



MT. AIRY VHF RADIO CLUB, INC.

PACK RATS'

CHEESE BITS

CLUB CALL: W3CCX



MT. AIRY VHF RADIO CLUB, "THE PACK RATS", PHILADELPHIA, PA. W3CCX
NET FREQUENCIES: 50.150, 144.150, 222.125, 224.58/222.98, 432.110, 903.100, 1296.100 MHz
AFFILIATED CLUB: AMERICAN RADIO RELAY LEAGUE ARNS

Meetings: Third Thursday of each month at 8:00 PM
Southampton Free Library, 947 E. Street Road
Southampton, Pennsylvania 18966

VOLUME XXXVIII

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Number 2

THE PREZ SEZ

The January contest is over for another year. There weren't any band openings to speak of and no significant enhancement was detected but the activity along the northeast corridor and up into western New York was the most intense that I can remember in several years. From all reports almost all of our members and many of our competitor friends set new personal high score records. I guess the sudden wet weather deiced everyone's antennas just in time. The final tally is going to be exciting and I wouldn't be surprised to find out that the Packrats score sets a new record. The big question is do we have enough logs? Please get your log to your band captain or the contest chairman (Al, N3ITT) as quickly as possible.

Don't put your microwave gear into storage now that the January SS is over! During the preparation for this years VHF SS the suggestion was made that a microwave activity night was needed to help everyone test their gear and improve their beam pointing skills. It's a great idea. We all would like an opportunity to find activity on the higher bands more often than just contests. And so beginning on Leap Day, February 29th, and continuing on the fourth Thursday of each month, we invite you to LEAP INTO THE MICROWAVES with the Packrats! The rules are simple; operate from 8 to 10 PM local time on any band 903 MHz and above. For coordination on those difficult long haul contacts 144.260 MHz is the suggested liaison frequency. So here's your chance to fix what broke in the contest and work all those stations you missed.

The February meeting is the annual Crying Towel session. This is one of our most entertaining events of the year. Bring your saddest story about the contest (props always score well with the judges) and you may walk away with the coveted Crying Towel.

73, Phil, WA3NUF

Pack Rats **CHEESE BITS** is a publication of the Mt. AIRY VHF RADIO CLUB, INC. Philadelphia, PA. and is published monthly.

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PACKRAT 222 MHz REPEATER - W3CCX/RPTR

222.98/224.58 MHz, Churchville, PA

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	WB3KRW,	Steve Dallas (2 YR)

MONDAY NIGHT NETS

<u>TIME</u>	<u>FREQ.</u>	<u>NET CONTROL</u>
7:30 PM	50.150 MHz	K3EOD
8:00 PM	144.150 MHz	W2EIF
8:30 PM	222.125 MHz	WB2YEH
8:30 PM	224.58R MHz	K3ACR
9:00 PM	432.110 MHz	WA3AXV
9:30 PM	1296.100 MHz	WA3NUF
10:00 PM	903.100 MHz	N3AOG

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Calendar of Coming Events - February 1996

- 8 Packrat board of directors meeting at the QTH of Pat, WB3DNI at 8:00 P.M. Call 215-672-5289 for directions.
- 9 Birth of Brendan Behan, Dublin 1923
- 3 January Contest wrapup session at the QTH of Bob, WB2YEH starting at 10 AM. Get your logs and checksheets to your contest coordinator so they can be checked and submitted.
- 12 **Lincoln's Birthday, 1809.**
- 14 **St. Valentine's Day.** Remember your sweetie.
- 15 **Packrat meeting** at the Southampton Free Library on Street Road in Southampton, Pa. at 8:00 PM. The theme of the evening will be our annual "Crying Towel" session. The best story of what went wrong during or in preparation for the January contest wins the coveted "Crying Towel". All friends and interested parties are welcomed to come enjoy the evening with us.
- 17-18 **ARRL International DX Contest-CW.** See Dec. QST page 105 for rules.
- 19 **Presidents Day**
- 22 **Washington's Birthday , 1732.**
- 29 **LEAP INTO THE MICROWAVES with the Packrats!** 903 and above. Starting on the 4th Thursday of the month and continuing every 4th Thursday of the month. operate from 8 to 10 PM local time on any band 903 MHz and above. For coordination on those difficult long haul contacts 144.260 MHz is the suggested liaison frequency. So here's your chance to fix what broke in the contest and work all those stations you missed.

