A Bio-electromagnetic Device of Unusual Properties

by Alexander MacRae

ABSTRACT

The paper concerns a device that produces anomalous speech products similar in many respects to the Electronic Voice Phenomenon, (although it was not intended to function in this way), and its purpose is to describe the characteristic behaviour of this device and its products, and to consider possible alternative explanations. For example, could what is happening simply be a case of stray pick-up - either electromagnetic or acoustic? To answer that question, experiments were carried out using a 'Virtual Faraday Cage and Anechoic Chamber'. Another possible alternative is considered - do these voices only exist in the mind - (like an "audible Roscharch Test" interpretation). An objective process for assessing the most probable meaning of the information contained in an anomalous speech product is outlined, with the conclusions that those products are real and betray characteristics of communication.

Bio-electromagnetism may be defined as the field of study relating to electrical, magnetic or electromagnetic phenomena, occurring within, or affecting, or being affected by biological systems.
It is a subject dealing with rather specialised technical matters (see Iyengar 1996, Malmivuo et al 1995), whose frequently initialised terms will be spelt out as necessary in the course of describing the evolution of one particular bio-electromagnetic device.

The latter proved to be capable of producing frequent and replicable phenomena inexplicable within the context of normal physical laws. It was not designed nor intended to operate in this way, and the utmost scepticism was levelled at the early results, but hundreds of experiments, by both the author and others, have shown that in fact the *normal* mode of operation of this device could only be described as "*paranormal*".

Having entered the territory of bio-electromagnetics, my original intention was to investigate mediumship capabilities with respect to the electronic voice phenomenon (EVP). But after trying for 2 years to get EVP based on white noise, no results had accrued in which one could place any confidence. So, having expertise in the fields of speech and hearing, it was decided instead to try to analyse the samples of EVP that were available, ignoring the significance of what was presumed to be said, and confining the analysis to what was objective and measurable. It was a "hard science" approach in a very grey area.

A tape of EVP utterances was obtained, (SPR 2002), other EVP utterances were available on the record accompanying Raudive's book Breakthrough, (Colin Smythe 1971), and samples were obtained from the UK investigators, Richard Sheargold, G.G. Bonner and Peter Jones B.Sc. The samples were then examined for common characteristics, when the main common feature observed was brevity. This had been noted earlier by Ellis who remarked that most utterances were less than two seconds in duration. (Ellis, 1978, p 64.)

Using an oscilloscope, the actual durations of the samples were measured and a histogram of the type shown in Fig. 1 was plotted. Here, there are 10 divisions, (horizontal axis), each of which covers a band of durations - for example, if an utterance has a duration between 0 and 0.55 seconds then it belongs in the first band. The height of the bars shows the number of utterances whose durations fall into each band. Thus, as we can see, the most common durations were around 1.8 seconds.

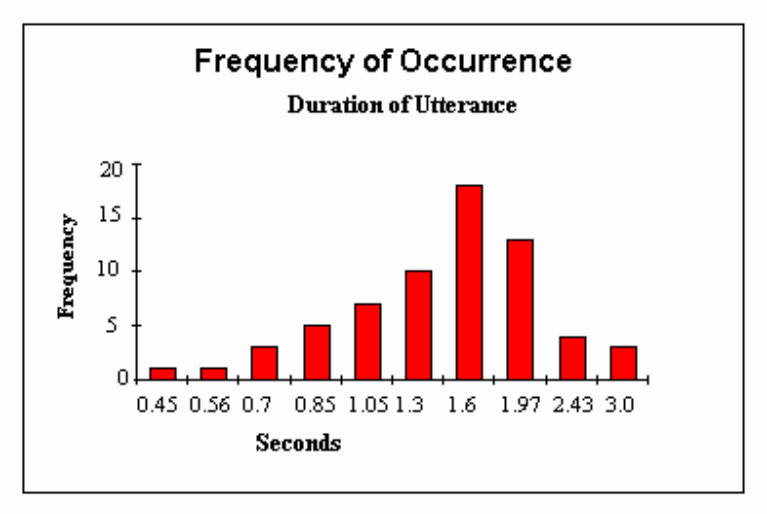


Figure 1

Just looking at the histogram one can see that it has a pattern, with a shape indicating that as a graph it would show a Bell curve, representing a normal or Gaussian - slightly squashed here because of the quasi-logarithmic time groupings. Thus those utterances were not random events, whose duration would be as likely to be 47 seconds as 1.8 seconds. However, because a phenomenon follows a rule does not mean that it is in any way paranorma*l*. Heights in a human population vary in a similar fashion.

