' intervals and the mid-section of each span flagged by cloth strips. The azimuth bearings of these antennas will be 260° and 325° anticipating major horizontal sidelobes of 35° at the lower and 20° at the upper frequencies of interest.

(ii) These antennas will be terminated in their characteristic impedance as calcualted from the ideal characteristic for a single infinitely conducting wire over an infinite infinitely conducting ground plane. Although a lump constant impedance cannot completely terminate the back wave on this travelling wave antenna, simple carbon resistors of 560 ohms (nominal) value will be used. Ground connections will be made by copper ground rods or their equivalent. In the terminated mode these antennas are expected to perform in the unidriectional sense. Tests for bidirectionality will be made by operating the antenna unterminated.

(iii) Medium Wave propagation is a function of many parameters including several mechanisms not yet fully understood. For reference find attached several articles related to the specific interests here. We propose to measure both on a qualitative and a quantitative basis the MW reception of stations propagating through the Auroral Polar Cap of North America coorelating these data with the A-geomagnetic indices of both Fredericksburg (Virginia) and Boulder, the latter being transmitted hourly by WWV. The standard broadcast band has the property that even under severe auroral disturbances that single paths doe not deviate largely from great circle paths so that the Auroral Control Point (ACP) and Limiting ACP for multihop paths can be calculated with very reasonable accuracy. The azimuth bearings of these antnnas are chosen so as to project the major sidelobes onto the areas of Alaska, Japan, Asiatic Russia, Korea and China as well as Australia and New Zealand. These locations all have moderate to high powered (megawatt) facilities operating in the broadcast band which regularly are heard in North America with magnetic dipoles (loop antennas) and communication receivers--although at very late night-early morning hours.

(iv) The month of October has the most potential, save for March, for such receptions since residual E-layer absorption is on the decline and the Midwinter Anomly commences in early November and continues well into late December-early January thus reducing the success of reception through the Polar Cap.

(v) Our requirements are that reasonably open land be available for the antennas and that a building with commercial power be designated for use by the Project. No equipment, save the antennas, will remain on University property while the project participants are not present. The antennas will be removed in very early November--prior to the Nebraska Hunting Season.

(vi)Our interests are solely non-commercial and results of the project will be made available to the University throught the Department of Electrical Engineering should significant data be obtained.

