LONG DELAY ECHOES ON TAPE

ALMOST 30 YEARS AGO a *TT* item 'Long-Delay "Cosmic" Echoes' noted that a team at Stanford University was planning a new investigation into "the baffling, 40-year-old puzzle of long delayed echoes (delay times measured in seconds) that have been reported only extremely rarely".

It was noted that these strange Long Delay Echoes (LDEs) were originally reported in 1927 in a series of experiments by Professor Stormer at Oslo and Dr Balthazar Van der Pol at Eindhoven. The 1960 translation of *'Radio Wave Propagation and the Ionosphere'* by the Russian scientist Ya L Al'pert includes a summary of this work: "The first cosmic echo was observed at the end of the summer of 1927. Searches were organised on 31.4 metres from March 1928, but it was not until near noon on 11 October that a large number of echoes were received in Oslo with delay times between 3 and 15 seconds (most about 8 seconds) . . . . during the night 120 echoes were observed at Eindhoven . . . . in 1930 echoes were reported in Indochina . . . . in 1934 more than 70 echoes were observed between 30 May and 8 July."

Post-war investigations showed LDEs being heard only very rarely, and some researchers concluded that all reports must be mistakes, hoaxes, subjective effects originating within the listeners own brain, etc, etc.

Al'pert distinguished LDEs from the far more common HF Round-The-World echoes, on which a good deal of research was carried out by the Germans during WW2 in the course of devising a means of locating a distant transmitter by measuring the difference in time of arrival of the short and long path signals. It was shown that the average delay time of more than 750 RTW echoes was 137.78 milliseconds, with a spread in the individual measurement of 218 echoes less than 10^{-4} seconds.

In the following 11 years I included at least eight further items on LDEs, including several reports of such echoes being heard, or not heard despite long periods of listening, and also several hypothesises of how they might occur.

Two of the more convincing reports of LDEs in the 1930s - not only heard but also recorded - were included in *TT* (November 1975, p846). R L A Borrow, G3ZTK, who was one of those who carried out listening tests together with Professor Appleton at King's College, London, during the original transmissions by Van der Pol from The Hague in 1928-29 wrote: "In addition to hearing a number of echoes I did succeed in obtaining what was then the only known photographic record of an echo. This record was examined by Appleton and he was quite satisfied that it was undoubtedly genuine (see his letter to *Nature*, Vol 122, December 1928) . . . . On a very few occasions I distinctly heard the signal (an X) . . . . on one occasion an echo was heard by me in the laboratory at King's and also by Appleton at his home at Potters Bar."

L A Reeves, G4CEM also verified that even if LDEs were not being heard in the 1970s, they were heard and recorded by himself and many members of the commercial telegraph fraternity. He wrote: "The last time I heard this phenomenon was around 1938 on the Cable and Wireless London-to-Bangkok route . . . . The Bangkok station when 'idling' had the habit of putting on a call-band of spaced Vs and callsigns. The space between each V was about 5 seconds, and following each V there could sometimes be heard a perfect echo-type signal approximately 2 seconds behind the original. It was nearly always strong enough to be recorded on the pen-undulators used at that time . . . . These echoes were recorded on the daytime frequency of 19MHz during winter, when the whole route was in daylight . . . . I can assure you that what we heard and recorded on these tapes was tangible and certainly not subjective."

The last time I included an item on LDEs was in 1980, but I have now received a most interesting report from Peter Martinez, G3PLX, who has recently observed and recorded echoes while using his electronic Hellschreiber equipment. The delay time of 209 millisecond ±5 milliseconds is clearly too long for an RTW echo, although less than what has generally been regarded as the delay time of an LDE. He writes:

"The subject of 'long-delayed echoes' is a bit like the Loch Ness Monster or the Abominable Snowman. However implausible their existence may seem, reports still appear from time to time describing them. Here is another, but this time I captured it 'on tape', as it were, that I can show to those who may be interested.

"I was in contact with PA0OCD on 3.5MHz at 1930UTC on October 25, 1997, using the 'Hellschreiber' mode (described in detail by the late Stan Cook, G5XB, *'Hellschreiber - What it is and how it works'* (*Radio Communication*, April 1981, pp320-323). In this mode, letters are transmitted by sending patterns of dots in on/off keying mode, the patterns representing directly the letter shapes as they appear on the printed tape. The original German direct printing telegraph equipment used mechanical methods, but several amateurs are using DSP software and computers. My own set-up displays the incoming signal on the computer screen as black letters on a white background, stronger signals giving a blacker image. The sending software works so that whenever I hit a key, the transmitter immediately transmits the letter shape, then drops back to receive, in quick-break fashion.

"Imagine my surprise when, over a period of about one minute, I started to hear short 'pips' in the receiver speaker at the ends of my words. I then realised that I could also see the right-hand edges of the final letters of my words appearing on the receive screen, but shifted out-of-phase so that they did not line up with the transmitted letters.