There could be many reasons for the distribution - and these were considered each in turn: distance between bias and record heads, automatic gain control in a radio (where used), automatic gain control in a cassette recorder (where incorporated), and so on. Some of the potential explanations were more plausible than others, but there was none that could cover *all* cases. And now that – by using a PC – one can create an audio file directly with the information held in digital form in RAM, finding an all-encompassing purely physical explanation is even less likely.

Another factor, corroborating the finding that EVP utterances were of short duration, was the observation that where utterances were longer, it was found that as a general rule they would actually be composed of two utterances of normal length, one following the other. An example (a real example): 'The answer to the riddle,' (pause) 'Lies in the middle', where the inter-segment interval is measurably longer than the inter-word interval, while another characteristic noted in passing was that a short utterance seemed to be louder than a longer one. This seems to suggest an energy limitation. For example, with one lung-full of air we can shout out a brief utterance loudly. But on that one lung-full, to complete a long sentence would require conserving energy by speaking quietly. This is an interesting area which should be addressed in depth - there may be some key to the whole thing here. But whatever the reason for the brevity of utterances there appeared to be no immediate physical cause. One thing was clear; though, EVP was *real* - whatever it was, and however it came about.

The received wisdom in the 1970s was that EVP was produced by people with mediumistic abilities. (Ellis, 1978, p.50), so the challenge was to assess in what way mediums were different. Now in the late fifties the author had written to Professor Leonid Vasiliev, then investigating telepathy at the Institute of Radio-communication at the University of Leningrad, suggesting that he try timed "pulsed telepathy" experiments with the subject connected to a psycho-galvanometer to monitor Electrodermal Activity (EDA). (Vasiliev, 1963, FDA 1997). Apart from the suggestion that he also perform a Fourier Analysis on the results (to increase analytical sensitivity) this was very similar to the experiments carried out in the UK and USA. (Tart 1963, Radin et al 1995).
Thus, to test for mediumistic abilities, my first resort, (being cheap and easy to do), was to return to the idea of EDA monitoring.

The Alpha Interface System

A New Way of Indicating EDA Changes

As well as EDA in general there was a particular interest in the faster electrodermal responses, so the device was designed to handle both long-term (basal) responses - and also these more rapid reactions. To facilitate pattern recognition, it was decided to make the device simulate voiced (vowel) sounds. Through the use of voltage controlled oscillators, the standing (or basal) level of voltage due to EDA was made to control an oscillator in the 80 - 150Hz range - corresponding roughly to the basic voice pitch, or laryngeal pulse rate. The voltage controlled oscillator produced square waves, tones rich in harmonics like those generated by the vocal cords in the larynx.

In the normal course of events - if these had been indeed laryngeal pulses proceeding up into the vocal cavities, these vocal cavities would have been induced to resonate at frequencies or 'formants' depending on their size and shape – something that can be altered through the facial muscles, thereby producing different vowel sounds. (Crabbe 1965).

To reproduce these effects in electronic form, a second oscillator was controlled by the fast EDA changes, operating in the frequency range of around 700Hz to 5kHz. This oscillator simulated the sound of a vocal cavity resonating, its actual frequency depending on how big or fast the change in EDA being monitored
Finally, to make this sound voice-like, (in order for the hearing to exercise its primary function, that of recognising patterns), the 80 - 150Hz, and the 700Hz to 5 kHz signals were mixed together using what is called a multiplexer (Mux), to provide the final output (o/p), as in the basic block diagram of the original system shown in Fig. 2.

