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Yes, I Built Sixteen Log Periodic Antennas!

Part 1: Theory and tests.

The broadband, unidirectional HF log periodic beam antenna was originally developed about 1957 (see references at the end of part 2). Although these very excellent beams are used extensively by commercial, military, and government agencies for both medium and long haul circuits, their use has been rather neglected by amateurs. I have assembled, erected, and tested a number of fixed log periodic wire beams since 1970 with excellent results and would like to pass along some information on these very efficient beams.

I believe that the amateur fraternity may have overlooked or shied away from these antennas due to:

1) Very little information has been published on HF log periodics in ham publications, although there have been several articles covering these for VHF and UHF. (Listed in a previous LP article in the September 1973 issue of 73 M*agazine,* p. 42.)

2) These antennas are quite complex and are highly mathematical. Several pages of formulas, reference to log tables and four or five graphs or monographs are required for optimum design. This information was best presented to the hams in the May 1965 issue of *73.* Although this covered the design of VHF LPs, the formulas also apply to HF.

The antenna manufacturers producing LPs for commercial and military use program this data on a computer. By supplying the frequency range desired, gain required, etc., the computer prints out the element lengths, optimum element spacing, boom length, etc., to provide for maximum forward gain, front-to-back ratio, minimum beamwidth etc.

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Although these formulas can be computed manually, several days may be required to design (on paper) an LP having optimum performance in a given space.

3) Most amateurs feel that log periodics are extremely expensive, which they are if purchased. The least expensive rotatable types by one commercial manufacturer are in the \$1500 to \$3000 range for a rotary covering 6 to 30 MHz, capable of 40, 20, 15, and 10m operation. Some of these are used by MARS stations. Rotatable LP ham antennas have recently been announced in the \$300 to \$1000 class.

The larger fixed types for the 2–30 MHz range having a higher gain are generally in the 10–30 "kilobuck" range. However, by assembling smaller, less complicated wire LPs for the 14–30 MHz range on a "do-it yourself" basis, one having an 8–10 dB forward gain (over a doublet

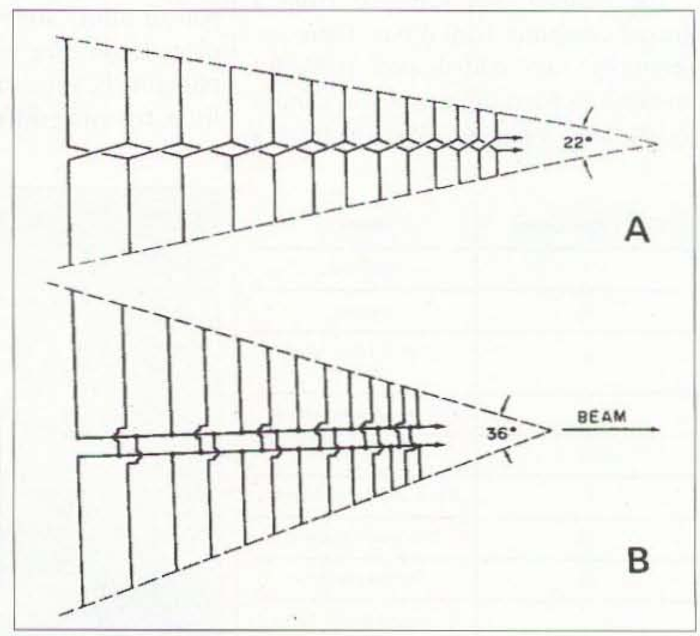

Fig. 1. Doublet log periodic configuration. This will cover a 2:1 bandwidth, say 7–14 MHz or 14–28 MHz. ***(a)*** *has a 22° aperture angle and gives about 10 dB gain. Note the criss-cross method of transposition of the feeder.* ***(b)*** *is shorter, with a 36° aperture and about 8 dB gain. Note alternate method of transposition of the feeder.*

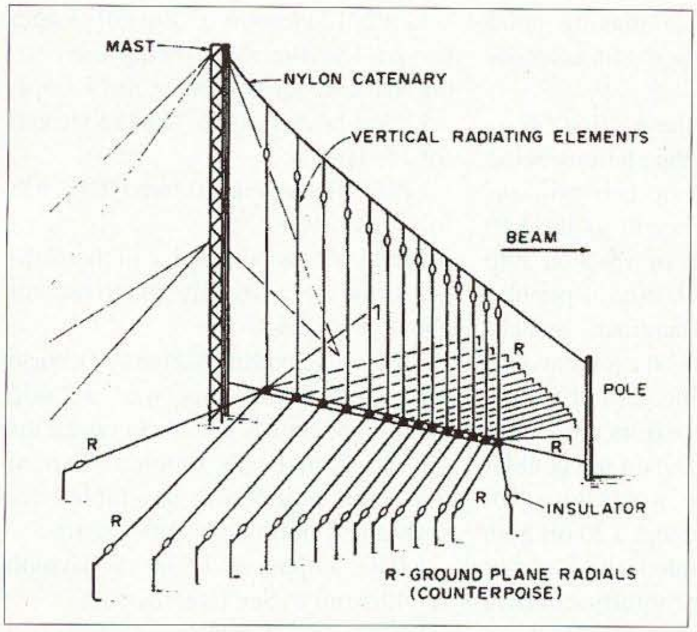

Fig. 2. Vertical monopole log periodic — 2:1 bandwidth.