"This appeared to be due an echo, so I did a quick test by sending a series of full stops in rapid sequence. Sure enough the dots showed up on the receive screen, appearing just after the transmitted dots but at the top of the text-line rather than the bottom. I quickly 'saved' the entire page. The effect faded and did not occur again.

"**Fig 2** shows a fragment of the screen-shot. At the top, the signal from PA0OCD; then my own test, with band-noise appearing between my words as a result of the quick-break operation. On the bottom few lines can be seen my remarks about the presence of this echo, followed by my tests with the string of dots. The echoes can be seen on some of the letters at the ends of words on the lines above, for example the 'K' at the beginning of line 5 and 'N' and 'CAN' in line 6. Where you see my text, this is 'forced' onto the screen by the software equivalent of 'sidetone', and are not signals received through the receiver which is muted while transmitting.

"I have spent some time analysing this screen-shot, picking out the actual sequence of received signals. The Hellschreiber signal scans

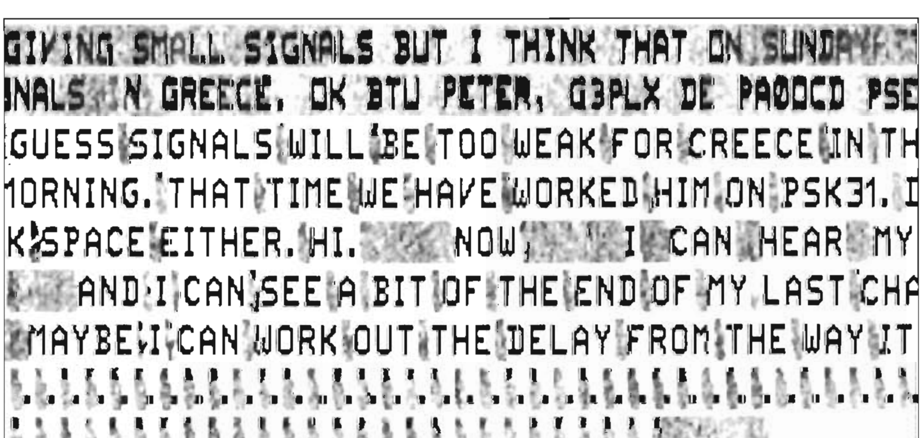

Fig 2: Screen-shot of a part of G3PLXs Hellschreiber-mode contact with PA0OCD.

in columns, bottom-to-top, the columns being transmitted at a precise rate of 17.5 columns per second. Each column is divided into 14 pixels or dots, each of 4.08mS duration. A full stop consists of 4 pixels in a square, and the waveform of a repeated string of dots is thus a pair of pulses 8.16mS long, separated by 57mS. They repeat at intervals of 457mS.

"I processed the screen-shot to unravel the rectangular characters into strips 457mS long, repeating down the page to show the repeated full stops. This is shown in **Fig 3**. I have added a line which is 49 pixels long, which represents exactly 200mS. As a separate exercise, by

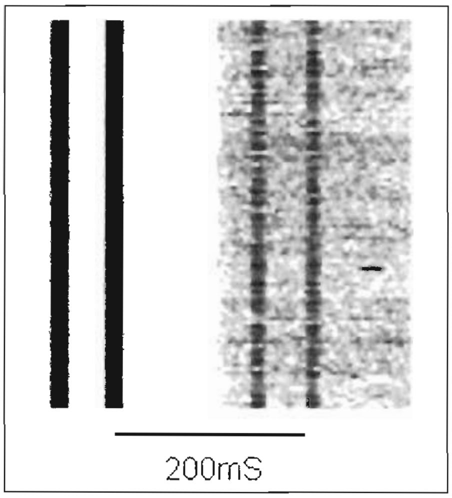

Fig 3: Processed version showing more clearly the echoes received 209 milliseconds after the transmission of the series of dots shown at the bottom of Fig 2.

listening to my own transmission on a separate receiver and displaying that on the screen while I was transmitting, I measured the delay from the 'sidetone' image on the screen-shot to the actual transmission. This was 55mS, formed mostly from a fixed software delay and a few milliseconds of delay through transmitter and receiver SSB filters. This enabled me to move the sidetone image from Fig 3 back by 55mS so that it represents the transmitted signal. The distance between the transmitted signal and the echo is seen to be about 209mS, with an uncertainty estimated at ±5mS.

"I have heard a similar echo once before on 3.5MHz, while transmitting AMTOR, but on this occasion I was fortunate in being able to record it for posterity. To put 209mS into perspective, it represents some 1.5 times the delay of a Round-The-World echo. Remember, this is 3.5MHz not 21MHz!"