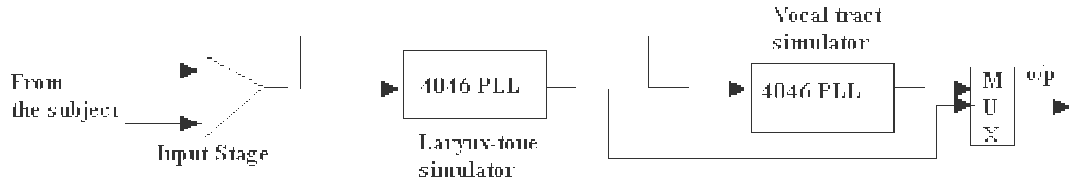


Figure 2

Here, the 4046PLLs are called phase locked loops. (Philips, 1995), while Fig. 3 shows the auto-balancing input stage in the original version of what has been named as the 'Alpha' system.

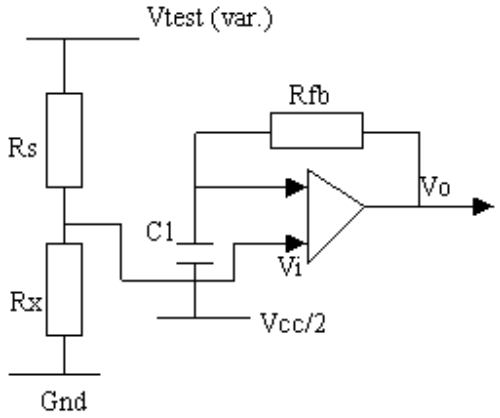


Figure 3

While testing the original prototype of the above, it was found that the higher harmonics of the square waves were prominent enough to be picked up by a radio receiver. This had the advantage of increasing the sensitivity by a factor of 100 or more through an effect called harmonic multiplication. And so, from now on, in view of the remarkable increase in sensitivity, a radio receiver was used to detect the sounds made – which were substantially the same as those produced directly by the oscillators.

During this development phase a commentary on what was being done at each stage of the experiments was spoken to a tape recorder which also recorded the audio output of the device. It was by this means that a small number of utterances which seemed to have the characteristics of EVP were heard. It was assumed that these were either ship-to-shore radio or CB radio in view of the frequent coarse language - in contrast to the somewhat inspirational utterances found in published examples of EVP.

However, when a change of location produced the same results, with no evidence of the language formalisms used in ship-to-shore or CB radio, there was still voice recognition and examples of short but intelligent conversation involving stimulus time and context appropriate responses. So it was decided to treat the results as EVP.

From the beginning it had been decided to ignore the *significance* of anything said, in order to avoid some of the facile interpretation-based "proofs" of EVP then common. At the same time, however, for the sake of completeness, and after the practice of the English researchers, attention was paid to recording the interpretation of everything heard, but concentrating on only one factor: *Increasing the probability of getting an utterance.* It was felt that only with a large number of results could an adequate study be carried out. The actual factor to be monitored would be p_u = number of utterances per unit time (in this case minutes).

Initially, the probability of getting an utterance was one utterance in 20 minutes, ($p_u = 0.05$), averaged. This was already approximately six times better than the average obtained by experienced experimenters at that time, according to Peter Jones, in correspondence. There is a report of Raudive typically receiving a hundred voices in a few minutes, but in view of known errors (Ellis 1978, pp.15, 61) this must be discounted somewhat; although it may support the case for a learning-type curve, or the operation of communications theory based on frequent usage.

As time progressed there were changes in the Alpha circuitry and operating methods, and both contributed to better probability figures. Experiments were aimed principally at improving the apparatus and operational methods rather than at any idea of eventual publication, although the experiments were as structured, rigorous, and consistent as possible.

