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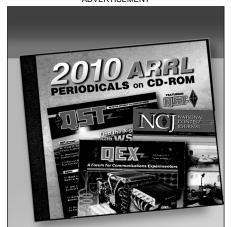
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There Is No Such Thing As

A Long-Delayed Echo Al

BY O. G. VILLARD, JR., * W6QYT, C. R. GRAF, ** W5LFM, AND J. M. LOMASNEY, *** WA6NIL

N September 22, 1969 (GMT), WB6VKV was in QSO with WA3KQA on 20-meter cw. At 0100 plus or minus one minute, he stood by. The frequency was QRM-less, and WA3KQA was unaccountably slow in coming back. When the receiver came alive, a signal could be heard in the background noise on WB6VKV's frequency, about S2 but clearly copiable. Although band conditions were normal for six o'clock on a California afternoon, and not much by way of DX could be heard, the signal sounded as if it had come a long way. It sent: "WA3KQA de WB6VKV K", and was an exact repeat of WB6VKV's transmission.

Sounds spooky? You bet. This was WB6VKV's initiation into a very exclusive club: those who have heard long-delayed echoes, or LDEs. The authors know of only about 50 other members in all, and they would very much like to add to the list, because LDEs are just possibly one of the world's "longest-delayed" radio mysteries, having first been discovered in 1927. It seems to be time that somebody tried to figure out what nature is trying to tell us in this way. (Of course, as in all similar situations nature's message may turn out to be trivially simple, but then it might be important. No one can tell until the particular Rosetta Stone gets deciphered.)

The "delays" are really impressive. For example, WB6VKV timed himself with a watch, as he simulated sending the above letters, and got a delay of 11 seconds. It takes only one-seventh of a second for a signal to travel all the way around the earth. Where had that signal been all that time, and why was only one echo heard? If the effect is not an illusion or a hoax, how in the world can nature "store" signals that long? Consider how difficult it is to build any purely electrical signal storage device capable of delays much in excess of milliseconds.

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Another curious feature of LDEs is that they are so phenomenally evanescent: WB6VKV estimates that his next standby would have come two or three minutes later; by that time all trace of the effect had disappeared.

The WB6VKV incident was chosen for mention because it happened fairly recently, because it has been investigated with some care, and because it is typical of a number of reports which have been received. LDEs are not just an anachronism from the 1930s; they still happen, and they still need to be explained.

The LDE Hunt -- Where We Stand

In their article in the May, 1969 issue¹ the authors told the story of LDEs and solicited reports from initiates into the "club". The response was impressive; there are now over 40 "good" reports (i.e., reports in which time, date,



Fig. 1—WB6VKV, who heard the LDE on September 21, 1969 (California date). Charley's dedication to science may be surmised from the fact that he allowed his station to be thoroughly checked over by the senior author, and in addition submitted to a polygraph test at Stanford University. The test showed conclusively that his report was not a fabrication.

A report on long-delayed echoes (LDE's), by way of a sequel to the authors' article in the May, 1969 issue. The 40-plus reports received thus far have permitted encouraging progress in the search for an explanation, but the mystery is far from solved; additional observations are clearly needed.

30 QST for

Long-Delayed Echo AR . . .

or, The LDE Mystery Deepens . . .

frequency, etc., were logged), and it has been possible to begin some statistical studies. Following are the authors' present views:

- (a) It appears that IDEs tend to be reported at times when magnetic activity is low.
- (b) According to psychologists, there is a chance that one- or two-second "echoes" may be a trick of the imagination. But the longer ones don't seem to be readily explainable as "internally" generated.
- (c) There appear to be two classes of unusual echoes. One is observable at 3.5 MHz over short distances, and involves one- or twosecond delays. The other usually is characterized by longer delays and seems to be associated with long-distance propagation. It is observable at the higher frequencies, especially at times of band opening and closing.
- (d) On balance, the evidence suggests that both effects are real and associated with the ionosphere.

The Spectrum of Effects Reported

In scientific work, one tries to operate "blind" as much as possible, because of a well-known tendency of the human mind to find whatever it is told to look for. For example, if observers are asked to walk through a grassy field and report the number of rabbits they flush, there is a high probability that some rabbits will be reported. However, the field may not have contained any rabbits at all: those brown furry fellows diving into their holes were actually woodchucks.

For this reason one hates to publish accounts of long-delayed echoes, because it may attract reports too closely matching the descriptions. But, on the other hand, if an observer doesn't know what to look for, he can scarcely be blamed for not finding anything, either. At the moment, in respect to LDEs, we can't even specify that the thing we are looking for has four legs and fur; this "field" we are investigating — to push the analogy further — might contain anything from a katydid to a kangaroo.

The diversity of reported effects is impressive. In longitude, the locations at which LDEs have been heard range from Africa to the Marshall Islands; in latitude, from Peru to Canada. The reported delays range from fractions of a second to over five minutes. The radio frequencies at

which unusual echoes appear extend all the way from 810 kHz up through 144 MHz. A purpose of this article is to list what has been reported, in the hope that it may stir latent memories and/or stimulate future observations.