BEACON REPORT

By Ron, WA3AXV

All of the Packrat Beacons are in operation from a new location in center city Philadelphia. This was a group effort that took a little longer than originally planned, but never-the-less, the early goal of having everything operational by the Jan 96 contest has been met.

Below are the details on each beacon. The frequencies will be updated as temperature and crystal aging have effects on the operating frequencies.

<u>Frequency</u>	<u>Output Power</u>	<u>Antenna</u>
432.298 MHz	5 watts	Big Wheel
903.071 MHz	5 watts	Big Wheel
1296.262 MHz	5 watts	Alford Slot
2304.034 MHz	1 watt	Alford Slot

All beacons are located at FM29JW @475 feet above street level.

This information should be deseminated freely. 3.4 and 5.7 MHz are planned for the spring of 96.

WANT ADS:

(send all ads to the editor)

For Sale: Toko 4 section Helical filters for insertion into your 903 LNA output. Two 2-section Tokos in cascade (4 sections total), pretuned for 902-903, with hookup and sweep 902-912 = 5 dB IL, rejection @ 890 = -20 dB, 880 = -35 dB, 870 = -45 dB, 860 = -55 dB MHz with test data. \$15.00 post paid. Contact Ron Klimas, WZ1V at 458 Allentown Rd., Bristol, CT 06010-5967.

For Sale: Dow Key BNC Relays (similar to DK77), 12 volt coil. \$10.00 each. Contact Gary, WA2OMY, 610-539-6409.

Wanted: Your tube type CB rig. Contact Gary, WA2OMY, 610-539-6409.

SOME JAN. '96 ARRL VHF SS CONTEST RUMOURED SCORES

: by Ron, WZ1V rev. f

CALL	N2WK	K3MQH	K1RZ	WA8WZG	WA2TEO	W2HPF	W2SZ/2	AA2UK	
GRID	FN03	FM19	FM19	EN81	FN31	FN13	FN22	FM29	
CLASS	M/U	M/L	M/U	S	S	M/U	M/U	S	
6	252/48	406/67	301/66	148/35	231/45		157/26	130/24	
2	478/50	797/62	469/54	252/49	361/39		366/44	274/38	
222	117/31	185/44	145/37	90/34	98/26		114/28	82/24	
432	183/37	321/50	205/40	166/37	142/32		150/31	110/25	
903	34/15		35/20	37/18	43/17		29/15	46/16	
1296	40/15		48/19	65/24	49/17		28/15	61/16	
2304	16/6		6/5	18/9	5/4		11/6	23/5	
3456	12/5		2/1	13/9			5/4	9/2	
5760	7/3			13/9			4/3	7/2	
10G	37/2		2/2	5/5					
24G	12/2								
LASER	18/2								
TOTAL	1206/216	1709/231	1213/244	807/231	929/180	868/179	864/172	743/152	
Score	527,472	511,665	459,208	395,241	266,000	247,500	247,508	232,256	
CALL	N2WK	K3MQH	K1RZ	WA8WZG	WA2TEO	W2HPF	W2SZ/2	AA2UK	
CALL	WA3AXV	WZ1V	KE8FD	KD1DU	WB2DNE	KP4XS	WB2YEH	N1DPM	
GRID	FN20	FN31	EM89	FN31	FM19	EM84	FM29	FN32	
CLASS	S	S	S	S	S	M/L	S	S	
6	87/15	141/33	85/35	119/22	99/28	178/78	104/17	70/21	
2	235/28	255/36	309/65	485/41	242/44	225/54	187/21	150/26	
222	95/18	71/17	59/34	69/19	51/22	39/26	86/13	58/18	
432	125/20	126/23	109/43	94/18	119/35	66/42	101/14	86/22	
903	43/11	37/13	6/5	20/8	13/10		43/10	29/13	
1296	63/10	45/12	16/11	27/9	26/12		53/10	32/12	
2304	24/5	16/6					19/3	13/6	
3456	15/2						13/2	7/4	
5760	9/2								
10G	9/2								
TOTAL	705/113	691/140	584/193	814/117	550/151	508/200	606/90	446/122	
Score	185,546	174,440	157,874	130,816	126,387	122,600	117,450	111,264	
CALL	WA3AXV	WZ1V	KE8FD	KD1DU	WB2DNE	KP4XS	WB2YEH	N1DPM	
CALL	W3IP	K1TR	KB3QM	K1FO	WB2VVV	WB0DRL	WA1MBA	K1GX	N2DSY
GRID	FM19	FN42	FM28	FN31	FN21	EM18	FN32	FN31	FN30
CLASS	M/U	S	S	S	S	M/U	S	S	QRP/P
6		141/25			73/17	53/34		77/13	
2		247/28		158/25	275/28	114/46	181/23	180/21	
222		74/19		76/19	65/18	24/21		49/14	
432		109/20		310/35	70/16	48/27	86/21	82/15	
903		20/9			25/9	5/5	27/11	17/7	
1296		5/2		34/10	32/10	29/20	37/11	21/8	
2304		8/4						12/4	4/2
3456		1/1				6/4			
5760		1/1							
10G		3/2						2/2	
TOTAL	604/119	609/111		578/89	540/98	273/153	353/77	430/80	500/74
Score	108,000	106,400	99,000	94,874	82,908	68,697	60,445	56,249	55,000
CALL	W3IP	K1TR	KB3QM	K1FO	WB2VVV	WB0DRL	WA1MBA	K1GX	N2DSY