One of the earliest changes in procedure was to try a recommendation of the English group - Sheargold, Bonner and Jones. This was to use what they called 'evocations', which meant addressing thin air orally ... as though someone was there to hear what one was saying - as is done in seances. This definitely increased the probability of getting a result, as in a number of experiments the total number of utterances when evocations were used was 31, but when evocations were not used only 18.

The implications of this are enormous. Here we have stimuli which, when present, raise the incidence of responses. If a stimulus causes a response - by whatever means - then a transfer of some kind has occurred. In fact, communication is occurring.

Note that the present author in this paper takes no position on the ultimate source(s) of the voices, or on the question of post-mortem survival. Note also that the findings have been obtained simply by counting numbers – without paying any attention to the *significance* or alleged meaning of utterances, or to the arbitrary selection of apparently appropriate time windows. This approach is recommended as a general procedure to others in similar experiments, such as the measurement of GSR responses when a person is being stared at by another. Forget significance, forget time windows – simply use probability as a guide. Explaining in acceptable terms what was going on is another business, which will be discussed later.

In a planned formal experiment it is proposed to use not just a speaker enunciating a standard set of evocations, but to repeat the experiment with those same evocations being played back by a tape-recorder, instead of being spoken 'live'.

Then to repeat the experiment but with the evocations being reduced to nonsense by being played backwards; then again once more using a synthesised voice "speaking" the evocations. The idea of using a synthesised voice is to remove any possible human influence on the sound and to use speaker independent standardised speech patterns. Finally, all the results will be compared with the results obtained without an evocation component. If resources are available it is hoped to use a larger sample of speakers, while development of an entirely electronic method of measuring the results has begun.

Results will indicate whether or not communication is taking place - solely by measurement, by counting - and without regard to whatever is said or its alleged meaning or significance.
If communication is in fact taking place then it may be indicated whether one needs a live communicant or not, or whether the words themselves constitute a sufficient evocation. In fact do the words have to mean something, or does the simple act of speaking suffice?
Returning now to earlier findings, another was that there were no specific best times or days for results. Yet if one kept to the same place and time for each session, then there seemed to be a gradual increase – similar to a learning effect. This increase continued over a few weeks, producing a form of sigmoid curve that became asymptotic to a final value. Although there was no way of assessing whether any *learning* as such was occurring, the defined conditions (same time, same place) seemed to lead to an improvement, and Fig. 4 shows the type of curve obtained. With utterances per minute set against time. The trial was repeated a year later after a period of absence from EVP - with similar results, but a sharper rise-time.

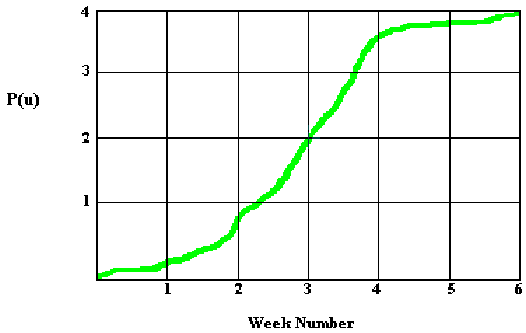


Figure 4

Another early advance came when it was decided to try to monitor electrical permittivity, the ability to store an electrical charge.
This was quite readily done by substituting the connections to the subject for the timing capacitor on one of the voltage-controlled oscillators. Prior to this, connection to the subject had been via two conductive Velcro pads – one on each thumb – but with this new configuration the connections were changed to 'hand-plates' - flat copper plates on which the palm or fingers could be placed, thus tapping the body's electrical capacitance (Huang et al 1997).
Now that frequent results were being obtained it was time to ask some awkward questions.
Question 1 - *was the author possessed of some special mediumistic skills that enabled this phenomenon to occur?*
At the outset, even before EVP was first produced, six Alpha units were made up and an advertisement placed in a suitable publication asking for volunteer testers. Of the replies, 12 were selected, and the units were sent out to each of the triallists in turn. All produced EVP results, some more, some less. And this was based on the use of Velcro pads and simple EDA monitoring.
Conclusion: *the operation of the device was independent of who used it.*