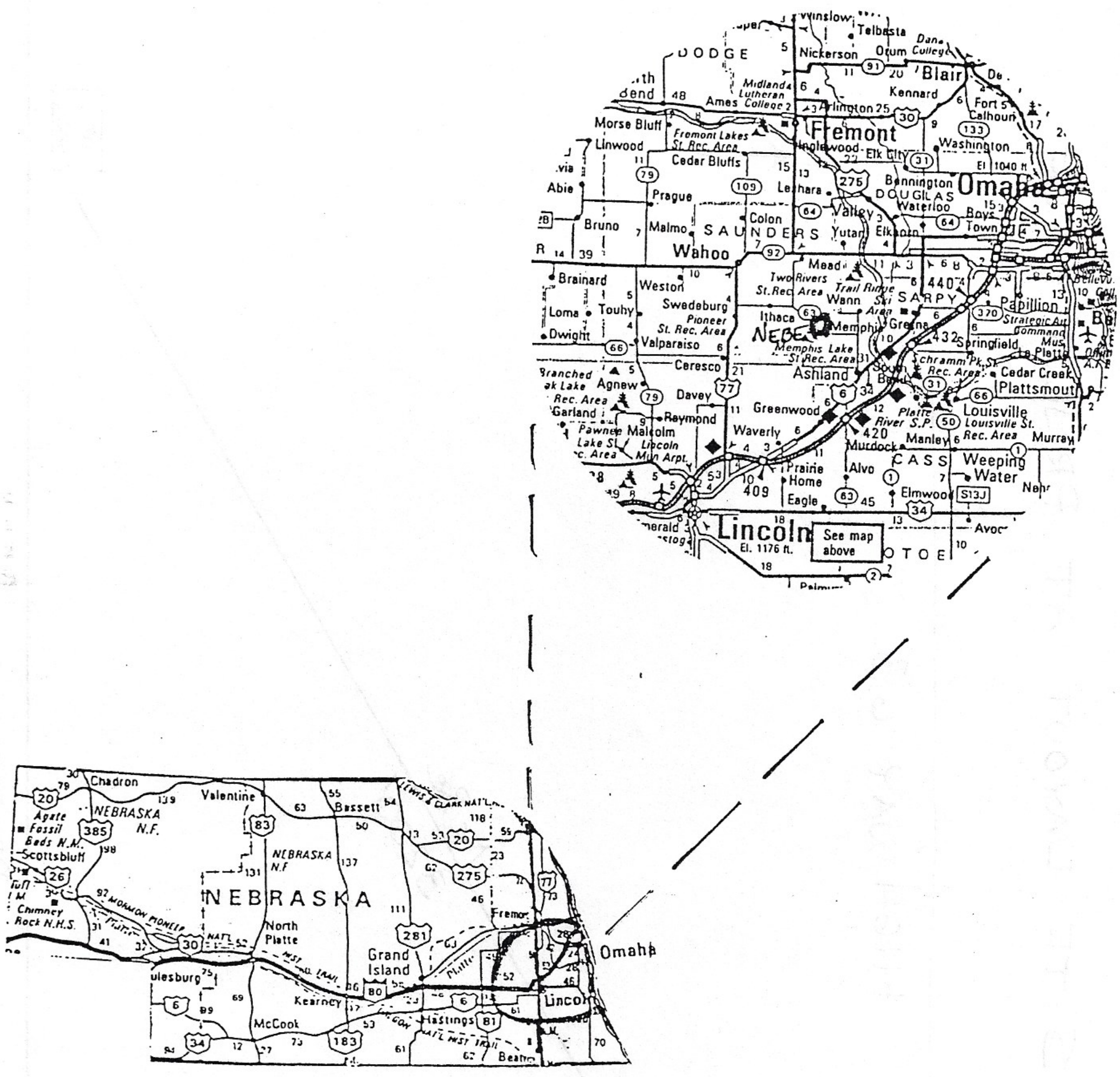
(vii) We also propose daytime use of the antennas to ascertain groundwave reception and to investiage the basic antenna patterns.

(viii) Persons engaged in this project are listed in the heading of this memo, but others may become involved but access to the Mead facility will always be accompanied by at least one of those named above. Certainly no more than 7-8 people will be present at one time