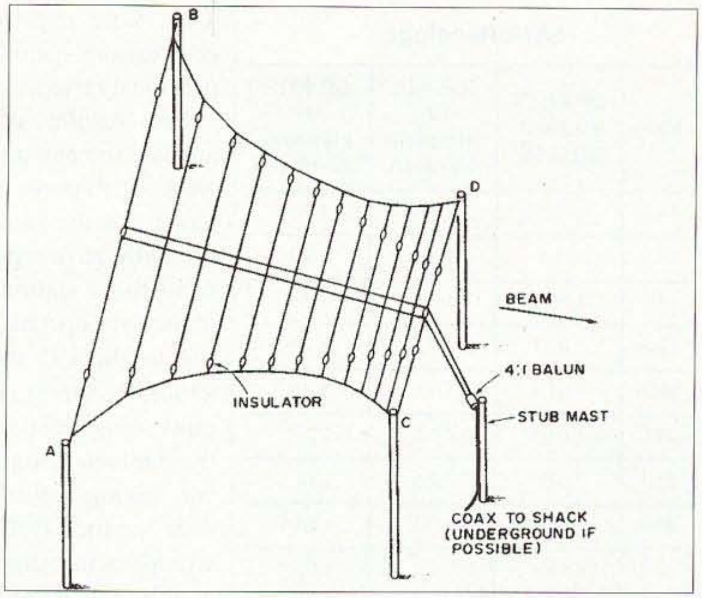

***Fig. 4.** For method of transposing the center feeder see **Fig. 1(b)** and **Fig. 6.** Illustrates the four masts used to support the antennas.*

at the same height) can be assembled for a material cost of $15 to $25 not including masts or coax, which will vary depending on the particular site. The largest 17-element 14–30 MHz LP being used here, having a 12–13 dB measured gain, should cost about $19.50

4) Many amateurs believe a fixed LP requires a great deal of "acreage." This is true of the large commercial types having a 10:1 bandwidth or a single beam covering 3 to 30 MHz. These are 63.5–127 meters (250'–500') in length, some even 203 meters (800'). However, a 14–30 MHz LP for 20–15 and 10m having an 8 dB gain can be erected in a space 10.16m (40') wide by 12.7m (50') long. If the length can be extended to 17.78cm (70'), the gain can be increased to 10 dB compared with a doublet at the same height. By extending to 25.4m (100'), 12–13 dB can be realized.

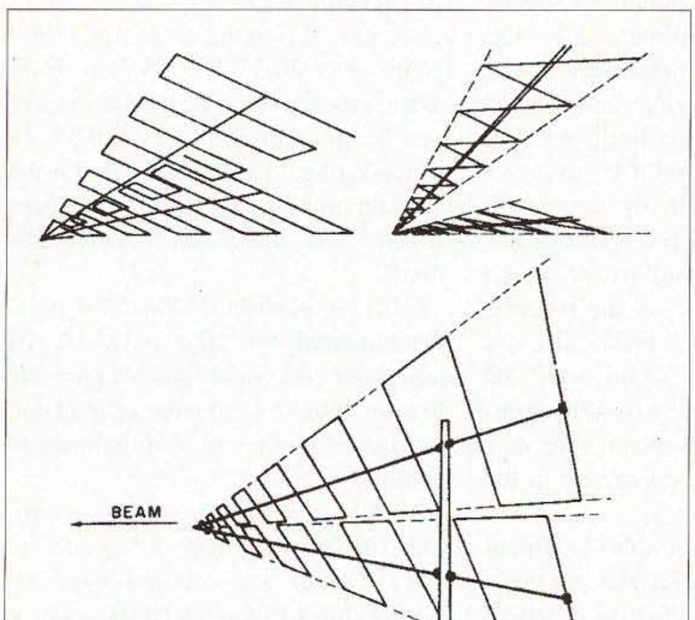

Fig. 3. Trapezoidal log periodics.

Log periodic types

Log periodic antennas can be classified under three general types:

1) The doublet log periodic (DLP) configuration. **Fig. 1** illustrates this type covering a 2:1 (plus) bandwidth suited for a ham beam for 7–14.35 or 14–28 MHz.

2) The vertical monopole log periodic working against ground or a ground plane counterpoise. **Fig. 2** illustrates this type, also covering a 2:1 bandwidth.

3) The trapezoidal zigzag or sawtooth configuration, **Fig. 3**. This type, being more complicated and not too suited for HF ham applications, will not be covered by this article, which will deal only with the first two types.

Before outlining the construction of the doublet and the monopole types, a brief report will be presented covering the tests conducted here over the past four years.

W4AEO test results on log periodic antennas

During 1970, the first log periodic was put up experimentally here for 20m and 15m only, to be compared with doublets and also a well-known "store bought" trap vertical for 40-20-15 and 10m (using separate radials for each band). The vertical had given fair results for DX, evidently due to its low angle of radiation and its 8.9m (35') height (at the base) above ground.