Question 2 - *the triallists were a selected group - perhaps all had mediumistic abilities?*
Certainly, at this stage the triallists had indeed been a selected group, casting some doubt on the above conclusion - but it was borne out on numerous later occasions, when un-selected people were all able to use the machine successfully. Conversely, those few persons who used the machine and claimed mediumistic abilities showed no exceptional results. In one amusing instance, a physicist new to the Alpha was getting immediate and spectacular results - until he asked how to use the device!
Conclusion: *if usage of the machine is dependent on inherent mediumistic ability then this must be common throughout the population. Or, alternatively, mediumistic ability is not a significant factor.*

Question 3: *how do we know that the supposed EVP is not just random pick-up of radio broadcasts or neighbouring or street noises?*
This would not have been asked by anyone with sufficient knowledge of the system used, who had an in-depth knowledge of telecommunications, acoustics and the hearing mechanism; nor by anyone who knew of the uniformity of the phenomenon as compared with a series of random events, and understood the implications thereof.

Nevertheless, one must address one's critics, actual or potential. Ideally, one would have gained access to a Faraday Cage (Ellis 1978, pp.32-33; Tart 1988, pp.129-146) to prove the above point, but efforts in that regard proved fruitless. It was therefore decided to adopt a *virtual* 'Faraday Cage plus anechoic chamber' approach. It would be a case of getting the effect of having a soundproof room inside an electrically screened room, without having either.

If the EVP utterances were all in *English* in the UK - which critics would say were really just snatches of conversation or radio broadcasts picked up by accident - then, following the same logic, the 'accidental' pick- up in S should all be in *Spanish.* The Alpha equipment and an operator were therefore relocated to S to carry out trials. In the chosen location a survey showed that the only non-Spanish radio stations which could be heard were two medium wave French stations that came on at night when the lowering of the E-layer facilitated reception. And a visiting Englishman was able to pick up the BBC on long wave at night by going down to the harbour in his car and connecting the car radio aerial to the half-mile long metal railing that ran around the harbour wall. There was no pick-up of noises from the street or neighbours. So the location of the experiments therefore was effectively like that of a soundproof enclosure inside a screened room - as far as *English* was concerned.

The experiments were tried for a week until 100 utterances of acceptable audibility were received. According to the stray pick-up theory these should have been in Spanish, but all were in English. Another Alpha user, a bi-lingual Briton, a native English speaker who lived in Paris, reported the same thing. Of 300 results he obtained, only three were possibly in French, the rest were in English. A third Alpha user, a South African fluent in both Afrikaans and English, found that about half the utterances were in English and half in Afrikaans.

Conclusion: *That the anomalous speech products were not being conveyed by acoustic or em radiation. Also, it would seem that the language of the utterances related to the native language(s) of the operator. A point remarked upon by Ellis. (Ellis, 1978, p.139).*

To be fair, though, it must be said that two words completely unknown to the author at the time, ('Grotin', and 'Cladach'), were recorded on other, later occasions. But the overall picture was that the language tracked the operator. Did this indicate, perhaps, that EVP was based on what one *heard?* Was EVP based on one's *perception* of the pattern of sound, just one possible interpretation like a response to a Roscharch inkblot test? That would be a natural enough response to a barely discernible pattern, but in that case was EVP in whole or in part, just a mental conjuration?

A factor pointing in this direction was the common practice of playing an utterance three or four times to facilitate interpretation, with short intervals between each play. This did not, as some have alleged, induce a state of hypnosis, but it was a good aid to comprehension. What seemed to happen was that a process of successive improvements in comprehension occurred, using what seemed to be a sort of short-term scratch-pad memory of limited extent. One had to play each successive utterance within a relatively short period of the ending of the previous play for the effect to occur, and on the basis of these results it was estimated that the "length" of the scratchpad memory would be of the order of three seconds. Possibly this could also explain the typical shortness of EVP utterances. So is there a "scratchpad memory" somewhere in the brain? Apparently yes, in the form of a 'phonological loop'. (Gupta et al 1993).