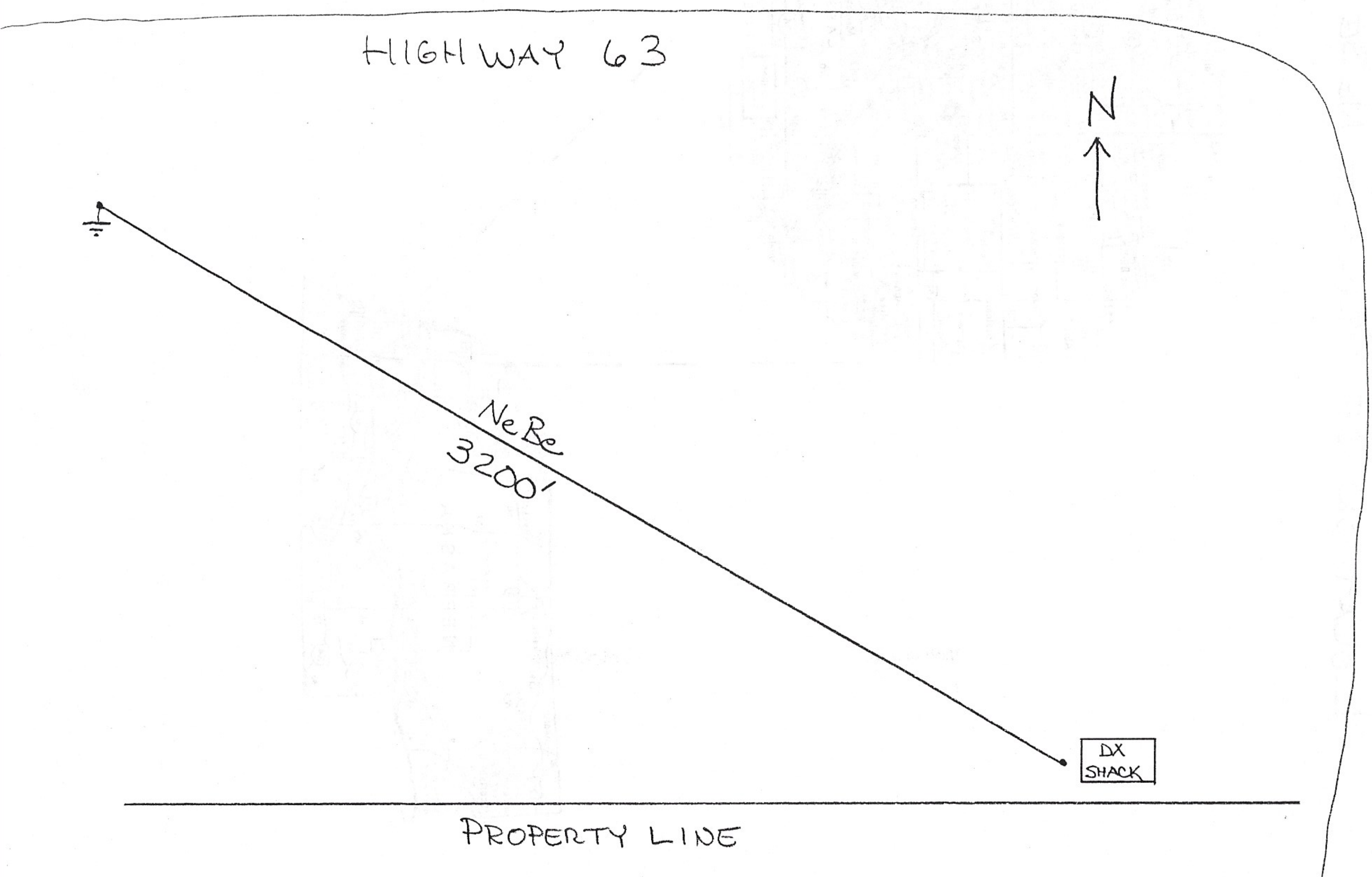
(ix) All persons in Project NEBE shall understand the waiver of University liability to thier person and personal property including the antennas. However, we do not claim liability for the antennas as a hazard to others for precautions are being taken to plainly mark the #24 gauge wire every 50' or so.

This memo is not intended to exhibit the full extent of the interests for use of thsee antennas. However, their use will be only for receiving purposes. We shall cooperate fully with the University Staff and will not leave the property without returning it to its original state.

LOCATION OF PROJECT NEBE



SITE LAYOUT AT PROJECT NeBe



NEBE - A DXER'S PARADISE

Carl Dabelstein KØSBV &
Robert Mitchell WDXØFXQ

We have been asked by Dave Fischer to write a supplement to his recent article "NEBE--A SUPER SIGNAL SNATCHER".

Our Project NEBE (NEbraska BEverage) was set up during the Fall of 1972 at the University of Nebraska Field Laboratories, about midway between Lincoln and Omaha. We were authorized to use one square mile of land for the erection of our BCB Beverage. The site, which included an unheated metal building about 8 ft. square, was approximately halfway between the towns of Ithaca and Memphis, one mile south of Nebraska Highway 63--a location totally free of manmade noise. We were roughly 22 miles from the nearest BCB transmitter, four miles from the nearest town and slightly over one mile from the nearest road. A more ideal setting for BCB DXing cannot be found.