Are the Echoes Real or Imagined?

The first step in trying to understand LDEs is to ask whether they could be a trick of the imagination. The hearing of "voices" is a well-known feature of some psychological derangements we all have our disoriented moments; why don't we hear occasionally our own voices or "fists" repeating themselves? The authors have consulted four psychologists on this question, including two specialists in "cognition", or the science of how the spoken or written word is perceived,2 They indicate that the possibility of psychological origin for the shorter delays - one or two seconds - should not be ruled out. But at the moment a physical — rather than a psychological — explanation for the longer delays seems to them more plausible. (On the other hand, physicists seem to feel that short delays will be much easier to explain than the longer



"WATCH OUT FOR WOODCHUCKS; REPORT WHAT YOU HEAR, NOT WHAT YOU THINK YOU WERE SUPPOSED TO HAVE HEARD."

Table I

Name	Call	Date	GMT	Band	sion	2000	tion, Sec	Original Control	Location	Audile	What Was Heard
Barton, A. J.	K4OHK	5/21/60	≈2300	21	A G	4-5	45	both	Tripoli, Libya	4 min	Complete contest call and signal exchange at 30 wpm.
Bates, H. S.	WA4FIU	March, 1034	morning (local)	88	ą	1-2	1-2	ожа	Rome, New York	few min	Repeat of call letters "W8GWZ".
Beek, K. H.	W3VDX	1950	late night (local)	-	ALC CAM	10-15	10-15	own	Newtown, Pa.	at least once	Call letters of called station plus "de W3VDX".
Birks, D.W.	KwIUI	2/3/68	1753	2	 	30	20	омп	Minneapolis, Minn,	once only	After 30-second delay, heard "WelOG, WelOG, Peoria, Illinois, this is K9IUI portable & Minneapolis, Minn."
Bock, A.	WIDNT	5/20/68	1230	14	Ê	N	20	own	Southwick, Mana.	ээпо	"Thank you very very much,"
Burr, A. F.	Wegne	10/8/68	2000	23	-Q	LO .	ro	other	Las Gruces, N. M.	опо	Delayed replica of a W2 transmission,
Butler, J. A.	K6CAZ	2/11/69	1445	41	Ç S	1-2	1-2	ожи	Pacifica, Cal.	5 min approx	Heard own words repeated.
Carroll, R. E.	W8DZD	7/26/66	0218	21	da.	7.7	3.7	other	Ann Arber, Mich.	at least 3 min	Words of WASLUI repeated.
Olark, C.	W7FFV	iall 1938	dusk. (focal)	.850	#-D	34-2	3,4-3	other	Logan, Utah	2030 sec	Heard distinct words, not just syllables. Koal, Denver, Believed not to be a recording artifact,
Clark, V.	WNANZK	7/20/60	0447	3,5	ом		-	омп	Cullowhee, N. C.	once	Heard repeat of "K" after standing by.
Clement, A. J. F.	W6KPC	12/18/68	2000	28	-Ç	Ţ	1	other	Northridge, Cal.	2 min	Short whole words, like "power", "name", etc. Station was a W8.
Ernst, A.	W2EXX	winter, 1968-9	٠	21	388	ro.	ro.	ожи	Buffale, N. Y.	1	Heard repeat of signoff (one sequence of oall letters); was weak but clear.
Feld, H. L.	OA4C	June or July, 1952	evening (local)	22	ew.	5(7)	m	амо	Lims, Peru	30 min	After standby, repeat of last three letters of own call, wavery.
Graf, C.	WalfM	1/27/68	1400- 1430	10.002 MHs	Time Tioks	黑	27.	other	San Antonio, Texas	% min	Delay of seconds ticks on U.S.S.R. Station RID, relative to WWV.
Grandgent, C. M.	WALFIN	69/8/8	0013	3.5	φM	*	22	other	Granby, Conn.	opee	Heard distinct celes of BTs on W1EO transmission.
Hall, W. R.	WSUVT	6/2/69	2345	14	- C	15-18	12-15	ожа	Milford, Del.	1 min (?)	Entire directional CQ plus signature, Repeated call and heard echo a second time.
Hallock, D. B.	Kaazj	11/20/61	0220	80 80	ΜO	14-1	14-1	омп	Marion, Iowa	I min	Echo of own signal,
Hill, E. R.	W3FEG	3/1/41	1612	14	H-4	22	22	other	Rehoboth, Del.	0000	Weak repeat of a transmission of WEEBB in New Orleaus, La.
Hollings, M. T.	OA4ED	March, 1954	late night (local)	21	æ.a	1	İ	ожи	Lima, Peru	10 min	Heard one or two letters of own call repeated,
Horton, C.	WN3JET	1920's	6	7	wo	1	į	other	New England	1	Heard part of transmission of WIBFQ repeated.
Jenkins, D. S.	WABOGH	June, 1965	0230	80 30	8 1	1.2- 1 1.6	1,2-1.6	ожп	Tarzana, Cal.	once only	Heard words "off and clear, goodnight".
Jones, D. L.	Wewku	3/7/80	0416	1.4	21-8	10	10	OW71	Deerfield, III.	iew min	Heard "his and my calls" after two different standbys.
Kattsa, G.	НК5ВQW	12/30/68	0400	14	ques	300	210	other	Cali, Colombia	once only	Repetition of several transmissions from VU2CT after