The first LP was quite simple, using only 7 elements for 20 and 15m and being only 9.7m (38') in length. The back end is supported by the peak of the roof, 10.2m (40') above ground, and the forward end by two cedar trees

SWR Readings			
kHz	LP #1: 7-element 20 & 15	LP #2: 12-element 20-15-10	LP #11: 17-element 20-15-10
14.0	1.1:1	1.4:1	1.4:1
14.1	1.1:1	1.5:1	1.4:1
14.2	1.02:1	1.6:1	1.3:1
14.3	1.02:1	1.7:1	1.2:1
14.35	1.01:1	1.7:1	1.1:1
21.0	1.01:1	1.1:1	1.3:1
21.1	1.01:1	1.2:1	1.15:1
21.2	1.05:1	1.3:1	1.05:1
21.3	1.15:1	1.4:1	1.01:1
21.4	1.25:1	1.4:1	1.02:1
21.45	1.3:1	1.5:1	1.1:1
28.0	*	2.0:1	1.5:1
28.2	*	1.5:1	2.0:1
28.4	*	1.6:1	2.25:1
28.6	*	1.6:1	2.0:1
28.8	*	1.8:1	1.3:1
29.0	*	2.0:1	1.01:1
29.2	*	1.6:1	1.5:1
29.4	*	1.6:1	2.0:1
29.6	*	1.4	2.0:1
29.7	*	1.3	2.7:1
kHz	LP #15: 5-element mono-pole 80 only	kHz	LP #9: 5-element 40 only
3.5	1.2:1	7.0	1.05:1
3.6	1.2:1	7.1	1.05:1
3.7	1.1:1	7.2	1.01:1
3.8	1.2:1	7.3	1.1:1
3.9	1.4:1	*	*
4.0	1.25:1	*	*
*Not applicable.			
Also see SWR readings for monopole LPs in August 1973 issue of *73*, pp. 23-24.			

***Table 1.** SWR readings.*

about 11.4m (45') high. It is beamed south, as I had been working friends in South and Central America also interested in improving beam antennas. They were capable of making good comparisons with the non-gain antennas previously used.

The results of these first tests amazed me and also the stations being worked. Reports on the non-gain antennas (at the same height as the LP) normally gave reports of S8–9 on 20m from these stations. I used a popular transceiver operated "barefoot." Switching to the LP, these stations would generally report an increase of two S-units, or at least a 10 dB increase over the doublet. Usually, when the doublet was giving S-9, they would give "20 over" on the LP. Although a 20 dB gain would seem exaggerated, the S-meter at this end would generally confirm this increase on their signal when switching to the LP.

It is realized that many S-meters exaggerate, but most are fairly linear and can be used for *relative* comparisons at the lower levels. Further, the S-meter here correlated very closely with the gain figures reported when switching to the experimental LP.

Although the original LP, **Fig. 4**, would only have a theoretical gain of 8–10 dB, LP gain figures are often based on VHF or UHF models tested over a line-of-sight path. It is noted that one of the large manufacturers of commercial and military HF log periodics (Hy-Gain) rates their 10–12 dB gains *"over average soil conditions."* It is therefore believed that this first experimental LP gives an honest 8–10 dB gain by averaging the many reports received from various stations to the south over the past 4 years. The S-meter on the receiver here is quite "Scotch." Generally, if a station reports a two S-unit or 12 dB increase when switching from the doublet to the LP, the S-meter here normally shows the same increase in his signal.

Since the original simple 7-element (LP #1) for 20 and 15m was put up in 1970, it has continued to give excellent results and is still being used as of this writing. Several others having more elements and greater length, providing greater gain, have been put up and thoroughly tested. Briefly, these are (in the order tested):

LP #2. 12-element, 17.8m (70') length for 20–15–10m. Now being used for the NE beam for W1s, W2s, and Europe.

LP #3. 12-element, 6.35m (25') length for 15–10–6m.

LP #4. 12-element, 10.16m (40') length for 20–15–10m.

LP #5. #2 tested on edge in the vertical plane or vertically polarized for about two weeks.

LP #6. 13-element, 22.86m (90') length for 40–20–15m. This was a "skip band" type with a portion between the 40 and 20m bands omitted. Two of these are now being assembled for permanent north and south beams.

LP #7. 5-element, 12.7m (50') length for 40m only. (See reference 18.)

LP #8. Two 5-element (same as #7) for 40 only; back-to-back in an inverted vee configuration suspended by a single center support line. One beamed north, one south — exactly 180° difference. Put up to obtain additional and more accurate forward gain and better front-to-back data on 40m.

LP #9. Improved 5-element, 40m only at increased height for additional forward gain data. Aimed south. Gave consistent 10 dB gain over doublet "standard" at same height.

LP #10. 5-element, 10m monoband LP. (See reference 18.)

LP #11. 17-element, 25.4m (100') length for 20-15-10, 15.24m (60') above ground. This is the permanent west beam that has a measured 12–13 dB forward gain to the west. By far the best and highest gain LP installed here to date. Side attenuation is down 25–30 dB.

LP #12. 6-element, 12.7m (50') length. Experimental for 20m only. 10 dB gain. Four additional forward parasitic directors (nondriven) were added later, but little if any increase in gain could be noted.

LP #13. 5-element vertical monopole LP for 40m only, using ground plane radials or counterpoise. Although this LP gave a 10 dB gain, it had an extremely low angle of radiation. Was good for DX, but horizontal doublet type LP #7 or #9 was better for normal operation.