Note: Many of these scores are very preliminary. Updates will be at <http://uhavax.hartford.edu/newsvhf>. Congrats to all who participated, and please check and send your log to ARRL, no matter what your score.

VHF+ NEWS & ACTIVITY

By Jerome Byrd, K3GNC

"GIVE ME E-SKIP, TROPO, AND AURORA STUFF, UNTIL I CRY OUT HOLD ENOUGH"

ON THE BANDS:

SANTA CLAUS and 6 Meter E Skip arrived at nearly the same time. Unlike SANTA, however, 6 Meter E Skip lasted 5 additional days! Double hop to the west coast and Mexico were reported by many stations from our area. There have been no real band openings on 144 MHz and activity has been moderate. If you are interested in 903 MHz....up, you should try and catch stations like WA3AXV, AA2UK, WA2LTM who are on nightly. The most reliable source for checking your equipment on bands 50 MHz....1296 MHz continues to be the "Packrat" Monday night nets. Take advantage of them!

STATION WATCH:

N2UAH has a new 350 watt amp, N3EXA is QRV 50 MHz, AA2UK has a 100 watt TWTA working on 5.7 GHz (YES VIRGINIA - 100 WATTS!), WA3NUF is on 5.7 GHz, NW3C, EN90 is back active after several weeks of having an ice-locked rotor, WC2K is back!!

LET LOOSE THE DOGS OF WAR:

The January contest has come and gone. Inspired and perhaps a little intimidated by the massive inner-city station of K3GNC (3 watts, 3 elem. -50 MHz, 3 watts, 20 watts, 25 elements. 432 MHz, 3 watts, 55 elements, 1296 MHz), and to a lesser degree - WB2JHG, AA2UK, and the return of WC2K, the PACKRATS old and new put on a thunderous effort. THE PACK IS BACK!!

WHERE OH WHERE IS CARMEN SANTIAGO:

Activity hours??? Activity Nights"", VE3ASO, VE3RKK??

ONE BRILLIANT, OBSERVANT MAN'S OPINION:

With the possible loss of part of our 2 Gigahertz band, one does not have to be a prophet of "Doom and Gloom" to acknowledge the fact that we MUST increase our activity on all VHF+ bands or we will lose them. We must stop treating 222 MHz...up as move up step children to the 144 MHz band. Let's really start being active on "Activity Nights" and activity hours in the major contests. With Oscar 10 currently OFF and Oscar 13 heading for burn-up, many satellite operators might start tuning around on the end of 432 MHz. I wonder what they will hear?

I know that contests are ego trips, and most people don't like to turn in a "small" score, but I must caution everyone with the fact that VHF+ activity is judged by how many logs are turned in, not by hearsay or casual/serious monitoring of the frequencies!

ALL PARTICIPANTS - PLEASE TURN IN YOUR LOGS!!

Please let me know about any openings, nets, propagation, etc.

CU in the CONTEST!!