King J.D. WolvILD	Name	Coll	Date	CML	Band MHz	Emis-	Delay,	Dura- tion, Sec	Own/ Other	Location	Interval Audible	Whit Was Heard
WebStR 1967 (520) 144 +m 2-3.5 year Oblibation City, Octabonas 20 min Description of over inclusive - believe days. WeBStR 40 WeBStR 50 (100) 7 cer over Holdness City, Octabonas City, Octabonas 20 min chain Hone city and days.	King, J. D.	WELUU	winter, 1950-51	0000	L +	GW.	re	ro co	OWB	Baton Rouge, La.	few min	Hoard own call letters repeated twice, after standby.
W GRD Wight Wight Wight Wight Wight Adjust, jun. cond 1 dataset conding jun. condi	Liebmann, J. G.	WEORH	1967	0330	144		2-2.5		OWD	Okishoms City, Oklaboms	20 min	Repetition of own signals believes delay 2-2.5 secs.
W W P UT NAME Mode 14 ov 2-3 2-3 over Shorting, III. finan Integrated from a signals in two online sinn. Regarded four two onlines in the School of the Construction of two and the School of the Construction	Lotze, A. W.	Werq	winter, 1932-33	0400-0400	2	cw	1	{	nwo	Indiana	-	Heard tail and of own CQ believed that someone was calling him.
WASING 4/31/57 1300- 14 6 w 3+4 3+4 6 w Eniverbal, M. I. cone only Hourst especiation of toro signals; two oth bourst WASING 2/21/60 0.016 14 8-m 6 6 ora Enat Williatom N. Y. cone only Hoard directions of toro signals; two oth bourst WASING 2/21/60 0.016 14 cw 13 15 ora HADrwood, Cal. once only Heard "WASINGA de WEADPT" which WASING 4/21/60 0.100 14 cw 11 11 ova Alpine, Cal. once only Heard "WASINGA de WEADPT" which 1/21/60 1/	Lundstrom, R. A.	WSFUR	March, 1952	00#0	¥ï	¢w.	2-3	2~3	own	Storling, III.	5 min	Heard own signals after 2-3 sec delay; believed another station was calling him. Repeated test several times.
WABLOR 9/21/69 O645 14 a-m 6 6 own Boat Williston. N.Y. Once only Heard Condensation indecess words, part of thus more only WABLOR 19/21/69 0190 14 a-m 11 11 own Algine, Cal. once only Heard Condensation in a concern. Heart Condensation in a concern. WIND 1/21/69 0190 14 own 12 other Algine, Cal. once only Heart Land to QRS to it wyn. WASTON 1/22/69 0430 14 own 12-16 own Hondolly, Hawaii 10 min Heart Land to QRS to it wyn. WASTON 1/22/69 1430 14 own 12-16 own Hondolly, Hawaii 10 min Heart Land to QR de KHGDVG K". Eff WASTON 1/22/69 1430 14 own 12-10 oth Color Almoduly, Hawaii Once only Heart Land to QR de KHGDVG K". Eff WASTON 1/22/69 1632 14 own 12-16 own Almoduly, Hawaii On	MacKinnon, J. C.	KX6CG	5/31/57	1800- 1800	14	6W	3-4	\$ 4	own	Eniwetok, M. I.	one half hour	Heard repetition of own signals; two other persons also heard the echoes.
W6ADP 10/16/32 = 1800 28 ova 13 ova HJUNOGI, Coll. one only Hearl "ONALOF (WALD)". WBARTS 6/24/89 0100 14 ov 11 11 ova Abjate, Coll. one only Hearl "WASRQA to Week Prizant. WTS 6/24/89 0190 14 ov 12-15 ova 1-1 ova Hondulu, Mass. son handle handle with the coll of the prizant. Son handle with the coll of the with the coll of the prizant. Son handle with the coll of the with the coll of the with the coll of the coll o		WAZLOR	9/21/60	0045	14	H-4	9	û	own		once only	Heard about nineteen words, part of the last transmission of a QSO.
WB9VKY 9/22/69 0100 14 cw 11 11 11 11 0 wp Appine, Cell 0 nore only Heard "WASKQA dis WB9VKV K". Eff. (WIPCeg) Falmouth, Mass. seyonal Echose on New British. Connectiont state 12-16 cwa 12-15 cwa Hondulu, Hawsi 10 min Heard "-Q Cq de KEGDVG K". Eff. (WIPCeg) 14 cw 12-15 cwa Hondulu, Hawsi 10 min Heard "-Q Cq de KEGDVG K". Eff. (WIPCEG) 1588 7 cw 3-4 3-4 cwa Clinton, Other Care only Hoard octor on U.S.R. station (UTQ). 1588 7 cw 3-4 3-4 cwa Clinton, Other Care only Hoard octor on U.S.R. station (UTQ). 14 cwa 3-10 3-10 cota Son through, Care only Hoard octor on U.S.R. station (UTQ). 12/2/67 1328 28 can 3-10 cota cwa Son through, Care only Hoard octor on U.S.R. station (UTQ). 12/2/67 1328 28 can 3-10 cota cwa Son through, Care only Hoard octor on U.S.R. station (UTQ). 12/2/67 1328 28 can 3-10 cota Son through, Care only Hoard octor on U.S.R. station (UTQ). 12/2/67 1328 28 can 3-10 cota Son through, Care only Hoard octor on U.S.R. station (UTQ). 12/2/67 1328 28 can 3/2/2 cota Son through, Care on U.S.R. 14 cota Cota Son through, Care on U.S.R. 14 cota	Means, G. H.	WGADP	10/16/32	~ 1800	28	cw	18	18	: UMO	Hollywood, Cal.	once only	Hearl "ON4AU de W6ADP".