LP #14. Same as #13 except inverted as an "upside-down" inverted ground

LP# & Length	#1: 38' 7 els	#2: 70' 12 els	#4: 40' 12 els	#7: 50' 5 els	#11: 102' 17 els	Exp: 25' 5 els
Bandwidth	14–22 MHz	14–30 MHz	14–30 MHz	40 only	14–30 MHz	20 only
Element	Overall Length (ft.)					
1	36	36	36	70	36	35
2	32	32	32	64	34	33
3	28	29	28	56	31	28
4	24	26	25	49	29	24.5
5	21	22.5	22	40	26.5	20.5
6	18	20	20		24	
7	16	18	17.5		22	
8		16	15.5		21	
9		14	13.5		18.5	
10		12	12		17	
11		11	10.5		16	
12		10	9.5		14.5	
13					13	
14					12	
15					11	
16					10	
17					9.5	
Total wire for els	175	246.5	231.5	279	345	141
	Spacing Distance (ft.)					
1	8	10	6	14	14	7
2	7.25	9	5.4	13	10	6.5
3	6.25	8.25	4.5	12	9	6
4	6	7.2	4.25	9	8.5	5
5	5.5	6.9	3.6		7.5	
6	4.25	5.7	3.5		7	
7		5.35	3.2		6.5	
8		4.8	2.8		6	
9		4.3	2.5		5.5	
10		4	2		5	
11		3.4	1.8		4.7	
12					4.2	
13					3.8	
14					3.5	
15					3.3	
16					3.0	
Boom Length	37.25	68.9	39.55	48	101.5	24.5
x2 Feeder Wire Req'd	74.5	137.8	79.1	96	203	49
+ Element Wire	175	246.5	231.5	279	345	141
Total Wire	249.5	384.3	310.6	375	548	190
Apex Angle	29° (α = 14.5°)	22° (α = 11°)	36° (α = 18°)	32° (α = 16°)	16° (α = 8°)	32° (α = 16°)
Approx. Gain	8–10 dB	10 dB	8 dB	10 dB	12–13 dB	10 dB
For Bands	20–15	20–15–10	20–15–10	40 only	20–15–10	20 only

Table 2. Element lengths and element spacing distances.

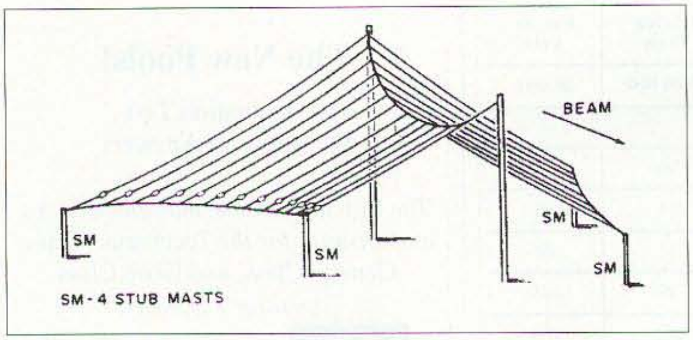

Fig. 5. W4AEO inverted vee log periodic.

plane. Strictly an experimental antenna to try for an even lower angle of radiation.

LP #15. 5-element vertical monopole LP for 80m only. Results similar to 40m monopole, LP #13. Good for DX but poor for close-by stations. Gave 10 dB gain (over 80m doublet at 11.43m, 45') from stations greater than 1500 miles.

LP #16. Trapezoidal LP for 20 and 15m only, both the zigzag and the sawtooth types tested.

In addition to the above LPs designed and tested here, several other directional antennas were erected for comparison with the LPs. Some of these were:

1) A 6-element, 15m "Long John" yagi mentioned below.

2) A 20m phased beam consisting of two 1/2λs in phase, collinear with two collinear reflectors and two collinear directors beamed toward Europe. Although this showed approximately a 10 dB gain, the lobe was much more narrow than the NE LP and the bandwidth quite narrow. At ±50 kHz, the SWR exceeded 1.5:1.

3) A 5-element Bruce array on 20m beamed for Caracas. The gain was lower than any of the LPs tested in that direction; possibly, being vertical, the angle of radiation may have been too low for this distance. It was only tested a few weeks.

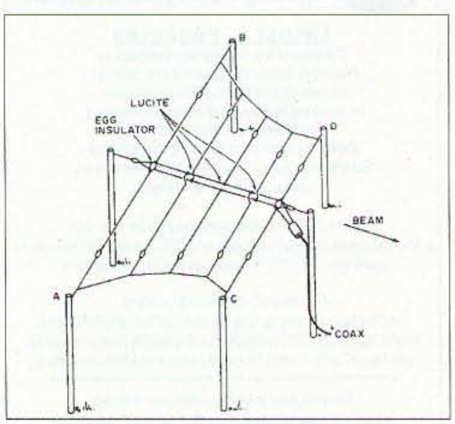

Fig. 6. Five-element monoband log periodic — fine for any band 10 through 80m — see the Aug. and Sept. 1973 issues of 73 Magazine *for details.*

In addition to the ham LPs assembled here, several other LPs have been designed "on paper" for friends and others, one covering 12–24 MHz for several MARS frequencies as well as 20 and 15m. These include several commercial LPs for 3–30 MHz, 2–4, 4–8, 6–12, 8–16 MHz; and several VHF and UHF for 30–50, 140–145, 150–470 MHz, including two for TV: 174–215 and 475–750 MHz. Several have been completely assembled for others on "custom-built" orders.

YV5DLT–W4AEO tests

The most accurate 20 and 15m tests have been made with my long-time friend YV5DLT (ex-W5DLT) of Caracas. We have been constantly testing the LPs for several years. He is able to give very accurate readings on any changes made here.

During the original testing of the first three LPs, schedules were kept daily between 1200 and 1400 local time here as these hours gave the worst case conditions on 20m. Other schedules were kept on 15m.

