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AUTHENTICITY EXAMINATIONS OF AUDIO RECORDINGS

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1. INTRODUCTION

It is nowadays commonplace for audio recordings to be brought in evidence in English criminal trials. Not only has there been an increase in audio surveillance and recording of criminal activities by the police and other prosecution agencies, but, since the implementation of the 1987 Police and Criminal Evidence Act, police interviews with suspects have also been recorded.

Like most other types of evidence, audio recordings are frequently subject to challenge. They may be challenged on a number of grounds [1, 2], one of the commoner ones being that they have been tampered with or edited. If such a claim can be supported by the results of forensic examinations, the recordings may be ruled inadmissible as evidence in court.

Forensic investigations of recordings for evidence of tampering or editing are conventionally termed 'authenticity examinations'. Such examinations involve the forensic analyst in a wide range of tests of different types, some of which, for example, involve expertise in the fields of linguistics and phonetics. Others are physical in character, involving microscopic examinations of the magnetic tracks in the oxide of the tape under conditions of chemical development [3]. For present purposes, however, these will be ignored and the focus will be exclusively upon those kinds of tests which may be of interest to a general acoustics readership.

2. ACOUSTIC EXAMINATIONS OF SWITCHING TRANSIENTS

Very often evidential recordings contain 'clicks', 'bumps' and 'knocks'. An important element of the forensic analyst's work involves the examination of such features in an attempt to determine their cause. In particular, one must address the question of whether or not they are switching transients.

Switching transients are caused by surges of electric energy being transmitted to the tape from the recording and erase heads of the tape recorder at points when it is switched in and out of its record mode. They are heard as 'click' sounds, and have a shape to their waveform which is characteristic of the make and model of tape-

recorder which produced them. A systematic introduction to the study of transients is provided by Dean [4] (see also [5]). The following summary information will suffice for a basic understanding of some ways in which transient analysis may be used in the resolution of legal disputes.

At the beginning of a recording one would normally expect to find only one clearly defined transient: a record head transient. The reason for this is that the erase head transient is immediately over-written by the signal from the record head as the tape passes over it.

At the end of a recording one typically finds two transients, one being a record head switch off transient, the other being an erase head switch off.

The vast majority of tape recorders tested in my own laboratory have shown a high degree of consistency with regard to the configuration of the waveforms associated with the record head switch off and erase head switch off transients over extended experimental series. The patterning tends to be more variable, however, in relation to record head switch on transients.