Question 4: *how do we know that EVP isn't just in the mind - especially as there seems to have been, historically, some difficulty in getting agreement on the meaning of what was heard?*

There are two methods of tackling this, one of which is to use a listening panel. This method is mentioned in the literature (Ellis, 1978, p.86); and the Appendix contains an intriguing report by Prof. Charl Vorster of the South African Medical University who used a Mk. 3 Alpha to get his results. But without the resources of a university or a large group from which to draw suitable subjects, this approach is difficult to manage properly, and so one based on purely physical evidence was sought.

PHYSICAL EVIDENCE

Funds did not run to a storage oscilloscope, but fortunately sound editing software such as Sound Forge and Cool Edit (which were reasonably priced and could be run on a PC) - became available.

Each phoneme - each "basic bit" of a word - has a particular and unique sound pattern. This is how we follow what someone is saying, by automatically recognising these patterns within words. With a microphone, such sound patterns are converted to electrical format, and can thus be stored in a PC's memory.

On playback, using a visual editor such as Cool Edit, the patterns can then be examined carefully. It is even possible for the long-experienced and adept to tell what is being said just by looking at the pattern on the screen. Indeed, one can now find software that can look at a visual waveform pattern and then synthesise this into a spoken result, and this is being looked into as a possible way of objectively interpreting reasonably good EVP. But even without such a rare skill, one can examine the pattern of each phoneme, looking at it as a waveform, as a spectral plot, and as a sonogram. And then, by comparison with a library of synthesised (WinSpeech□, 2002), or public domain recordings of phonemes (IPA, 2002), or with someone mimicking what it is believed was said, one can tell whether the EVP phoneme is a good match or not.

It is not however, an easy option. Speech pitch varies according to sex, age, accent, from one person to another - even within one person according to the emotions and stress they feel at the time. One is dealing with meaningful inexactitudes a lot of the time. What one is looking for are *features* - patterns - rather than absolute values. And even the patterns may have somewhat 'fuzzy' definitions. The brain, evidently, can deal with such fuzziness and come up with a result in which one demonstrably has a high degree of confidence. But by persevering, in a standardised and objective way, we can find a best match to what was actually being said, although this technique can obviously only apply to known languages.

Conclusion: *EVP is a real acoustic phenomenon and conforms within its own limitations to normal speech as far as phoneme matching goes. Through the examination of waveforms, spectral plots and sonograms it can be shown to have an objective and verifiable existence. It is not a mental conjuration.*

It had been the received wisdom for a long time that EVP was the result of rudimentary noises, white noise, or sideband splash, etc, being *transformed* into actual utterances. (Ellis, 1978, p.61). So, is there something in the lab transforming raw acoustic energy into speech – some PK effect, perhaps?

The Alpha system in its Mk 3 and Mk 3.5 versions initially did not use a radio - instead there was simply a direct connection from the section containing the PLL devices (see Fig. 2) to a circuit performing what is called synchronous detection. Basically, this meant that only those signals that were in-step with the "PLLs" would be converted into audible sound. However, there were complaints about the quality of the sound - "it was not as good as when a radio was used" – so the radio configuration was restored, and that has been the situation until the present (Fig. 5).

Now, there are various methods that are used to produce EVP, or are claimed to produce it; but it is the author's belief that if we are to solve the mysteries associated with this phenomenon, one has to stay focused. Concentrate on solving the mysteries using the Alpha and then broaden the findings to include other methods.