TID BITS

For those of you pursuing VUCC awards, you can have your cards certified without sending them in by mail. Bring them to a meeting and Harry, W3IIT, will check them and certify that they are correct. The VUCC award requires 100 grids to be confirmed on 50 and 144 MHz, 50 grids on 222 and 432 MHz, 25 grids on 903 and 1296 MHz, 10 grids on 2304 MHz and 5 grids on 3456 MHz and above.

The Jan/Feb issue of the NTMS Feed Point has an article on "A 2 Watt 10 GHz Amplifier" by WIRIL, Simple Tracking generators That You can Build by John, W7HQJ, and Cassegrain System Evaluation by WA5JAT.

HOW TO KILL A CLUB

From the Masonic Times via the Rochester VHF Journal

No one purposely sabotages a club that they have joined. But a glance at this list might reveal ways to work against a club without being aware of it.

1. Don't come to meetings.
2. If you come, be late.
3. If the weather doesn't suit you, don't think of coming.
4. If you attend, find fault with the work of others.
5. Never accept an office - it's easier to criticize.
6. Be angry if you're not appointed to a committee.
7. If you are asked your opinion, say nothing. Afterwards, tell everyone how things should be done.
8. Do no more than necessary. If a few persons work tirelessly, complain that the club is run by a clique.
9. Don't bother to help get new members.
10. Don't tell the officers how the club can help you, and when they don't quit coming to meetings.
11. When you vote at a meeting, forget about it when you get home.
12. Agree with everything at a meeting, then complain later.
13. Get all the benefits your club provides, but don't make a contribution.
14. Talk about cooperation, but don't practice it.

NEW 2300 MHz USES

ARRL Bulletin 111

From ARRL Headquarters Newington CT

December 19, 1995

An October report by the National Telecommunications and Information Administration (NTIA), entitled Land Mobile Spectrum Planning Options, suggests a new use for the band 2300-2310 MHz, now allocated to the Amateur Service on a secondary basis. The report states that the band has potential for new, non-Federal radio location, fixed and mobile communication technologies. The report also notes that constraints are necessary for the protection of NASA's Deep Space Network and Planetary Radar operations in an adjacent band. A table in the report describes a possible future use of the band as Wide Area Land Mobile. The 2300-2310 MHz band is expected to be the subject of an FCC allocation proceeding as a follow-on to ET Docket No. 94-32, which dealt with 2390-2400 and 2402-2417 MHz.

ANTENNA; Height and Stacking

Summary by: Zaba, OH1ZAA/NN0Y

Editors Note: The following note is an example of the good things that can happen on the Internet mailing lists. It is a summary of discussions that got started on antennas and stacking distances. It grew a bit and although it does not represent an "expert" view on the subject, it represents a lot of real vhf operational experience.

With additional contributions of WA1YHO, WD4ECK, NO0Y, NU6S, WB2KMY and WD8ISK after the KP4XS, W9IP, W7LZP, PA3BFM, WA9JML and OH1ZAA opinions, I think that we have a delightful collection of practical experience and backgrounds, that will be useful for future stacked antenna systems, and not just for 50 MHz. It is easy (but lot's of hard work) to expand the whole thing toward a book, but this time I would rather like to conclude with some remarks that hopefully give still more precision to the thoughts. We found that there was no controversy as such, but the subject has been "illuminated" from a number of personal viewpoints with an emphasis on particular features.

(Contd. on page 7)

CHEESEBITS SUBSCRIPTIONS

Cheesebits subscriptions are available to everyone interested in activities and information from the VHF thorough the microwave frequencies. Subscriptions are for 1 year of 12 issues. For a subscription, send the following information:

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February 1996

Send to: SUBSCRIPTION/ADVERTISING MANAGER:

Bob Fischer, WB2YEH

7258 Walnut Avenue

Pennsauken, NJ 08110

SIDELobe NOISE POWER LEAKS ARE WORST FROM TOP AND BOTTOM

If you use an antenna program like Yagi Optimizer with the horizontal (E-plane) plot you really don't know what happens to the top/bottom lobes, since the 3 D-pattern is always at minimum toward the end of the dipoles. Therefore a smooth E-plane plot can show good F/B ratio, but it can hide big lobes in the vertical plane. Therefore I recommend to observe the H plane, and always optimize with that option activated. I only have the old 1988 version of YO but I have seen the newer one, and it is really a marvelous tool.