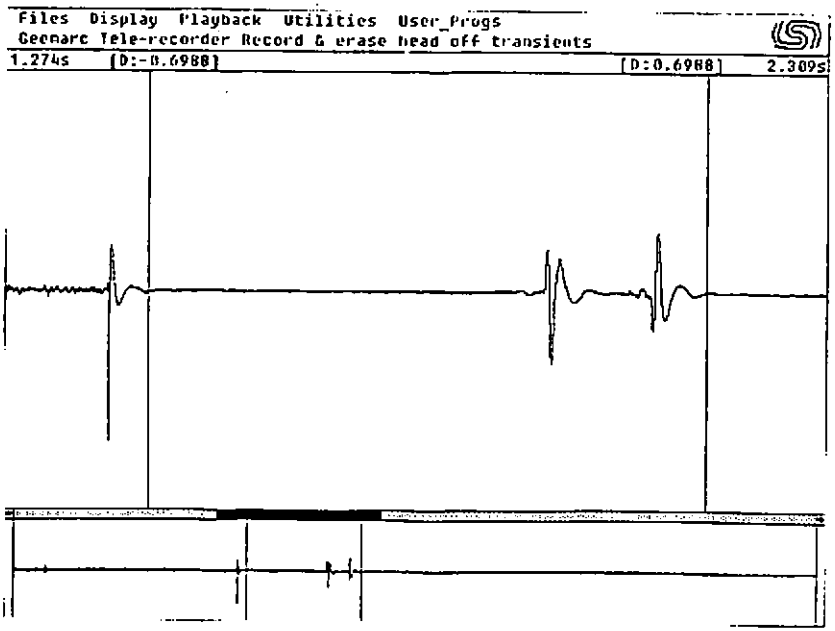

Figure 1: Record and erase head switch off transients from Gemarc Tele-recorder

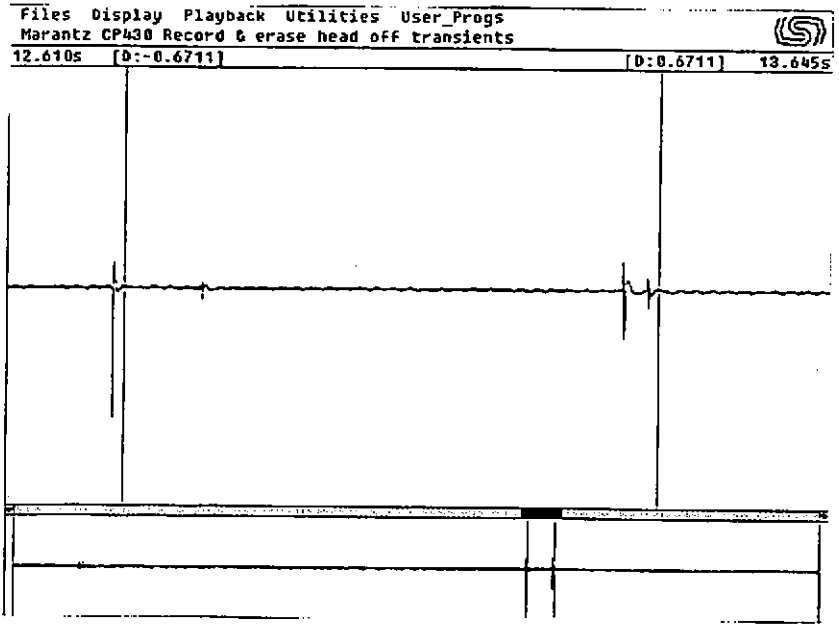

Figure 2: Record and erase head switch off transients from Marantz model CP430

In undertaking authenticty examinations of evidential recordings, it is important, whenever possible, to have submitted with them for examination the actual tape recorder upon which they were made. Where this not available, a machine of the same make and model may be deployed. One of the reasons for having available the machine is to generate experimental series of transients which may be checked against any suspicious features found in the recordings. This is particularly important in the following circumstances:

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(a) Where there is a claim that 'contemporaneous editing' occurred, ie, the original recording process was discontinuous, the machine being switched in and out of its record mode or paused by the operator, in order to arrive at a selective representation of events;

(b) Where there is more than one recording on a tape and an allegation is made that a subsequent recording has been made over the end of a previous one, in order to obscure material;

(c) Where there is a challenge to the originality or integrity of the recording more generally.

The relevance of switching transient analysis to each of these circumstances will be addressed in turn, giving illustrations from forensic casework records.

(a) Contemporaneous editing

If a recording is continuous (leaving aside the possibility of accidental damage during playback) only three transients should be detectable; a record head switch on at its inception and a record head switch off and erase head switch off at its completion. The occurrence of off and on transients at any other point may be taken as evidence of discontinuity, as may any features found to have been introduced by the operation of a 'pause' control.

Case study

A teenage girl had been taken from the custody of her mother and stepfather on the basis of a court order obtained by the social services on the grounds of alleged abuse. She was placed in local authority care pending the prosecution of the mother and stepfather, at whose trial she was to give prosecution evidence. Several weeks before the trial she went to their home with her older brother. (At the trial the defence claimed that she went there voluntarily, the prosecution that she was abducted.) Whilst in their home, the stepfather made an audio recording of her apparently retracting the allegations of abuse she had earlier made to the police and upon which the case was to be based. The stepfather claimed the retraction was voluntary and the recording was continuous; the girl claimed that it was gained from her under duress, over an extended period of time, with the stepfather stopping and re-starting the tape recorder. The tape-recorder, an Olympus model S906 Pearlcorder microcassette machine, and the tape were submitted to the laboratory by the Crown for forensic examination, in an attempt to resolve the matter.