KH6DVG April, April, Os60 3.5 ow — — (WHCEG) Philomotth, Maas. Echoes on Now Birshin, Commedicate stern and that had also QRS to 5 wpm. Hondold, Hawsii 10 min Heart "—Q Cq de KH6DVG K". Eff. Ref. Devn. Hondold, Hawsii 10 min Heart "—Q Cq de KH6DVG K". Eff. Ref. Devn. Hondold, Hawsii 10 min Heart "—Q Cq de KH6DVG K". Eff. Ref. Devn. Per Prof. Devn. <	Miller, C. M.	WB6VKV	9/22/69	0100	**	C.W	=	11	OWD	Alpine, Cal.	once only	Heard "WASKQA de WB6VKV K".
KH6DVG 14g11 0400 14 ow 13-15 12-15 own Honolulu, Hawaii 10 min Hoard "—Q CQ de KH6DVG K"." Eff. W80L 1/21/60 1538- 14 cw 6-10 other 3an Jose, Cal. one only Hoard "—Q CQ de KH6DVG K"." Eff. WABZNO 7/3/60 1538- 14 cw 6-10 other Chinoon, Ohio one only Heard "CQ de KH6DVG K"." Eff. WABZNO 7/3/60 16 a.n 3-1 ovn de Chinoon, Ohio one only Heard "CQ de KH6DVG K"." Eff. WABLD XU canty sun. 20 15 ovn de Chinoon, Ohio one only Heard "CQ de KH6DVG K"." The Chino	Mix, D.	WITS	6/24/59	0430	3.5	¢w			other (WICEG)	Falmouth, Mass.	several min	Echoes on New Britain, Connecticut station so severe that had to QRS to 5 wpm.
W. H. W. H. W. H. W. H. W. H. W. H. Once only Heard = VV de VASZKO: W. H. V. E. W. MASZKO 7/9/69 1633 7 cw 3-4 own Chinton, Ohin once only Heard = VV de VASZKO: Acadimity tries to dinjuleate, without same conversions. G. Jr. W. H. A. H. sat 20 15 own Fort Wayne, Ind. once only Heard = VV de VASZKO: Acadimity tries to dinjuleate, without same dilt. G. Jr. W. Jr. W. Jr. W. Jr. W. Jr. W. Jr. W. Jr. Heard = Color on KOA, Dev VASZKO: Acadimity tries to dinjuleate, without same dilt. G. Jr. W. Jr. W. Jr. 12/2/07	Montague, J. E.	KH6DVG	April, 1961	0400	14	Mo.	12-15		OWIL	Honolulu, Hawaii	10 min	
NASZNO 1633 7 9w 3-1 3+4 9wn Clinton, Ohio once only Heard "CQ, calling CQ, this is W9H A. J. M. H. M. H. M. H. M. H. M. M. S. J. M.	Myers, W. H.	Weol	1/21/69	1536- 1538	1.4	CW.	£ 10	6-10	other	San Jose, Cal.	once only	Heard echo on U.S.R. station (UT6).
W3HKX 7/14/84 0413 14 84b 20 15 04nd Port Wayne, Ind. Once only Carefully tries to duplicate, without auco carly sun ≈ 0600 50 8-m 3-10 3-10 04nd Once only carly sun ≈ 0600 2215 .850 8-m 3-16 04nd Once only carly sun ≈ 0600 2215 .850 8-m 3-16 04nd Once only carly sun ≈ 0600 Heard educes on KITZC and self. Carefully tries to duplicate, without auco carly carly sun ≈ 0600 14 may 04nd 14 may	Noul, J.	WASZNO	69/6/1	1633	2	CW	7,	3-4	OWB	Clinton, Ohio	once onty	Heard "VV de WA8ZNO".
WAID YU cardy yrun. can yr	Yold, D. E.	WHEX	7/14/89	0413	14	que	20	15	own	Fort Wayne, Ind.	once only	Heard "CQ calling CQ this is W9HFX etc." Carefully tried to duplicate, without success.
W5VY 12/2/67 1328 28 sp 4-5 4-6 one San Antonio, Toass only one Only one Heard edo on KOA, Denver, local (1c., Local Least) W9TUT 2/3/80 2215- 2218 .850 s-m ½-½- 5 other Hayden, Colo. one only Heard edo on KOA, Denver, local (1c., Local Least) W5JXK 4/26/69 aftermoon 14 may- cw 7 5 other New Orleans, La. core only Edos art "GB OM SK;" may have had shifted. It is a set of the core only in the color of the north of both sations. It is a set of the core only Action to be to the north of both sations had color of the north of both sations. It is a set of the core only Action twice	Yoyes, G., Jr.	WALDYU	early sum- mer, 1966	∞0000	20	#-m	3-10	3-10	own &	West Bridgewater, Mass.	5 min	Heard echoes on KITZC and self.
Ψ9TUT 2/3/60 2215- .550 a-m ½-½ 54-½ other Hayden, Colo. once only Heard edu on KOA, Denver, local (1-a) hond, Denver, local (1-a) hond (1-a) hond, Denver, local (1-a) hond (1-a)	Satterson, J. C.	W5VY	12/2/67	1328	2.5	ges	4-5	4-5	оми	San Antonio, Texas	only once	Heard "W5VY, W5VY, W5VY"