It was during this period that the 17.78m (70') LP #2 and the 15 and 10m LP #3 were put up for comparison with the original LP #1, which had performed so well on both 20 and 15m. LP #3 was especially good during the 15m tests, generally showing 5 dB over LP #1 and even slightly better than LP #2; however, #3 was aimed at approximately 165°. Caracas is 149° true, 1854 miles statute. The other two LPs were approximately 180°. All three were about the same height above ground.

After several months of 15m tests on #3, we wished to make a direct comparison with a good yagi aimed in the same direction. I assembled a 6-element "Long John" yagi per reference 20, p. 104. This was erected to the side of LP #3, exactly parallel and aimed in the same direction; both were 11.43m (45'), or about a full wave above ground.

Several weeks were spent comparing these two beams. Invariably, YV5DLT would report LP #3 to be 3–5 dB better than the yagi. The S-meter readings here confirmed this.

40m LP tests

Most of the 40m tests were conducted over a period of several months with old friends W4QS and K4FBU in Florida at the same time daily. During this period, four different 40m LPs were beamed south for Florida at various times for comparison with a good 40m horizontal doublet at 11.43m (45'). One 40m LP #8 was also beamed north for comparisons in that direction. All of these LPs produced 8–10 dB gain in these directions over the dipole; however, many of the tests indicated as much as a 20 dB improvement, which was confirmed by the S-meter at this end and a number of other stations in various parts of Florida.

Since the usual 2-element 40m yagi or two extended 1/2λs in phase collinear do not normally exceed 3–4.8 dB gain, the 10 dB average gain of the LPs tested is worth considering — especially because of their low cost and ease of construction.

75 or 80m vertical monopole LP tests

A 5-element vertical monopole, LP #15, was assembled for 75m. Since the mast height limited the longest rear element (the reflector) to 16.51m (65', 1/4λ + 5%), this LP was limited to 3.8–4.0 MHz, and all tests were within this range.

It was soon evident that this vertical beam was strictly for longer range communications, due to its lower angle of radiation. The 1/2λ 80m dipole up 45° (not an inverted vee) used as the "standard" was better for distances from 400–500 miles. Beyond this range, the vertical LP was better in the forward direction. At night the doublet was better to about 1000 miles; beyond, the monopole LP would show its increase, giving a good gain over its beamwidth.

For ranges greater than 1000 to 1500 miles, the 75m monopole, LP #15, showed at least a 10 dB gain over the dipole. However, for the normal working range on 80m or 75m, the doublet was better for the shorter distances.

A similar test using a 5-element 40m vertical monopole, LP #13, was conducted, with results similar to the 75m test. The horizontal doublet-type 5-element 40m LPs #7, 8, or 9 were better for normal operations, and the vertical monopole for DX. This beam was aimed NW.

During a predawn 40m test with LP #13, a W7 (working a VK on phone) in the NW, about 2,000 miles from here, was monitored. On repeated S-meter readings taken, the monopole was consistently 2 S-units or 12 dB better than on the 40m dipole when receiving the W7 in line with the monopole beam.

Receiving advantages of the log periodic

In addition to the excellent forward gain of the LP which is quite apparent to those being worked, the received gain is also quite noticeable. Another plus factor of the LP is its excellent diversity or "capture" effect during reception.

When QSB is bad on the dipole used as the "standard," switching to the LP reduces fading considerably, since the "readability" on the LP is much better.

Evidently the number of elements and its "boom length" produces the diversity effect due to its size and length compared with the doublet or even a smaller 3- or 4-element beam. The greater the number of elements and the greater its length, the better it performs for reception in addition to the increased gain apparent on both transmission and reception.

For those more acquainted with the yagi, the LP can be considered as a multi-element, unidirectional endfire array having a driven (rear) reflector, a 1/2λ driven "active" radiator, and a number of forward-driven directors.

LP theory implies that for a given discrete frequency within its bandwidth, 5 elements are generally excited or driven as an "active cell." However, while testing the 17.78m (70'), 12-element LP #2, it was excited with low power on 20m. RF voltage could be detected (using a neon bulb) on *all* elements except the long rear (reflector) element. The second or 1/2λ driven element (on 20m) was quite "hot" at the ends, as would be expected. The RF voltage on the driven director elements 3, 4–11, and 12 decreased gradually toward the forward end. Some RF could still be detected on the short forward element, 12.

Evidently these multi-element, driven directors add gain and also possibly help lower the angle of radiation in the E

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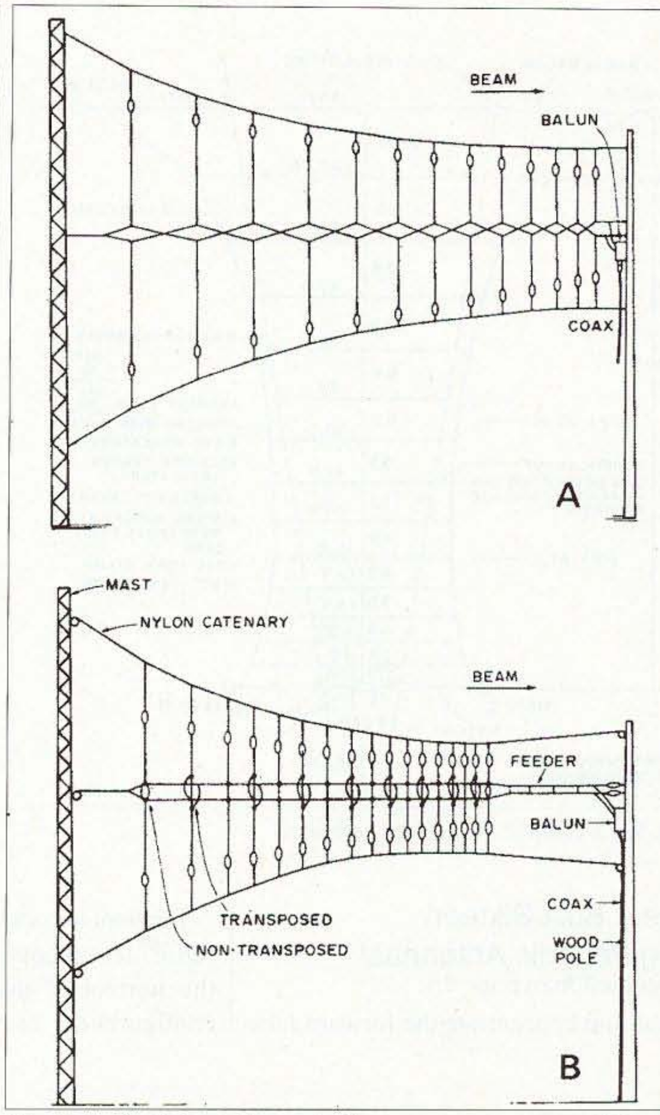