[A check of DK0WCY beacon propagation forecasts (see *TT*, October 1997, pp80-81) shows that during October 25 there was a warning of a minor geomagnetic storm expected, and this must have been pronounced since, most unusually, I did not hear the beacon on October 26-27. There must be some suspicion that the echoes and the magnetic storm may have been connected, with the echo possibly arising from a storm-enhanced Van Allen belt - G3VA]

"BBC EXPERIENCE"

An opportunity arose to see a preview of the new permanent "BBC Experience" exhibition at Broadcasting House, London. This includes, in the reception area, the Marconi Collection which was so nearly dispersed by GEC-Marconi at public auction. To my mind, this was the most interesting part. The Experience proper, although extremely well presented and good fun, is directed squarely at the lay listener or viewer, rather than those genuinely interested in the history and technology of broadcasting. Those in charge cheerfully admit that they consider transmitters "boring", but then of course the BBC has now sold-off all its domestic transmitters to an American firm.

Even so one would have liked to have seen some mention of P P Eckersley, G2OO, responsible as both engineer and presenter of the original Writtle 2MT broadcasts, who became the BBC's first Chief Engineer (and Honorary Vice-President of the RSGB) and responsible for the original National/Regional twin-transmitter network. The BBC's historian, (Lord) Asa Briggs, has written of him: "Peter Eckersley had more ideas about broadcasting than any other man in the country. Some he put into effect, some were never realised, and some never could have been." Eckersley, unfortunately, was sacked by (Lord) John Reith for having been named in a divorce case, while still a young and highly talented engineer.

Broadcast engineering in the UK and elsewhere has always included many licensed radio amateurs, yet the only reference at the Experience to the amateur connection is a mock-up of the Tony Hancock's "The Radio Ham" television set - an extremely funny broadcast but one that by no stretch of the imagination could be construed as a credit to amateur radio!

TINY CMOS KEYER

GARY DIANA, N2JGU and Bradley Mitchell, WB8YCG in *'TiCK-2 - The Tiny CMOS Keyer 2'* (*QST*, October 1997, pp42-45) describe a keyer which vies for the title of being the smallest, lowest-cost, feature-packed keyer in the world! Based on one of the latest microcontroller technologies, it uses an 8-pin DIP microcontroller from Microchip Corporation, the PIC 12C509. The authors claim this IC is a perfect candidate for all sorts of Amateur Radio applications, because of its small size and high performance capabilities. It permits an iambic keyer at a cost that makes it accessible to virtually all amateur radio operators, and should encourage designers to include the keyer in their transceiver designs.

It features one memory message (eg "CQ CQ DE callsign callsign K"); mode A and B iambic keying; speed control; low cost; low current requirement for portable operation; small size; low parts count; simple interfaces both to the rig and the user; tune function to hold the keying line active while adjusting equipment; sidetone; paddle select allowing operator to swap the dot and dash paddles; manual keying to permit interfacing a straight key or external keyer; and weighting (3:1 default).

While the *QST* article provides detailed instructions, including component sources and programming, **Fig 4** at least provides the complete circuit diagram.

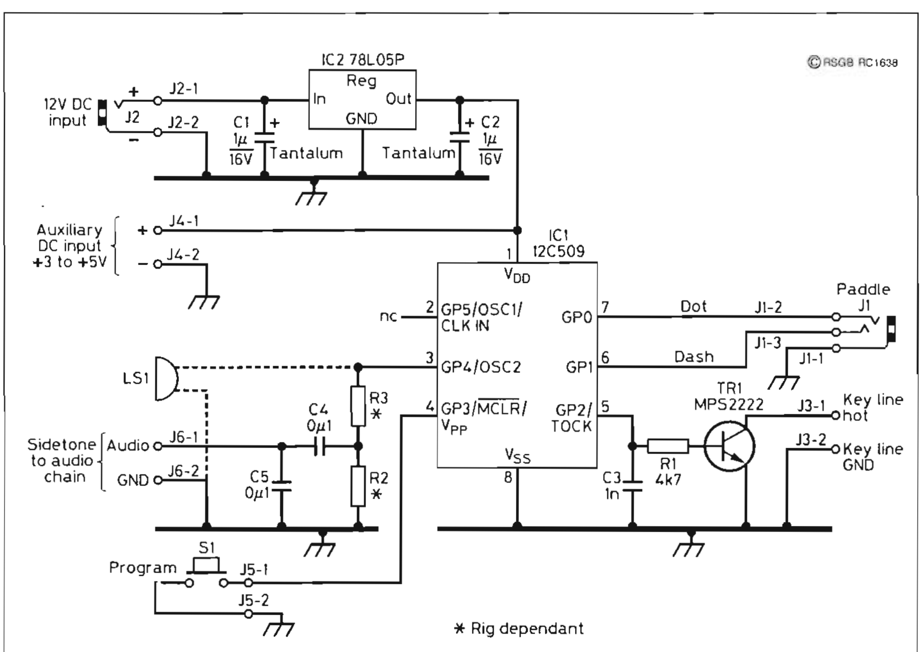

Fig 4: The low-cost TiCK-2 electronic keyer. The PIC12C509 IC must be programmed before use (see *QST*). C1, C2 tantalum; LS1 is an optional piezo element; TR1 NPN MPS222A or equivalent; S1 normally open push-button; IC2 5V, 100mA regulator.