W5JXK 4/26/69 afternoon l4 may- (boul) cw 7 5 other New Orleans, la. once only slift. Station probably in U. S. Echo sent "GB OM SK." may have had slift. Station probably in U. S. VE4AS 2/25/69 0118 14 seb 1 other St. Bouiface, Manitoch and 10 min Toning to be to the north of both stations. K6EV November, 05/09 14 seb 3-4 ovn Los Angeles, Cal. choice only released to the north of both stations. W4BIH 9/7/58 6345 14 cw 300 20/7) own Torrington, Conn. once only minutes atter standing by for any DX call". W5EMI 3/15 4-5 4-5 othor Winfield, Kanasa 5 min Heard expense of standing by for any DX call". W6ONY 12/1/61 166 26 4-5 othor Wyoming, Ohio once only Heard repeat of standily transmission of standily transmission of other W6ONY 12/1/61 650 3-5 4-5 othor Women Monetonic, Once only Heard repeat of standily transmission of other	Prewitt, S. J.	Wetut	2/3/60	2215- 2218	.850	#-II	X-X		other	Hayden, Golo.	once only	Heard echo on KOA, Denver, local (i.e., non-network) broadcast.
VE 4.AS 2/26/69 0118 14 seb 1 other St. Bounitace, Manifecha 10 min YNIGLB had coho repeating words; by found to be to the north of both stations. KGEV November, 0600- 1965 14 seb 3-4 own Los Angeles, Cal. cobserved coho twice Heard "standing by for any DX call". WABRI 9/7/58 6345 14 cw 300 20(?) own Torringtoa, Conn. once only Heard "standing by for any DX call". WABRIM winter, 1600 21 a-m 4-5 othor Winfield, Kanasa 5 min Heard echoes on SW broadcast from East WBONY 12/1/61 050 35 is-1/6 is-1/6 <td>ditzer, S. M.</td> <td>W5JYK</td> <td></td> <td>afternoon (local)</td> <td>14 me be 2</td> <td>cw.</td> <td>2</td> <td></td> <td>other</td> <td>New Orleans, La.</td> <td>once only</td> <td>Echo sent "GB OM SK," may have had some Doupler shift. Station probably in U. S.</td>	ditzer, S. M.	W5JYK		afternoon (local)	14 me be 2	cw.	2		other	New Orleans, La.	once only	Echo sent "GB OM SK," may have had some Doupler shift. Station probably in U. S.
K6EV November, 0660- 14 seh 3-4 3-4 own tos Angoles, Cal. cobserved cent of the call of the call of the call. Heard "standing by for any DX call." W1BIH 9/7/58 6345 14 cw 300 20(?) own Torrington, Coan, cent of the call to DX minutes after standby. WA&KMD winter, =1600 21 a-m 4-5 othor Winfield, Kanses 5 min Heard complete repeat of his call to DX minutes after standby. W8HBI 7/13/69 1341 14 seb 1 othor Wyoming, Ohio once only Heard complete repeat of his call to DX minutes, and the complete repeat of standby transmission of Yahou W6ONY 12/1/61 0500 3.5 seb i/g-1/g i/g-1/g Los Angeles, Cal. yahour Boho heard by various stations in LA and outside. Tape recording made.	йтрвоп, А. А.	VE4A8	2/25/69	0118	Ť	aet	` 	. ~	other	St. Boniface, Manicoba	10 min	YNIGLB had coho repesting words; by DF-ing source found to be to the north of both stations.
WIBIH 9/7/58 6345 14 ew 300 20(?) own Torrington, Conn. once only Heard complete repeat of his call to DX minites after standby. WAØKMD winter, =1600 21 a-m 4-5 4-5 other Winfield, Kanasa 5 min Heard echoes on SW broadcast from East C WBHBI 7/13/69 1341 14 seb 1 1 other Wyoming, Ohio once only Heard repeat of standby transmission of Standby arious stations in LA and Standby Standby Standby and Standby Stand	it. John, Ed	K6EV	November, 1965	i	\$ 1	qse	4-8	8 4	OWD	Los Angeles, Cal.	observed echo twice	Heard " standing by for any DX call".
WA@KMD winter, 1966 =1600 21 a-m 4-5 4-5 othor Winfield, Kanasa 5 min W8H8I 7/13/69 1341 14 seb ½-½ ¼-½ won & Los Angeles, Cal. ½-hour W6ONY 12/1/61 0500 8.5 seb ½-½-½ id-½- other Los Angeles, Cal. ½-hour	hompson, J. H.	Wibih	9/1/58	0345	14	cw.	300		оми	Torrington, Conn.	once only	of his call
. W8H31 7/13/69 1341 14 neb 1 1 other Wyoming, Ohio once only W6ONY 12/1/61 0500 3.5 neb いかが igー)は いかれを Los Angeles, Cal. がわour	on Dielingen, D.	WASKMD	winter, 1966	=1600	21	A-m	4-5		other	Winfield, Kansas	5 min	Heard echoes on SW broadcast from East Coast station — N.Y.C.?
W6ONY 12/1/61 0500 3.5 ssb i编字k i编字k own & Los Angeles, Cal. 沒 hour Echo heard by various stations in LA other	Vellman, H. J.	W8H8I	7/13/69	13#1	14	skel)	г		other	Wyoming, Ohio	once only	Heard repeat of standby transmission of WAZYKU.
	Viggins, B. A.	WGONY	12/1/61	0200	3.5	dass	1/ 4 -1/4		own & other	Los Angelos, Cal.	14 hour	Echo heard by various stations in LA area, but not outside. Tape recording made.