Comparisons of the waveforms of experimentally-generated switch off and switch on transients from the Olympus machine were made with those found at suspect points in

the evidential recording.The results indicated that the recording had been made in five sections, thus supporting the girl's claims concerning the circumstances of her retraction.

(b) Over-recording

Where more than one recording figures on a tape, it has sometimes been claimed that the subsequent one has maliciously been recorded over the end of the previous one, in order to obscure from the attention of the court material that would not have supported the case of the party bringing the recording in evidence.

Case study

A claim of this kind arose in the course of a recent case in which the defendants were being prosecuted by HM Customs and Excise Drugs Investigation Division for importation of heroin. A drugs courier had been arrested by Customs Officers and had agreed to co-operate with them in attempting to gain evidence against others involved in the importation. This entailed his attending a meeting with the others in a car park and recording the conversation which took place. According to the prosecution, the recording procedure was as follows:

(1) A Customs Officer placed a microcassette into the tape recorder, a Sanyo Model TRC 550A, switched it into its record mode and produced an introductory message stating the date, time, location and circumstances of the anticipated meeting.

(2) The machine was then switched off before being switched on to record again and placed into the pocket of the co-operating courier.

(3) After the meeting had been recorded, the machine was taken out of the courier's pocket and switched off by the Customs Officer before being switched on again to record an 'outroductory' message once more giving date, time, location and circumstances.

At the ensuing trial the defence were to claim that step (3) did not occur as the prosecution claimed. Specifically, it was alleged that, during the closing phase of the meeting, things were said which would not have helped the Crown's case. The Customs Officer had therefore rewound the tape a little way and over-recorded the unwanted material with his 'outroduction'.

In support of this version of events, the defence were able to show that the recording of the meeting was significantly shorter than it should have been according to timings written in the notes in the Officer's pocket book. They also produced an expert witness who gave testimony to the court to the effect that over-recording had occurred.

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The Sanyo TRC 550A microcassette recorder and the tape were submitted for forensic examination by the Crown during the progressing trial. An experimental series of switching transients was generated from the machine and the waveforms associated with these were compared with waveform displays of the area of interface between the recording of the meeting and that of the 'outroduction'. Resolution of the issue in favour of the defence would have involved one finding only a record head switch on transient at this point, the switch off transients from the end of the meeting recording having been over-written; resolution in favour of the Crown would involve there being record and erase head switch off transients prior to the occurrence of the switch on.

Figure 3 shows an instance of the waveform associated with experimentally-produced record and erase head switch off transients from the Sanyo TRC 550A.