Fig. 7. Vertical dipole log periodic — acreage-saver model.

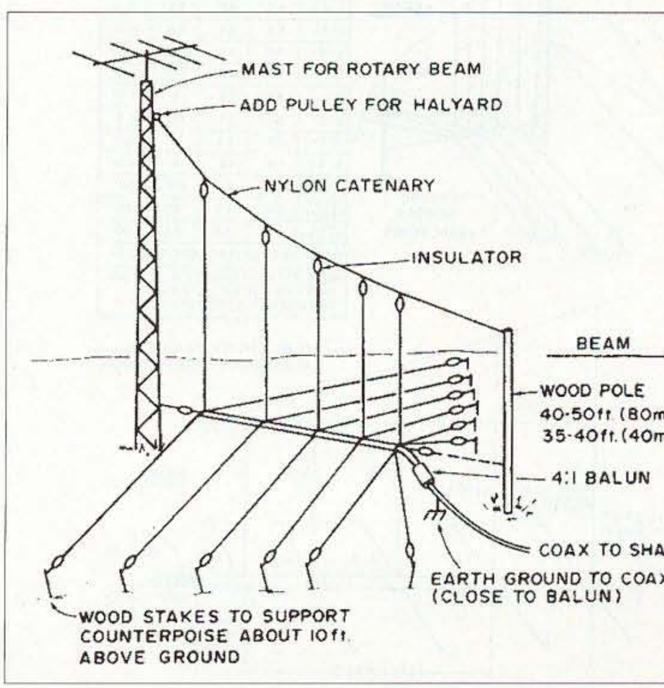

Fig. 8. Single-band vertical monopole — for 40 or 80m. About 10 dB gain.

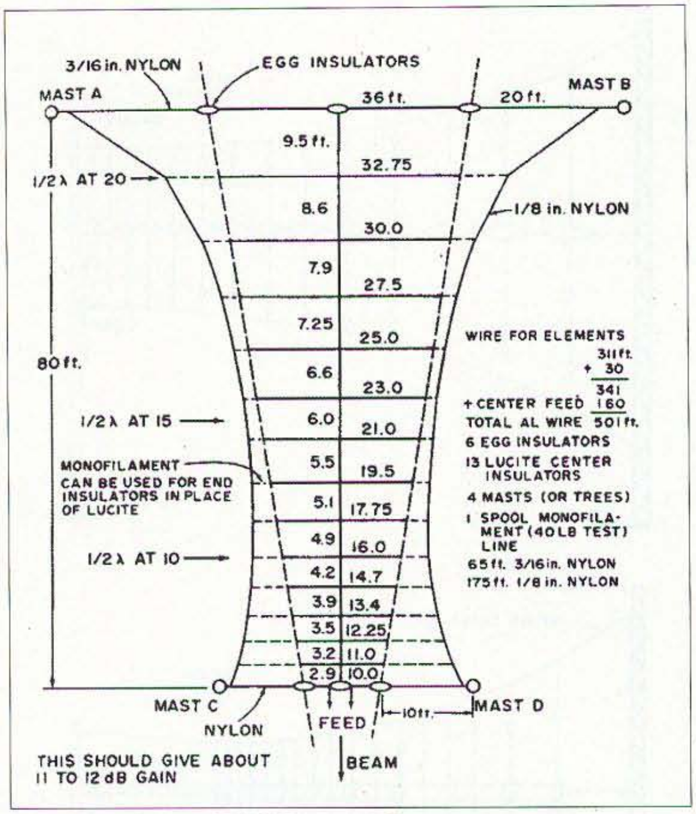

Fig. 9. 15-element 20/15/10m periodic.

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plane and concentrate the forward lobe in the H plane. This may be the reason the apparent gain generally exceeded the theoretical during tests.

Front-to-back ratio

The front-to-back of the LP is generally less than that of a well-designed monoband yagi. The LP seems to be 14–15 dB maximum with 10 to 13 dB as typical. From the tests made here, the front-to-back improves as the LP is raised to at least a 1/2λ above ground (at its lowest cutoff frequency).

The front-to-back or the 40m dipole LPs (DLP) tested appeared to be better for the horizontal than the inverted vee configuration, as would be expected, and the forward gain also better.