Observations on Long-Delay Radio Echoes

An Opportunity for Amateur Cooperation

By J. H. Dellinger*

SPECIAL signals are being transmitted from two European stations for the study of long-delay echoes. The signals and the whole undertaking are adapted to the perfetipation of pursues all over the world who have high-frequency receiving sets, no technical framing from required.

tame-belay echoes are a most surprising and builling phenomenon. Mr. J. Hals was listening in Nerway, one day in 1927, to desperable signals from station PCM in Holland on a frequency of about 1900 ke. Some of the signals were followed, after about 38 seconds, by a faunt celle or reproduction. Echo signals occurring our-securith of a second after an emitted signal had been well known, being due to the reception of success that had travelled all the way around the earth. But the discovery of occlose after a materially greater interval than a seconth of a second immediately reised the puzzling question of where such an echo could come from.

The phenomenon has been verified to a few scattered observations by Dutch, British, and French engineers. Echoes have been heard from I to 30 seconds after the emitted signal. Not mough is known, however, to determine what causes the echo signals nor low they are propagated.

listen with a high-frequency receiving set, Listences in all parts of the world have been enrolled in the enderson, over 10,000 of them in Great Britain. It seems likely that internation of unique value to source will result, and an orderly explanation of the racious phenomenon developed, when demate data are secured on the frequencies and the times of day and senson at which these echoes occur, their intensities, the arm over which a given echo is funcif, their relation to magnetic storms, sunspots, etc.

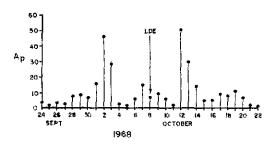
THE SPECIAL TRANSMISSIONS

The stations transmitting the special signals are CSB, Daventry, England, and HBL, Geneva, Switzerland (the League of Nations station). The GSB signals are transmitted on 9510 ke., with a time or modulation of 1000 cycles per second, each Sunday. Tuesday, and Thursday, from 3-25, to 3:55 a.m., Eastern Standard Time The HBL signals are transmitted on 6575 ke., andulated continuous waters, each Sunday, Wednesday and briday, from 5:00 for 6:00 a.m., E.S.T. Each trensmission costs of a five-minute adjusting period (GSB using phonograph music, and HBL using its call letters in each expected followed by the letters of the highlaster in code, spaced a minute letters of the highlaster in code, spaced a minute

Fig. 2—The first U.S. amateur search for LDE's! The article by the late J. H. Dellinger appeared in QST for August, 1934, and was drawn to the author's attention by Ray Rinaudo, W6ZO, It is not known whether any reports were received in response to this request. The special transmissions alluded to were in all likelihood far too infrequent.