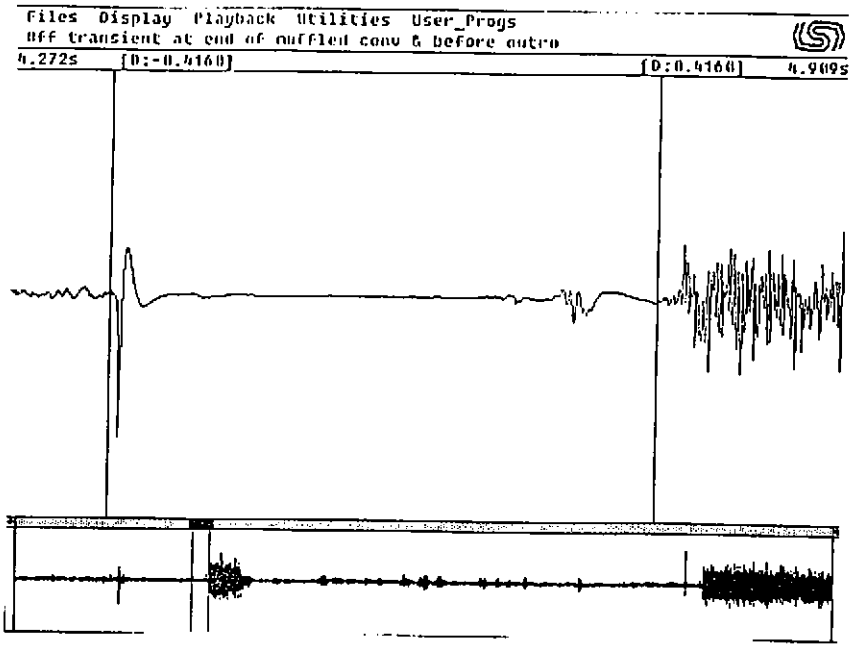

Figure 3: Experimentaly-produced record and erase head switch off transients from Sanyo TRC 550A

As shown in figure 4 switch off transients were located at the end of the recording of the meeting, directly prior to the on transient at the beginning of the 'outroduction'.

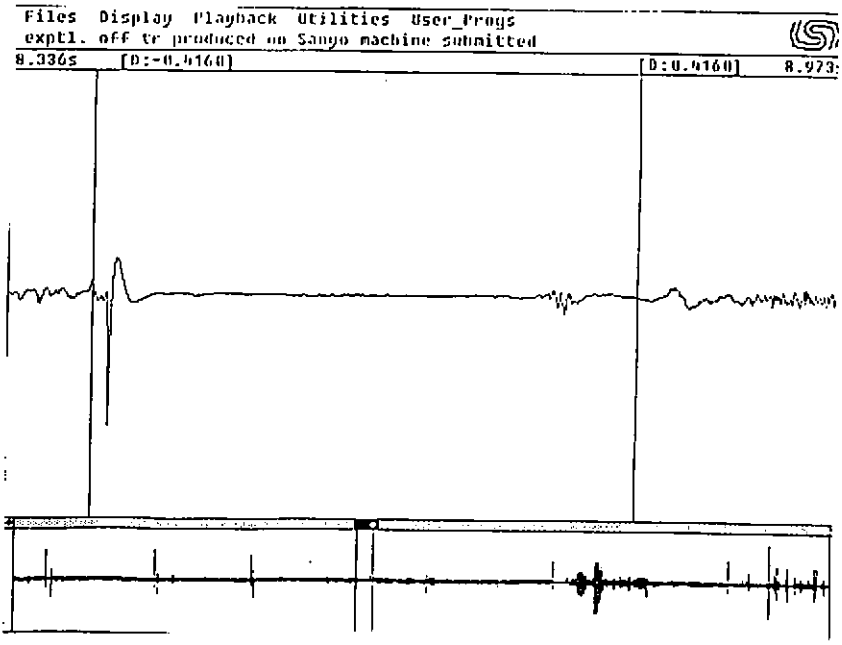

Figure 4: Record and erase head switch off transients from the end of the recording of the meeting

The finding of the switch off transients gave strong support to the prosecution's version of events. However, one was left with the question of why the recording of the meeting should be shorter than the duration stated in the Officer's notes. This question was answered from an examination of the Sanyo TRC 550A's recording options. Like many tape recorders designed for the recording of dictations and

meetings in business and commercial contexts, the machine could be set either to record continuously or switched into a 'voice activated' ('vox') mode. In the latter, the recording process continues so long as the incoming signal remains above a threshold level. If the signal falls below that level, the progress of the recording is automatically arrested until such time as it again transcends the threshold. Time-amplitude plots of experimental recordings made on the TCR 550A showed a characteristic shape to the waveform of 'vox' arrests and restarts. A similar feature was found in the evidential recording. Waveforms of the feature from experimental and evidential recordings are shown juxtaposed in the split screen display in figure 5 below:

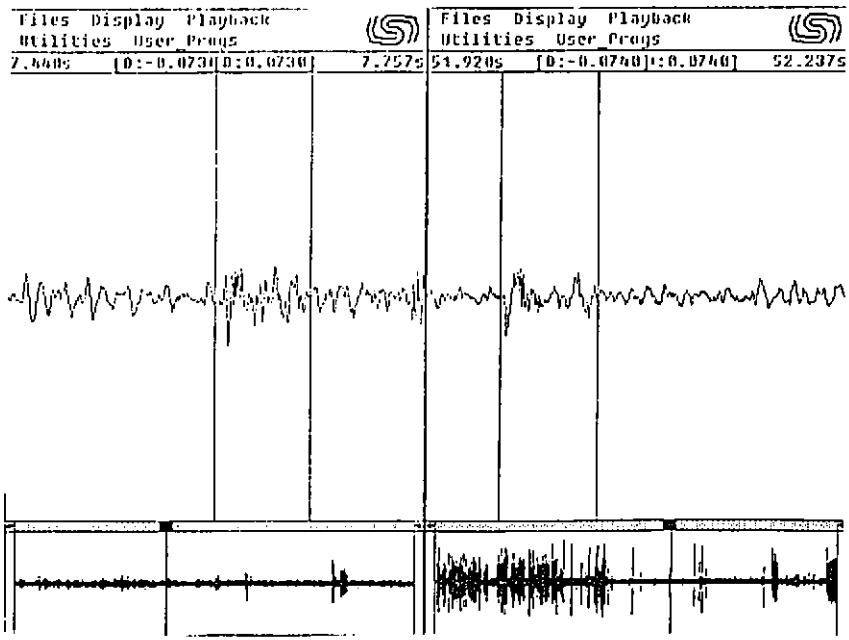

Figure 5: Split screen waveform display of 'vox' arrest and restart from experimentally-generated recording (left) and evidential recording (right)

It will be noted that the the degree of correspondence between the two plots is approximate rather than precise. In view of this, sound spectrograms were also made utilising a 78 Hz bandwidth filtering option in order to reveal harmonic trajectories. Figure 6 below shows in both cases a pattern of rising - falling harmonics across the transient occasioned by deceleration of the tape into stop followed by acceleration into restart.

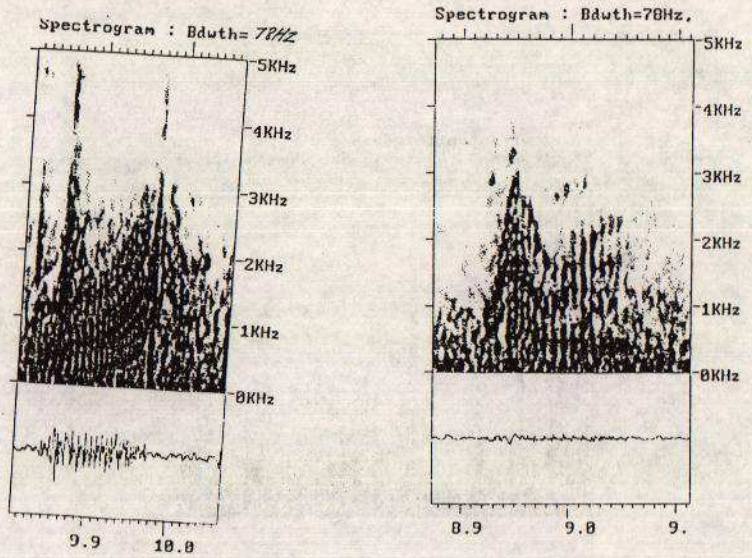

Figure 6: Spectrograms of experimental (left) and evidential (right) 'vox' arrests and restarts

Once it was established that the recording had been stopped any discrepancies in timing with the Officer's notes became irrelevant.