The forward lobe

The forward lobe of the LP is generally wider (about 90–100° beamwidth) than that of a well designed yagi; however, for a large fixed beam, this is good, as it can be aimed to cover a certain part of the country or a particular DX continent. For example, the NE (LP #2) covers Europe quite well and the 30.48m-long, 17-element west beam (LP #11) seems to cover all of Australia. The side attenuation of this long LP is down 25–30 dB.

A W1, -2 or -3 could use one or two LPs to cover most of the states. A W6 with an LP beamed east would cover most of the east coast. At this QTH, 4 LPs will cover most continents of interest: NE, Europe; east, Africa (and Australia long path); SE or south, South America; west, Australia; and NW — Alaska, Japan, etc. One for SW may be tried later for long path to Europe.

Fixed beam antennas vs. rotaries

An advantage in using several fixed beams over a single rotary is that they can be switched instantly from one to the other (and to the doublet used as a "standard"), whereas it takes some time for the rotary to swing, making quantitative readings difficult (especially when QSB is bad).

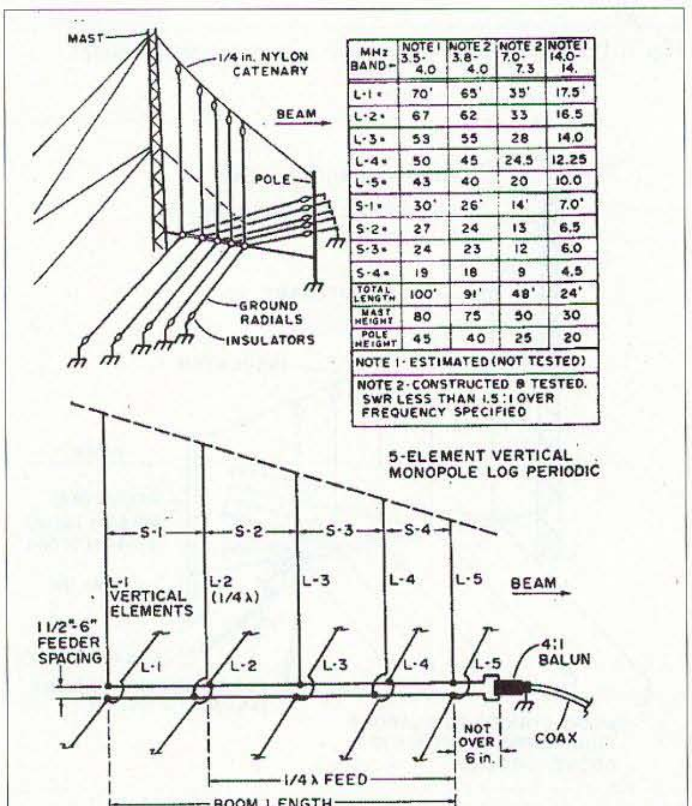
Another item noted during the first year these LP tests were started: About half the stations worked during the winter of '70–'71, using rotaries, would come back, "Sorry OM, I can't swing my beam, it is frozen up for the winter." I noted less of this problem the second winter. Evidently better rotators are being used.

The following comments are comparisons of the LP with several other beams.

Compared with the yagi

As more hams no doubt use yagis than other beams, these will be compared first. A well designed and properly adjusted 3- or 4-element monoband yagi should give about the same gain as a moderate-size 20-15-10m LP when both are at the same height above ground. The LP will, of course, cover all frequencies 14 and 28 MHz and can be operated with a comparatively flat SWR any place in the three bands. The bandwidth of a high-Q yagi may be limited to a portion of a band as the bandwidth at resonance may be only 2.5%.

Compared with a triband yagi for 20-15-10m, which is generally a compromise antenna, the LP should give the greater gain.



MHz BAND–	NOTE 1 3.5-4.0	NOTE 2 3.8-4.0	NOTE 2 7.0-7.3	NOTE 1 14.0-14.
L-1 =	70'	65'	35'	17.5'
L-2 =	67	62	33	16.5
L-3 =	53	55	28	14.0
L-4 =	50	45	24.5	12.25
L-5 =	43	40	20	10.0
S-1 =	30'	26'	14'	7.0'
S-2 =	27	24	13	6.5
S-3 =	24	23	12	6.0
S-4 =	19	18	9	4.5
TOTAL LENGTH	100'	91'	48'	24'
MAST HEIGHT	80	75	50	30
POLE HEIGHT	45	40	25	20

NOTE 1 - ESTIMATED (NOT TESTED)

NOTE 2 - CONSTRUCTED & TESTED. SWR LESS THAN 1.5:1 OVER FREQUENCY SPECIFIED

Fig. 10. 5-element vertical monopole log periodic

Of all the contacts made while testing these LPs during the past four years, not a single station worked (most using yagis for 20, 15 and 10) had a doublet for use as a "standard" or test antenna for comparison with this beam. Many have been most cooperative in rotating their yagis the full 360° to demonstrate the front-to-back, but none were able to demonstrate its forward gain. The front-to-back on some of the monoband yagis was quite good, while others were very poor.

One MARS station worked had both a rotatable LP and a yagi. He obliged by rotating the LP 360°, which gave a good demonstration of its pattern. When both antennas were beamed in this direction, the LP showed greater gain; however, he did not have specifications on the yagi.

An advantage of having several fixed beams for various directions is that they can be selected instantly by a coax switch or relay. This allows for more accurate data in comparing antennas. Even under fading conditions, a fair comparison can be made by switching rapidly and averaging the readings.

Compared with a rhombic

Anyone having room for a rhombic certainly has room for several LPs for various directions and is then not limited to one direction as with the rhombic.