Reaching the NEBE site required a trek of one mile over land, and the only "road" to our site was frequently impassible. This proved to be the only drawback to our location. The slightest rain or snow made ready access impossible. We could have made the journey on foot, but we would have been unable to carry our receivers, recorders, power and audio cables, etc. Due to this limitation we were able to spend only a few DX sessions at the NEBE site after the antenna was erected.

Comfort in sub-freezing temperatures was possible, thanks to an electric heater, a Coleman stove, heavy coats and a great quantity of hot coffee and tea.

Our Beverage was 3200' (about 0.6 miles) in length, situated on a bearing of 300^{o}, or just west of northwest. The antenna performed much better than we had anticipated. Everything you have read about the performance of the Beverage is true. Any time of the day, the performance was fantastic. The remainder of this article will describe some of our reception observations during the day, night and transition periods.

I. Daytime Reception. Due to the bearing of our Beverage, we were somewhat handicapped in evaluating its daytime performance. The station density along a bearing of 300^{o} in this part of the country is very low. There were some definite surprises though. At our home QTH in Lincoln (some 25 miles to the south), the daytime regulars on 1350 are KRNT, Des Moines, IA, and KMAN Manhatten, KS. At NEBE there was no trace of these stations; rather, KBRX, O'Neill, NE, dominated the frequency with an S-9 signal. Other loggings included KTWO, Casper, WY, on 1030, with an S-4 signal, which is totally inaudible at the home QTH in the daytime. KIOA, Des Moines, IA, completely dominates 940 in Lincoln. At NEBE, this signal was fighting it out with KVSH, Valentine, NE. In five years of BCB DXing in Lincoln, Ghoti was never able to log KCSR-610, Chadron, NE; the usual pest being WDAF in Kansas City. At NEBE, KCSR was definitely audible under WDAF. Obviously, the above daytime loggings were only possible due to the signal-snatching power of the Beverage Antenna.

II. Transition Period Reception. DXing both the sunrise and sunset conditions proved to be most interesting. Evening signals from the west appeared at least one hour earlier on the Beverage than on the home equipment. As a

result of the antenna's directional characteristics, many sunset sign-offs previously unheard became regulars. The nulling of signals from the east really opened up many of the frequencies. Regular evening sign-offs included KMER-950, Kemmerer, WY, KBHB-810 Sturgis,SD, KBRJ-950, Boise, ID, KURL-730, Billings, MT, and KBLI-690, Blackfoot, ID.

Sunrise skip also was unique. Daytime signals from Wyoming, Montana and Idaho were heard nearly 3-1/2 hours after our sunrise. This is long after the respective signals have disappeared at the home QTH. Stations which could regularly be heard at this time included KURL-730, KGHL-790, KSEN-1150, KGCX-1480, and KOFI-1180 from Montana, and KYME-740, KBOI-670, KSEI-930, KAYT-970, KUPI-980 and KGEM-1140 from Idaho.

III. Nighttime Reception. Both the directional and the gain characteristics of the Beverage were quite apparent during the nighttime hours. Many pests at the home QTH were totally absent at the NEBE site.

Due to the limitations noted above, we were able to have only two all-night sessions at NEBE. Surprisingly, although both occurred during periods of high auroral activity, reception to the northwest was outstanding.

The most surprising station of all our NEBE loggings had to be KBMY-1240, Billings, MT. At a distance of over 700 miles, their 250 watts provided a consistent S-9 signal between midnight and 6 a.m. local time.

One has to hear the tapes of this station to appreciate the value of the Beverage. Fellow DXers Paul Hart, Dick Truax and Bill Nittler have heard some of our tapes and will readily attest to our description.