(c) General integrity and originality

The finding of switching transients which cannot be reproduced by the machine on which it is claimed the recording was made inevitably gives cause for concern. Their

presence raises the question of whether more than one tape recorder has been involved in its production and whether or not it is an edited copy. Where transients from a 'foreign' machine are accompanied by abrupt and unexpected changes in the energy-frequency characteristics of background noise or of the speech signal itself, suspicions may be confirmed. Figure 7 is a spectrogram showing a change in speech signal bandwidth across a switching transient in a very crudely edited recording. Speech from the same person spans the point of edit.

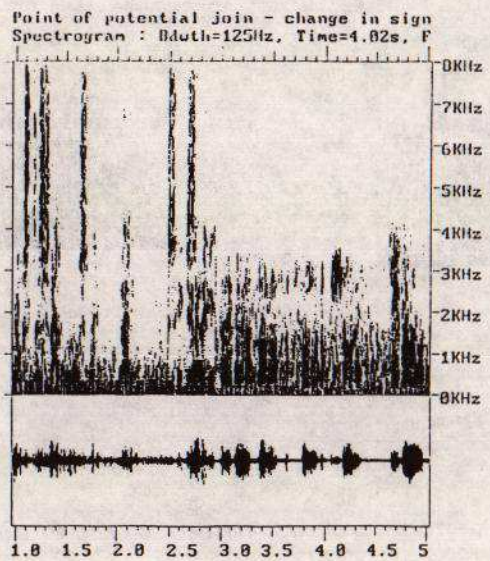

Figure 7: Spectrogram showing changed bandwidth of speech signal across point of edit

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There is in English law a 'best evidence' rule which determines that tape recordings submitted in evidence must be originals, or, if they are not originals, then the party submitting them must be able to explain why the originals are not available to the court and guarantee that the copies are continuous and unaltered. Transient analysis may be deployed in examining recordings for evidence of copying.

Case Study

A blackmail victim was receiving a large number of menacing telephone calls from the perpetrator. His brother installed a tape recorder on the line and a series of calls was recorded across five compact audio cassette tapes. The police brought charges against a suspect and produced in evidence tapes handed to them by the brother of the victim. These were submitted for examination by the defence, as the suspect claimed that the recordings were a 'mosaic' of utterances edited together from a variety of unrelated sources. No evidence of discontinuity was found in any of the recordings. However, it became clear from an examination of the switch off transients at the end of the series of recordings on each tape that the police had been given copies not originals.

Each tape showed one of two patterns. Firstly, two tapes in the series (numbers 1 and 5) had two sets of record and erase head switch off transients, the first set having been transferred from the original tape and the second having resulted from the switching off of the machine on which the copies were made.