The TCI engineers (Technology for Communications International of Mountain View CA) advertise their "Extended Aperture" LP, which is only 60.98m (200') in length and has a gain of 17 dBi. A rhombic to produce this gain requires a length of 518.29m x 228.66m (1700' x 750') width according to the TCI ads.

Further, the gain of a rhombic generally decreases at its low frequency end (fewer wavelengths per leg), whereas the gain of the LP is approximately the same over its bandwidth. If anything, at least from the tests here, the LP seems to give slightly better gain at the low frequency cutoff end. The forward lobe of the LP is generally wider than the rhombic, requiring less accurate aiming than the latter.

Compared with phased arrays

To date I have only made comparisons with two phased arrays on 20: a 5-element Bruce and a 6-element collinear array mentioned above, both strictly single band antennas. Neither gave the performance of the LPs. I do plan to test the LP vs. a multi-element Sterba curtain or similar stacked arrays later.

The SWR of log periodics

As a general rule, the SWR of an LP does not exceed 2:1 over the bandwidth for which it is designed, i.e., 14–28 MHz. From the tests here, the SWR over an entire band, 7.0–7.3; 14.0–14.35, or 21.0–21.45 does not exceed 1.5:1. **Table 1** gives some of the readings taken from several of the LPs tested. (Also see reference 18 for SWR readings taken on the monoband LPs.)

Log periodic site selection

The first step is to determine if space is available for the LP when beamed in the desired direction. The second step is to decide the desired bandwidth or the bands it must cover and the gain desired. These will, of course, determine the size (length) of the LP and if it will "fit" the space available.

The long rear element (reflector) must be at least 5% longer than the lowest cutoff frequency. The short forward element should be 50% shorter than the high frequency cutoff. The pages of math required for their complete design will not be presented here. (See references 2, 3 4, 5, 8, 11 and 13.)

To simplify the design and eliminate the formulas entirely, **Table 2** presents in tabular form some of the doublet-type LPs (DLP) assembled and tested here for the ham bands as mentioned above. (Dimensions for single band LPs were given by reference 18.)

This tabulation gives frequency bandwidth, element lengths and element spacings, overall (boom) length, apex angle, etc., of each.

Similar information on the vertical monopole LPs for 40m and 80m is supplied by **Fig. 10.**

If space is available for an LP at your QTH, at least one of these can be tried.

Fig. 4 is a sketch illustrating four masts used to support a typical DLP for 20-15-10m. These masts can be inexpensive 12.20m (40') collapsible guyed TV masts, power poles, towers, trees (as used here), or other supports if available.

Fig. 5 illustrates two high and four stub masts for an inverted V-log-P which I call my "λ-log-P" configuration.

Fig. 6 illustrates a simple 5-element monoband LP that requires the least space. This is especially adapted for 40m. (See reference 18 for complete information.)

Fig. 7 illustrates an "acreage-saver," using a DLP on edge in the vertical plane. This only requires one high and one lower mast and little width.

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Yes, I Built Sixteen Log Periodic Antennas!

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This one is only suited for the higher bands due to the rear mast height. The vertical DLP will usually have a lower angle of radiation than an equivalent horizontal DLP. It will generally not be too good for short-haul on 20m or 15m, but might be better on longer, multihop circuits. The one tested here worked extremely well on 10m.

Being vertically polarized, it is more subject to man-made QRM. This type is only suggested as a space saver or possibly for mounting on the roof of a building where length may be available but with insufficient width for a four-mast horizontal DLP.

Fig. 8 illustrates a single band vertical monopole LP using ground radials suited for a 40m or 80m beam.

The advantage of the monopole is that only a single high rear mast is required (which might be the tower for a rotary beam), plus a shorter wood pole for the forward mast. As the vertical radiating elements are only $1/4\lambda$, the rear mast can be approximately one half that required for a vertical DLP, **Fig. 7**, for the same frequency. A rear mast height (for **Fig. 8**) of 15.24m (50') is required for 40m; 22.87m (75') for 3.8–4.0 MHz; or 24.39m (80') for 3.5–4.0 MHz.

The disadvantage is that at least 30% more antenna wire is required for the monopole LP using ground radials, compared with a DLP.

A vertical beam of this type should have an open area in the direction of the beam. Aiming toward a hill, heavy wooded area, etc., should be avoided due to its low angle of radiation. From the tests made here, a two- or three-story dwelling in the beam's path seems to give about 5 dB attenuation. No doubt the plumbing, electrical wiring, or air conditioning ducts either resonate or give sufficient screening to cause this attenuation. It is therefore suggested that vertical beams be used only on open terrain having good ground conductivity. Avoid trees or other obstacles in the path of the beam.

The ideal location for a vertical beam of this type would be at a coastal area as near the shore line as possible, with the beam aimed seaward toward a DX continent. Those lucky enough to have such a location would no doubt have excellent results with a monopole LP having a 10 dB gain on 40m or 80m. One aimed across a lake might also be good.

A vertical monopole for both 40m and 80m of the "skip band" type is not out of reason, but would require at least 45.73m (150') in length by 42.68m (140') or 6,042.44m^2 (21,000 sq. feet) of open space, which is quite an area unless you are lucky enough to live on a ranch or farm.

Next time, we'll get into the step-by-step procedure for assembling simple, inexpensive 2:1 bandwidth DLPs for 20-15-10m, single band LPs for 40m or 20m, and 40m or 80m vertical monopoles. 73