The following is a summary of some typical after-midnight reception during the Fall of 1972 at NEBE compared to that at the home QTH:

Frequency	Lincoln Dominant	NEBE Dominant
550	KSD,KOY	KFYR,KBOW
560	KWTO	KMON
690	XETRA	CBU
730	XEX	CKDM
790	KULF,WAKY	KGHL
800	XELO,PJB	CHAB
850	KOA(MM's)	CJJC
900	XEW,CHML	CKBI,CJVI
910	KGLC,KPOF	CJDV,KISN
930	WKY	CJCA
940	KIOA	CJGX
960	KOOL,WERC	CFAC
970	WAVE,XEJ	KOOK,KREM
980	KMBZ	CKRM
1030	WBZ	KTWO
1060	KYW,WNOE	CFCN
1080	KRLD	CKSA
1140	WRVA	KGEM, CKXL
1150	CKOC,WIMA	KSEN,KAGO

1180	WHAM	KOFI
1230	WQUA	KGEK
1240	KAKE,WINN	KBMY
1260	KVSF	CFRN
1270	KFJZ	CHAT
1300	WOOD,KCNW	KOZE
1310	WRR,WIFE	KEIN
1320	WILS	CHQM
1340	KICK	KCAP
1350	WSMB	KRLC
1370	WSPD	KXLF
1380	WAOK	KRKO
1400	KFRU	KATI
1410	WING,WIZM	CFUN
1450	KLWW	KUDI
1480	KLMS	KGCX
1510	WLAC	KGA
1520	WKBW(MM's)	KYXI

In conclusion, it's difficult to talk about the Beverage Antenna without using superlatives. Everyone should have an opportunity to use this remarkable piece of BCB DXing equipment. Our time spent at NEBE, as explained above, was all too limited. Plans are presently being made to construct a new Beverage "Son of NEBE" this coming summer. Now, if someone will only figure out how to make it both portable and rotatable!

QSL **417·LONDON BROADCASTING** QSL

ON 417 METRES, 719 kHz and 97.3 VHF

The London Broadcasting Company confirms as correct the reception report

of: G.A. CALKIN BM-BOX 1926 LONDON WC1V 6XX

Date of reception: 18.8.74 Time of reception: 1550 - 1640 GMT

Signed:

NEBE ------- a Super Signal Snatcher *-- de Ghoti, Ph.Dx*

As a sequel to the SUPER SIGNAL SNATCHER which appeared in both DXN and DXM, this writing, as stated, paritally describes Project NEBE (NEbraska BEverage) which began in October 1972. Described here are the method of construction, the antenna location; a subsequent writing will give the basic performance of NEBE and a description of the receptions on the BCB.

Project NEBE participants: Carl "Skip" Dabelstein, KØSBV, Lincoln, NE (NRC,IRCA); Bernie C. Macholan, exKØMKV, Wahoo, NE (IRCA); Bob Mitchell of Back to the Bible Broadcasts, Lincoln, NE and de Ghoti. We regret very much that "Mac" died of cancer in late 1973. His fundamental grasp of things abstract was indeed out of the ordinary!

The first antenna was erected in about two hours time and was 3200 feet in length, about 5 feet above the ground and located on an envious square mile of land given over to the Project by the University of Nebraska at its Field Laboratories about 7 miles southeast of Wahoo.

As pointed out by GPN in THE BCB DXer's BEVERAGE in DXN and also in the Super Signal Snatcher, a Beverage operates with improved efficiency as the conductivity of the ground over which it is located becomes increasingly lower (poorer) but also that a good ground is required to terminate or ground the ends of the antenna and receiver system. So, one works against the other: High conductivity allows an easier good ground but the antenna pickup is reduced and conversely so for low or poorly conducting soils of the earth. The conductivity at the NEBE site is about the highest (best) in the USA. As a guide to the type of soil across the USA, refer to GPN's article above where the FCC Conductivity map of the region can be found.

Other than the conductivity dilemma, which exists at any location in general, the NEBE site is as ideal or envious as one could desire. A BCB shack including operating tables and power is located on the site--out in the middle of nowhere there's a BCB shack beautifully positioned for BCB Beverage work!! Furthermore, the land lays very flat for tens of miles around and the largest elevation differential at the site is on the order of 7 feet. We realize that few will have it so lucky!