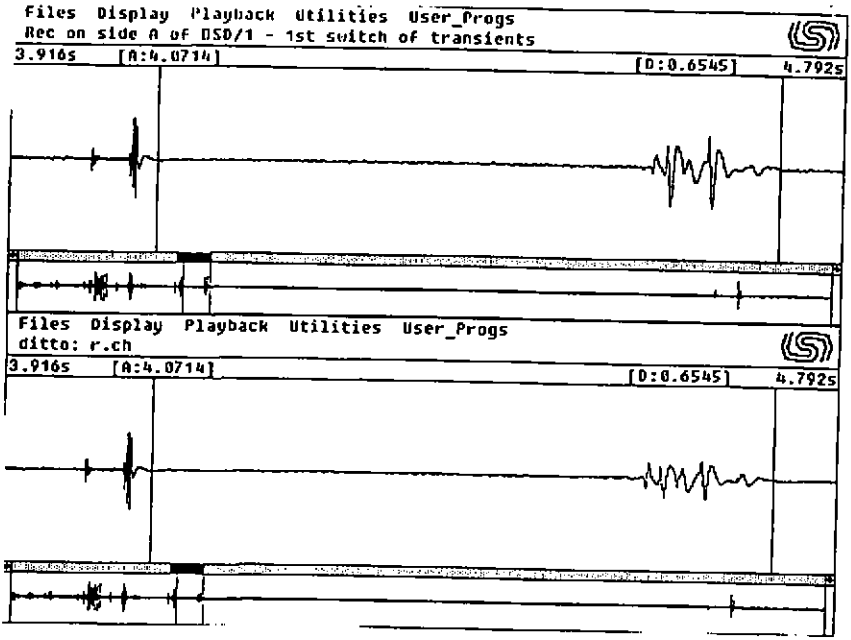

Figure 8: First set of record and erase head switch off transients - copied from original tape

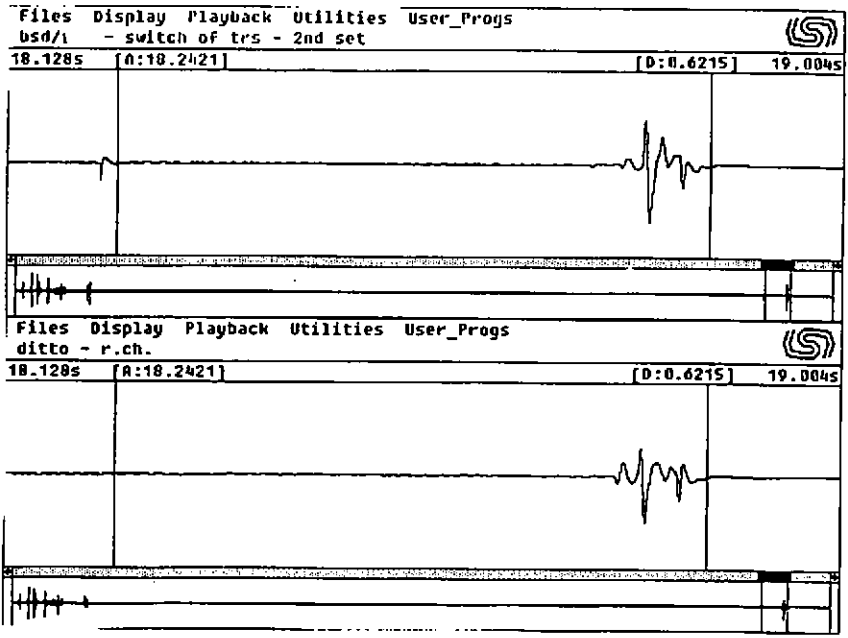

Figure 9: Second set of record and erase head switch off transients - produced by machine used for copying

The three other tapes (numbers 2, 3 and 4) only showed one set of transients. However, in each case it was the set which appeared second on tapes 1 and 5: One could therefore surmise that these were also copies, the copying machine having been switched off some time before the end of the original recording.

The Crown was unable to produce the original recordings or locate the person who had made the copies. The defence was therefore set to argue that, in the circumstances, the recordings should be ruled inadmissible as evidence - when the defendant changed his plea to one of guilty.

3. CONCLUSIONS

In this paper I have been concerned to show how examinations of switching transients may be used to good effect in undertaking authenticity examinations of audio recordings. However, three factors must be borne in mind. Firstly, the types of transient examinations set out here are elementary in nature. More detailed acoustic analyses of such transient features as the energy-frequency characteristics of erase head noise and the spacing of the erase head and record head switch offs coupled with physical examinations of the tape are often necessary in resolving the types of legal disputes discussed. Secondly, as indicated earlier, switching transient examinations must be considered in the context of a wider battery of tests, only some of which are acoustic in nature. A basic introduction to some of the procedures is provided by Hollien **[6]**. Finally, the new generation of computer-based digital editing technology has made it possible to achieve relatively 'seamless' edits. It is therefore becoming imminent that new techniques of authentication are developed to address the possibility of digital editing. At this point in time, it would be misleading to describe the state of development associated with these techniques as anything more than 'embryonic'.

4. REFERENCES

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