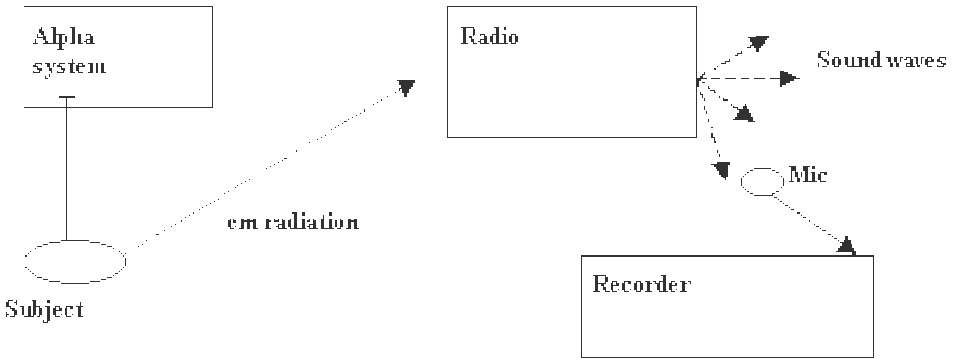


Figure 5

In the configuration shown in Fig. 5, with the use of a radio restored by request, the subject is connected to the Alpha, and, through the means previously mentioned (EDA) causes changes in the frequency of the Alpha output. At the same time, the subject acts as an antenna for the Alpha, enabling the radio to pick up what is being radiated. What is picked up is converted into audio in the radio and the resultant sounds from the loudspeaker are picked up by a microphone and recorded.

On the basis of early tests (and received wisdom already mentioned) it was believed that what the radio did was produce acoustic energy approximating to the final utterance, energy then *transformed* into the final utterance by means unknown. In other words it was thought that what the Alpha did was produce rough sounds which were then moulded into clear speech.

A Test Regarding The Acoustic Origin Of Alpha EVP

In a recent experiment the signal applied to the loudspeaker was compared with the signal produced by the microphone "listening" to that loudspeaker. The vowel 'O' was extracted and is shown as the upper waveform in Fig. 6.