The following materials were obtained or prepared prior to the construction of the antenna:

1) *a sufficient number of 1"x6'x6" stock lumber cut into 3/4"x3/4"x6' stakes to allow about 50-60 foot spans of wire along the antenna run;*
2) *four 1 lb spools of 24 gauge plain enamel copper wire (about $15 at that time);*
3) *a hammer and a few nails;*
4) *a 560 ohm carbon resistor (suggest a 1000 ohm carbon potentiometer);*
5) *a box of small U-tacks;*
6) *a roll of rubber based insulating electrical tape;*
7) *a propane to rch and rosin solder;*
8) *a 50 foot tape measure;*
9) *several copper ground rods (1/2" x 8');*
10) *twenty foot or so of cloth clothesline rope and a number of cloth ribbons;*
11) *a magnetic compass;*
12) *a geographical topography map of the site; and*
13) *a 7 foot by 1.75 inch round steel rod (wrecking bar) with a pencil pointed end.*

We recognize that the last item may be hard to find! But there are substitutes as mentioned below. It was merely fortituous that one was on hand.

The azimuth bearing of NEBE was chosen to be 120°/300° (roughly SE/NW) with the 300° azimuth for use in the unidirectional Beverage mode.

True North was determined from the BCB shack housing the RX and the tape recorders by use of the topographical map and then crudely checked with the magnetic compass. Once this N/S line had been determined, the tape measure was used to determine a point 600 feet due North of the RX shack. (600' was merely convenient--any distance of that order is fine). Then from that Northern point, with the compass again and the topographical map an E/W baseline was determined. Then by some trivial trigonometry, a point was located along the E/W line by measuring off with the tape measure. The point so determined lay on the 300° azimuth line from the BCB shack. The point and the shack then determined the line of construction for the antenna.

Now the antenna erection began. Always siting along the reference points marking the azimuth line of the antenna, the wrecking bar was used to punch 5" to 6" deep holes in the ground, the holes being separated about 50-60 feet apart. While one person did this, another followed placing a wooden stake (3/4 x 3/4 x 6') in each hole. No effort was made to cause the stakes to stand vertically before the wire was attached. When the wire is attached, the wire catenary causes the stakes to come vertical and align with excellent form!! Following close behind the staking operation, two of us attached the wire to the top of each stake as follows --in a very simple manner. A short piece of the rubber based electrical tape was cut and folded flat over the stake top, then a U-tack was hammered into the stake with the antenna wire passing thru the U-tack and over the rubber electrical tape. No U-tack was nailed completely down or into the top of the stake, thus allowing the wire to slide across the top of the stake as required. When an end of a spool of wire was reached, the torch was used to solder a "Western Electric" splice to the beginning of a new reel of wire. Note, if the wire has plastic insulation on it, the rubber based electrical tape is not necessary.

When the 3200' point was reached, the end of the antenna was wrapped (to prevent slippage) about a nail driven into the top of the last stake with about 10 feet of wire left over to allow the end to be soldered to the resistor which would then be soldered to wire connecting to the ground rods in the ground near the last stake. (NEBE was first operated in the bidirectional, unterminated mode). Rope was used to guy the last stake to smaller stakes driven in the ground around to keep this stake from breaking due to the torque from the antenna wire. The same guying was used on the first stake at the start of the antenna next to the BCB shack. The arc or catenery formed by the wire as it spanned from stake to stake was determined by merely pulling the wire forward from span to span as it was being installed. Common sense determined the tension of each pull--perhaps the wire sagged a foot at the most in the middle of a span.

After being up for a few days, the copper wire stretched (as expected) and the wire had to be respanned. About 70 foot of wire was pulled out at the end stake as a result of stretching (that's about 2% of 3200'). Thereafter very little increase in sagging between stakes was noted even though cloth ribbons were attached at each mid span to alert any trespassers of its existence--hoping they would then not walk into it or through it.

After the extra wire due to stretch was pulled from one end of the antenna, and a few hours of operation in the bidirectional mode, the resistor was connected on the NW (300°) end by soldering it in series with the end of the antenna and the ground rods. The propane torch was used and is necessary to solder the wire to the heavy metal rods--we chose not to use a mechanical "crimp" connection. That's all it took to erect NEBE!