I have also the Antenna Optimizer 6.35 (1994). In clear environments it may be worthwhile for best F/B ratio to slightly adjust antenna dimensions when running a stack instead of a single yagi. On a cluttered tower it's hard to predict all the detuning unless it is completely in the model.

If you know the H plot, you automatically know the E plot, since it is the H plot multiplied with the dipole pattern. Small H plane sidelobes, give still smaller sidelobes in any other 3-D direction. In total integrated noise power this means that the bulk of galactic noise is trying to creep in from over your head, unless your preventive measures are rigid.

0.6 WAVELENGTH STACKING FORGIVES POOR DESIGNS A LOT (but not everything)

Look at the plot of two in phase dipoles (in almost any antenna book) with about 0.6 wavelength spacing (like the two driven elements of stacked yagi's). The pattern is compressed enormously to the sides, and gain increases to 4.9 dB over a single dipole. However, the 0 dB F/B ratio does not change.

With stacked yagi's at 0.6 wavelength a poor F/B ratio is not forgiven, but anything to the top/bottom sides (and skew) is tremendously attenuated. H plane sidelobes in wide cones around the Z-axis are virtually eliminated. However, the more complex mutual coupling due to parasitic elements limits stacking gain to lower values than with dipoles, but with very short yagi's the 3 dB mark can even be slightly exceeded.

There are two simultaneous benefits: Overall parasitic noise power is greatly reduced, and mostly nearly 3 dB additional gain is produced with the stack. The net S/N ratio gain with uniform noise from all directions is at least 5 dB, but with the cosmic hot spots much bigger contrasts occur. Remember also that the earth turns with a speed of 1 degree in every 4 minutes, so that certain azimuths are not "jammed" all the time. The sharper your main lobe, the shorter the suffering. We need someone with a good "electronic noise map" (meaning a sky noise data map on a PC) to calculate the advantage for a specific stack (when compared to a single yagi).

0.6 WAVELENGTH and 1.2 - 1.4 WAVELENGTH STACKS for MAXIMUM GAIN

Stacking at 0.6 wavelength always assures the noise power cancellation, but if booms get long (say longer than 8 m (27 ft), the stack starts to look as a single yagi gain wise. The stacking gain may fall well under 2 dB (which is still a lot), but if the single yagi pattern is relatively clean it is better to go to for 1.2 wave stacking for moderate length yagi's and 1.4 wavelength stacking for the long ones. This is just due to the mutual impedance: a 0.8 wave separation is always poor for gain and sidelobes (see the consistent gain dips in W2PV's YAGI book).

With four antennas it is superior to use non uniform stacking: first stack 0.6 wave with each pair, and then allow the two bays to cancel the residual sidelobes of the separate bays (then there will be hardly any noise power from any unwanted direction). For maximum gain shortcuts can be made, but due to the S/N issue on 50 MHz, I would never neglect the 0.6 wave basic cell as building block for optimal listening. This is also the reason why VE7BQH's collinears on 144 MHz work so well. Close spacing and careful current balancing eliminates all parasitic noise leaks.

COMBINING LOW/HIGH ANTENNA PATTERNS WITH WIDE SPACING

It is a fairly wide spread misunderstanding that you can simply connect a low and high antenna to one cable and that the coverage is then the same as with each one separately. Remember that the pattern is a summation of FIELD VECTORS and that the combination generally forms a ZERO field in at least one angle of takeoff where both antennas would launch a considerable field, when used one at time. Also the result is 3 dB worse at an angle where one of the antennas has a pattern null due to ground reflection (since the power has been shared; half lost).

Also stacking of two antennas does not lower the takeoff angle, but it will correspond to the AVERAGE height of the two (when fed in phase). Therefore the maximum field of the higher antenna will peak at a lower angle, but the higher gain of the two makes that the combination will still produce a stronger field at this same lower angle, though the peak strength of this lobe is a bit higher.

Varying the phase between the two yagi's gives new orders of freedom, but it always weakens the field in an initial maximum (any new formed field maximum will be lower in strength and offset in elevation)

TERRAIN ANALYSIS IS NOT SUFFICIENT IN ONE DIMENSION

A relatively flat environment (or sea/lake) will produce a fairly neat analysis assuming that things are fairly homogeneous.

penetration depth of the wave (this is a completely neglected issue, since a thin layer of wet clay over rocky ground may not suffice as a real substitute on lower frequencies). Most hilly landscapes tend to act like optical lenses, but it is hard to get into a clean focus. The problem about a focus is that when that makes a signal terribly strong in one place, it must be weak somewhere else. This is why a Fresnel zone is always an area and has to be considered in full for a even a two-dimensional far field analysis.