Are the Echoes Houses?

Unfortunately, the authors know of no way by which this can be ruled out in any given case. Extremely clever practical jokes have been pulled off in the past, and doubtless there will be more in the future. The number of hoaxes will probably grow with the number of people looking for LDEs, and with the amount of publicity the whole matter receives. Oddly enough, this fact is an important reason why many reports are



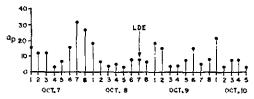


Fig. 3.—Representative example (chosen at random) of the way in which LDEs seem to occur during dips in relative magnetic disturbance. The lower plot (ap) is an average of this quantity over three hours, plotted for each three-hour interval of the three-plus days centered on the LDE. The upper plot (ap) is an average of the eight daily ap figures, plotted for each of the 30 days centered on the LDE.

needed: hoaxes often become obvious when a large number of observations are examined for internal consistency.

Correlation with Magnetic Conditions

Dr. A. C. Fraser-Smith of Stanford University has correlated the level of magnetic activity on days when LDEs are reported with the average level for that month. He finds that "78 per cent of the LDEs occur on days which are quiet relative to the rest of the month". This finding needs further checking, but if it stands, it will be an important result because it tends to reduce the credibility of both the psychological origin theory and the "hoax" theory. There is little reason to believe that the tendency to hallucinate would be greater on days of low magnetic activity than on any other. Likewise, it seems unlikely that practical jokers would consult magnetograms before turning on their equipment.

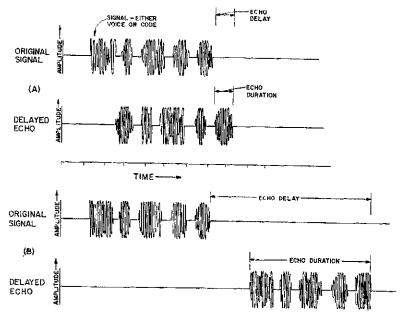
Two Kinds of Echoes

A striking feature of several reports at 3.5 MHz is the fact that the echoes are heard on the signals of a particular station (usually one nearby) but not at the same time on other stations near to the same radio frequency but somewhat farther away. (This kind of observation is helped by the multiple-station netting usually practiced at the lower frequencies.) If the presence or absence of an echo is a sharp function of distance at the lower frequencies, a possible explanation is that the defay may be a consequence of slowed velocity of propagation accompanying deep penetration of the layers directly overhead.

At higher frequencies, such deep penetration of the layers is highly unlikely, and other explanations must be sought.

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Fig. 4—Definition of "echo delay" and "echo duration." A—In this case echo delay equals echo duratión, B—Here echo delay differs from echo duration,



One might imagine that if LDEs are in fact more likely to occur at times of magnetic calm, then more than one instance ought to be reported on the same day. But there are no such coincident reports thus far. One concludes from this that the chance of any given echo being heard must be very low. It is probable that a fairly large number of requirements must have to be satisfied in order for an echo to be observed. Some of these are not hard to visualize. For example:

- The radio frequency may well have to be just right.
- The frequency must be free of interference.
 The called station, or the other half of a QSO, or general QRM, must not drown out the echo.
- The operator must be alert and aware that an echo of this sort is unusual and worth reporting.
- 4) Because the echoes are normally weak, the receiver must be sensitive and must be operating with sufficient gain so that antenna noise is audible, and
- Any beam antenna should be pointing in roughly the right direction.

Of course, there may well be other requirements that cannot even be guessed at as yet!

On the Origin of the Longer LDE's

The longer LDEs are frequently reported when transmission in the higher-frequency bands is just opening up or shutting down. These are times of day when QRM is low, when long-distance propagation may be good, and when tilt-initiated ionosphere-to-ionosphere reflections often take place. Such reflections are now known to be an important feature of round-the-world (RTW) propagation, but they have not as yet been studied in detail. With the aid of such propagation, the ionosphere can function as a giant echo box or "whispering gallery." Could LDEs be temporarily-lost whispers in the

whispering-gallery? It's a possibility. For example, RTW propagation is also best at times of low magnetic activity. In addition, only two of the reports thus far have mentioned any Doppler shift, although in many instances frequency changes as small as plus or minus 20 Hz ought to have been recognizable. This suggests that the "reflecting" regions — whatever they are — are relatively fixed in position, like the earth's ionosphere itself. On balance, it seems desirable — at least initially — to seek a relationship between LDEs and the quality of long-distance transmission.

A difficult thing to explain, however, is the fact that without exception — so far — only one echo is reported! Yet in the early days more than one repeat of a given test transmission was quite frequently noted. Is this entirely a threshold effect resulting from the lower powers of today?

It doesn't strain the imagination much to visualize that there might be times when the ionospheric echo box could achieve phenomenally high "Q", either due to fortuitous focussing or exceptionally low losses or both. In that event, however, one would expect to hear a jumble of decaying energy, rather like shouting at a piano with the damping of the strings removed. But no one has reported this type of behavior at all.