Later on, about late November 1972, the antenna was moved some 10° to the North, 310° and instead of placing the stakes in the ground, they were mounted or strapped atop every other metal fence post of a wire fence running almost the length of the antenna. (We discovered that cattle broke into the area and that they do not mix well with Beverage antennas!). The antenna was now some 7 to 8 feet above the ground. This was NEBE 1A. The results of NEBE 1 and 1A were affected by the fence but the receptions were still so phenomenal or out of the ordinary that the effect was of little concern to us--if noticed at all.

The antenna was used on quite a number of occassions for many hours--MM on a Beverage is something else!!! Ice accumulated on the antenna once or twice and we had to resplice it and respan it and were back in operation. Use of larger diameter wire would have prevented this problem however. The way the antenna was constructed, once the wire broke, the tension was sufficiently relieved that only one break was found.

About the wrecking bar. It can be replaced by a 1" diameter piece of pipe which can be driven in the ground with a sledgehammer or some such klobberer. Removal of the pipe isn't easy--suggest a hole be drilled thru the side of the pipe and a heavy wire or cable be attached, then pull for retrevial.

Note that not every procedure mentioned here need be followed in the construction of other Beverage antennas and not all items listed in the materials list absolutely necessary. Too, other structures are conceiveable for a Beverage, the method used in this case seemed most appropriate for the location and the ease of installation.

Finally, a few comments on grounding and terminations. A good ground is absolutely essential for proper termination of a Beverage, but obtaining and maintaining such is like holding a tiger by the tail! Multiple ground rods well spaced and well connected are a good start. What appears to the eye as a sufficient ground system is not necessarily so!!! A cheaper method than ground rods is to use coffee tins punched full of holes, bare copper wire then threaded thru the holes thus running both around the outside and thru the inside of the cans and soldered at every point the wire passes thru a hole. A multitude of such can wired together is then buried about the earth in the vicinity of the end of the antenna. Other such objects to which electrical connection can be made prior to burial are car radiators, tanks, pipes, metal sheeting (ideal!), and so forth. Once you've got what is believed to be a good ground, a single good sized wire will run from the ground system to the point of connection with the terminating resistor for the Beverage.

Regardless of the ground you obtain, the termination in most cases will "float" and it will be quickly discovered that the termination is not ideal. A Beverage must be pruned or tuned with some method of varying the termination over a range of resistance (simplest case) while monitoring at the RX. For a Beverage like the 3200' NEBE, this can be quite a feat. Communication between antenna ends is not easy to come by. Some have used walkie-talkies or even a separate "talk" wire. Use of the beverage for such communcation is not correct when the RX is being used simultaneously however.

Such tuning presupposes a variable potentiometer (resistor) for the termination. The simplest method of tuning is to have some one or someway of tuning the termination while the receiver is monitored. The RX is tuned to a station off the backside of the antenna (RX end) and the resistor is varied until the best "null" is obtained on the backside station. Once such a setting is obtained, it will be discovered that it is also frequency dependent and that off on another frequency the setting will be different. Too, the ground electrolysis, etc. will cause the termination to change and resetting is required with respect to time because ground conditions have changed. Treating the ground with salt, etc. may help obtain a somewhat improved LOCAL ground, but its change with time will likely be more pronounced. A tiger by the tail.

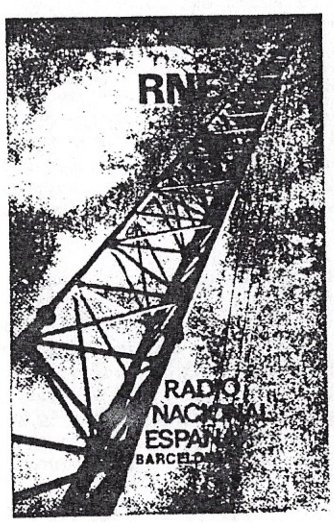
GPN has written a beautiful paper titled "On the Goodness of Beverage Terminations" as I recall, that covers the techniques extremely well and based on adroit theory as well as practical verification. This paper remains to my knowledge as unpublished correspondence.