A nice example of the preceding is the story of VK3UM, who used to drive around in Australia (probably on his motorcycle), while listening to the BBC transmissions. When he finally found an area where signals peaked awfully high, he bought his new QTH at the hot spot. I remember working him on 14 MHz, while turning my power down to about 20 milliwatts, and still got a 57 report (loud and clear). My sea reflection was a big help too (though only 20 mS/m at best, but near perfect on 14/50 MHz h-pol.).

PILEUP's, S/N RATIO and ONE-WAY PROPAGATION

Most so called one way propagation I tend to explain with local S/N ratio and the fact that signals from small antennas tend to drown in the noise, but big signals keep at least head and shoulders dry. A pile-up is the most brilliant example of that. Why is one calling for 8 hours without results, and the other makes it with one shout, while both receive the DX at reasonable strength? It is no one-way propagation at the DXer's end, and even less on yours!

On receive, think about the pile up as the cosmic noise and a weak DX as the new DXCC you need. Your stack pushes the noise floor down to get one more, and otherwise you would witness a dead band.

No one can understand the difference of a few dB unless he has worked a couple of years with a piece of wire, and is then allowed to work with a 6 el monoband yagi for a day or two. The contrast will be finally clear when returning to his own setup (this is why newcomers should always play first with a simple antenna, albeit just for a while). Due to the inflation of S meter scales, most reported differences of a few S units is not more than those few dB's, but in S/N ratio those values may often approach the truth.

ORDINARY AND EXTRAORDINARY IONOSPHERIC MODES

With microwave equipment, Magic T's and the like are used for one-way propagation (isolators etc.). These mostly require magnetic fields and coupling of different modes. In geophysics we may expect one-way propagation when the geomagnetic field is ready for the game. That is when the magnetic field is perpendicular to the movement of free electrons induced by the impinging radio wave. Therefore there are ordinary and extraordinary waves in ionospheric propagation, and the MUF is about 1.4 MHz (the gyro frequency) higher for the highest extraordinary mode.

This may explain an effect like WD8ISK's vertical beating a 6 el yagi, but there it could as well happen that the elevation of the yagi was proper to make a null for the vertical angle of arrival. A polarization rotation is also possible, but will gradually continue to the other polarization in time.

One way propagation may occur when the extraordinary wave is excited to the one direction of the path and inhibited to the other. The cause may be the initial state of polarization. Since waves tend to gradually change polarization in ionospheric layers (Faraday rotation effect like in EME) it is not that simple, and we may again play with the idea of crossing marginal S/N levels, when it seems to appear. This means that the process is there but it is not completely ON/OFF. The stack will again provide there rescue close to the near off state.

BREWSTER and POLARIZATIONS

For poor ground the Brewster angle is high and this makes patters of horizontally and vertically polarized yagi's or groups very similar for the DX angles. Mainly at the ocean shore ("liquid copper"), the maxima are interlaced to cover practically all angles, while switching between the two polarizations. Therefore, just switching the polarization is not sufficient to cover all angles inland. Antennas are required at least at two different heights, and should also have provision to operate separately. The vertical reflection coefficient from poor ground is worst at the Brewster angle (with a 90 degree phase shift) and is always weaker than the horizontal coefficient.

COMMON VOLUMES WITH SCATTER

With sliced patterns due to high antennas and good ground reflections, there will be a multitude of common slices in the cross section. The total common volume and the scatter angle determines average levels (height is a bonus, even on one side).

TILTING MOUNTAIN TOP YAGI'S

I remember a Boulder Foothills Field Day in Colorado with the W0DK group in 1985. It was a steep down slope so ground reflection was not useful. The city covered most of the below horizon angles, and most noise was spiky man-made. Since the main lobe of a single yagi's is fairly wide, tilting did not help much. Any 0.6 wave stack would have been the answer (and partly hiding behind the if the top had been wide enough with a proper flat tilt for ground reflection gain). Let's leave out the other ten chapters for this theory for sporadic E (partly based on computer analysis of Nordic 144 MHz QSO's).

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