The authors will be grateful for further reports of echoes greater than one or two seconds in length. Shorter echoes can in general be explained by round-the-world propagation, and are of lesser interest. Address: W6QYT, Radioscience Laboratory, Stanford University, Stanford California 94305. All reports will be acknowledged and credit given.

Comments on the Reports

Table I is a summary of the principal features of the reports received thus far. Some reports which are inexact as to time, place, and other details, have been omitted. In cases where authors have submitted more than one report, the most complete one has been chosen for inclusion.

It can be seen that -- strictly speaking -the list is not exclusively echoes of "long" delay, according to the classical definition of "long" which is 3-30 seconds. It is really a list of echoes which the observers felt to be unusual enough to report. The authors thought it wisest to be guided by the reporters' judgment in this respect. It is well known that the ability to estimate the passage of time depends strongly on the observer's mood. Hence, the estimates of echo duration in seconds must be treated with great caution except for those cases where there is memory of the exact words heard, and the rate of speaking or sending.

Of particular interest are the two reports of echoes heard in the broadcast band, the VHF reports, and the two reports of delays in the order of minutes.

Note that where an undesignated time appears, it is GMT and the date is GMT; where the time is designated as "local", the date is local. Also, please note the definition of "echo delay" ccho duration," which is given in Fig. 4. "Audible interval" refers to the length of time during which the echoes could be heard.

Home station call letters are listed opposite reporters' names. The "location" column lists the locations (often different from home) at which the LDE's were actually heard.

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Acknowledgements

In addition to the reporters included in the list, the authors wish to thank the many others who have taken the trouble to write, and regret that space does not permit all the names to be included.

The report by W3FEG was referred to us by O. P. Ferrell.

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A.R.R.L. QSL Bureau

The function of the ARRL QSL Bureau System is to facilitate delivery to amateurs in the United States, its possessions and Canada of those QSL cards which arrive from amateur stations in other parts of the world. All you have to do is send your QSL manager (see list below) a stamped self-addressed envelope, about 414 by 914 inches in size, with your name and address in the usual place on the front of the envelope and your call printed in capital letters in the upper left-hand corner.

Cards for stations in the United States and Canada should be sent to the proper call area bureau listed below. W1, KI, WA1, WN1¹ — Hampden County Radio Asso-ciation, Box 216 Forest Park Station, Springfield, Massachusetts 01108.

W2, K2, WA2, WB2, WN2 — North Jersey DX Assn., PO. Box 505 Ridgewood, New Jersey 07451.

W3, K3, WA3, WN3 — Jesse Bieberman, W3KT, RD 1, Balley Hill Rd., Malvern, Pennsylvania 19355
W4, K4— H. L. Parrish, K4HXF, RFD 5, Box 804, Hickory, North Carolina 28801.

Hickory, North Carolina 28601.

WA4, WB4, WN4!— J. R. Baker, W4LR, 1402 Orange
St., Melbourne Beach, Florida 32951.

W5, K5, WA5, WN5 — Hurley O. Saxon, K5QVH, P.O.
BOX 31307, El Paso, Texas 79931.

W6, K6, WA6, WB6, WN6 — No. California DX Club,
BOX I1, Los Altos, California 94022.

W7, K7, WA7, WN7 — Williamette Valley DX Club, Inc.,

P.O. Box 555, Portland, Oregon 97207. W8, E8, WA8, WN8 — Paul R. Hubbard, WASCXY, 921 Market St., Zanesyille, Ohio 43701.

W9, K9, WA9, WN9 - Ray P. Birren, W9MSG, Box 519,

Elmhurst, Illinois 60126. Wø, Kø, WAB, WNØ — Des Moines Radio Amateur Assocustion, P.O. Box 88, Des Moines, Iowa 50301.

KF4 - Alicia Rodriguez, KP4CL, P.O. Box 1061, San Juan, P.R. 00902.

KZ5 — Gloria M. Spears, KZ5GS, Box 407, Halbon, Canal

KH6, WH6 - John H. Oka, KH6DQ, P.O. Box 101, Alea, Oahu, Hawaii 96701.

KL7, WL7 - Alaska QSL Bureau, Star Route C, Wasilla, Maska 99687.

VEII — L. J. Fader, VEIFQ, P.O. Box 663, Halifax, N.S. VE2 — John Ravenscroft, VE2NV, 353 Thorncreat Ave., Montreal 780, Quebec.

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monton, Alberta. VE7 — H. R. Hough, VE7HR, 1291 Simon Road, Victoria,

British Columbia.

VES - George T. Kondo, VES ARRL QSL Bureau of Department of Transport, Norman Wells, N.W.T.

VO1 — Ernest Ash, VO1AA, P.O. Box 6, St. John's Newf. VO2 — Goose Bay Amsteur Radio Club, P.O. Box 232, Goose Bay, Labrador.

SWL -- Leroy Waite, 39 Hannum St., Ballston Spa, New York 12020.

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