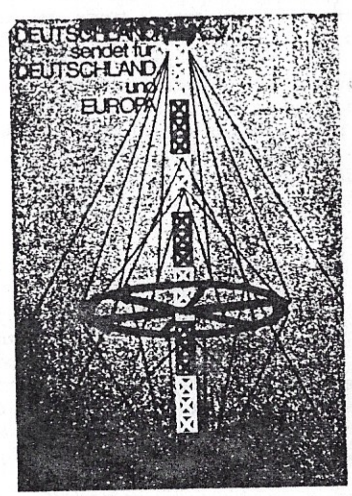
The Beverage antenna is indeed a phenomenal BCB antenna. It's employment in more serious technical endeavors in BCB work is extremely justified. For one, daytime DX! Those of you who have made some long haul day time receptions in the 1000-1330 local time period by the mechanism of partial D-region reflections will understand my point. Who will be the first to log a daytime E-layer hop? That's a real challenge and a noteable objective. There's a lot of high noon DX work that can be found in the USA during the winter months.

To end, NEBE was surely a noteable experience for all of us and more details of receptions made will follow in a writing to be authored by Skip Dabelstein. He has some interesting data to display as a result of our early morning and late night trecks out to the NEBE project. We can only encourage others to erect such antennas but caution to take the time to install properly. The reward is certainly serendipity!

--de Ghoti

(Note: For those interested in a source for Beverage antenna wire, contact me!!!)





Project NeBe Taped ID's

Graveyards

1.	KGEK - 1230	Sterling, Colorado	(1)
2.	KBMY - 1240	Billings, Montana (a)	(2)
3.	KATI - 1400	Casper, Wyoming	(3)
4.	KUDI - 1450	Great Falls, Montana	(4)

Regionals

1.	KTW - 1250	Seattle, Washington(c)	(5)
2.	KPOK - 1330	Portland, Oregon	(6)
3.	KVI - 570	Seattle, Washington	(7)
4.	KOOK - 970	Billings, Montana	(8)
5.	KEIN - 1310	Great Falls, Montana	(9)
6.	KAGO - 1150	Klamath Falls, Oregon	(10)
7.	KRKO - 1380	Everett, Washington	(11)
8.	KGCX - 1480	Sidney, Montana (b)	(12)

Clear Channels

1.	KEX - 1190	Portland, Oregon	(13)
2.	KGEM - 1140	Boise, Idaho	(14)
3.	KOMO - 1000	Seattle, Washington	(15)
4.	KOFI - 1180	Kalispell, Montana	(16)

Canadians

1.	CHAT - 1270	Medicine Hat, Alberta	(17)
2.	CJJC - 850	Langley, British Columbia	(18)
3.	CKXL - 1140	Calgary, Alberta	(19)
4.	CHQM - 1320	Vancouver, British Columbia	(20)
5.	CFAC - 960	Calgary, Alberta	(21)
6.	CKVN - 1410	Vancouver, British Columbia	(22)
7.	CKWX - 1130	Vancouver, British Columbia	(23)
8.	CFCN - 1060	Calgary, Alberta	(24)

Notes:

(a) By far, this was the most surprising station logged on the NeBe. The signal was of this strength and consistency throughout the night, every night we DXed.

(b) Simultaneous identification from KLMS in Lincoln, Nebraska, transmitting from a site about 25 miles south of the NeBe. This is illustrative of the typical "off the side" signal reduction capabilities experienced with this antenna.

(c) WREN in Topeka, Kansas was the dominant "pest" on 1250 Khz in the Omaha - Lincoln area back in 1972. Although WREN was on the air when this ID was taped, its signal was all but eliminated by the directional capabilities of the antenna.

LOCATIONS OF STATIONS WITH TAPED ID's