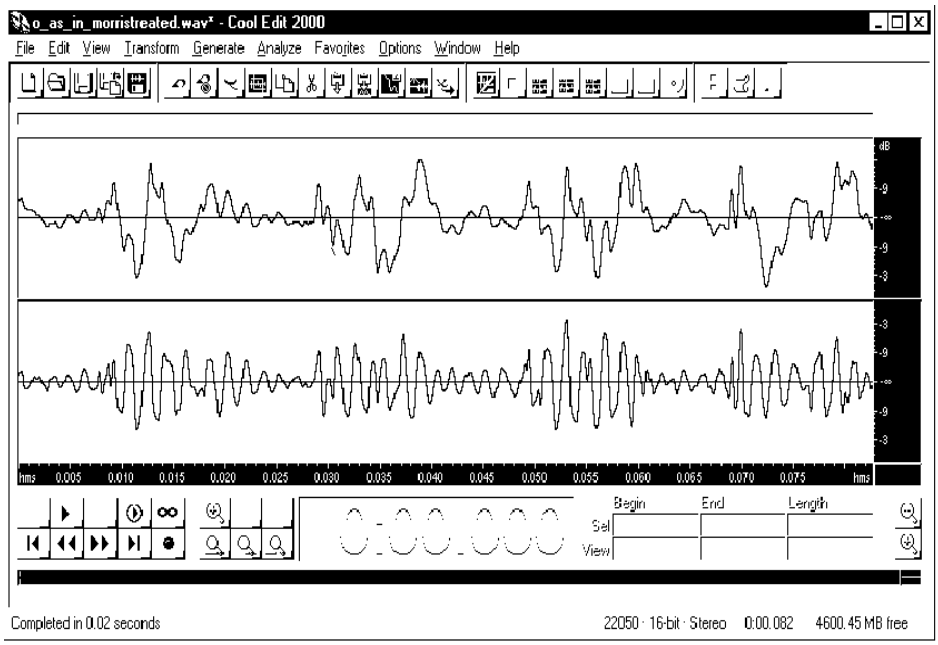


Figure 6

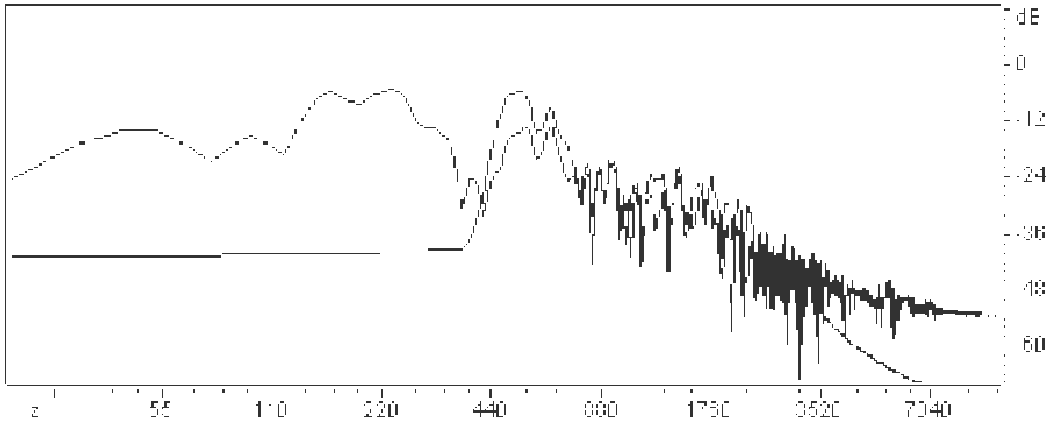


Figure 7

As can be seen, the microphone signal (lower trace) is much more complex, whereas the loudspeaker signal looks rather like the pulses that stimulate resonant vocal cavities into producing vowel sounds. But when we look at the spectral plot, (Fig.7), we can see that actually the upper and lower traces take the same route over much of the spectrum. And this is significant.

The problem seems to be that in the upper (loudspeaker) trace the lower frequency components are too large, (up by 24 dB or more), causing masking, and loss of intelligibility. Accordingly, the upper trace in Fig.6 was filtered and then normalised to give equal peak amplitudes, and as we can see from Fig.8 the traces are practically identical.

As the radio was not set so as to enhance bass, we must assume that this is the natural form of the signal produced by the Alpha in its current stage of development, and that the excessive lower frequencies shown as present at the loudspeaker were effectively removed during acoustic transmission by the limited frequency response of the microphone used, which favoured middle frequencies, being principally designed to handle speech. However, it does indicate the hazards of using 'lo-fi' equipment in experiments of this nature – although in this case the results were to my advantage.

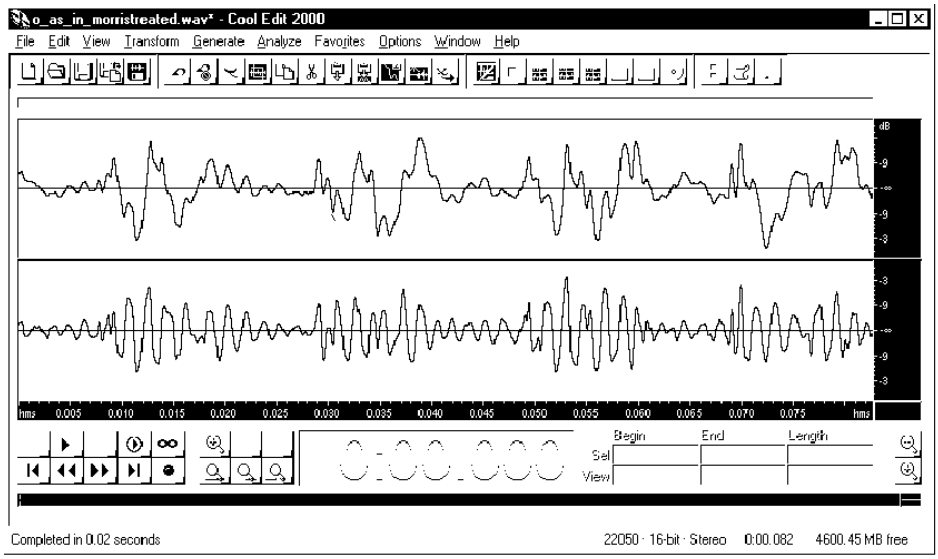
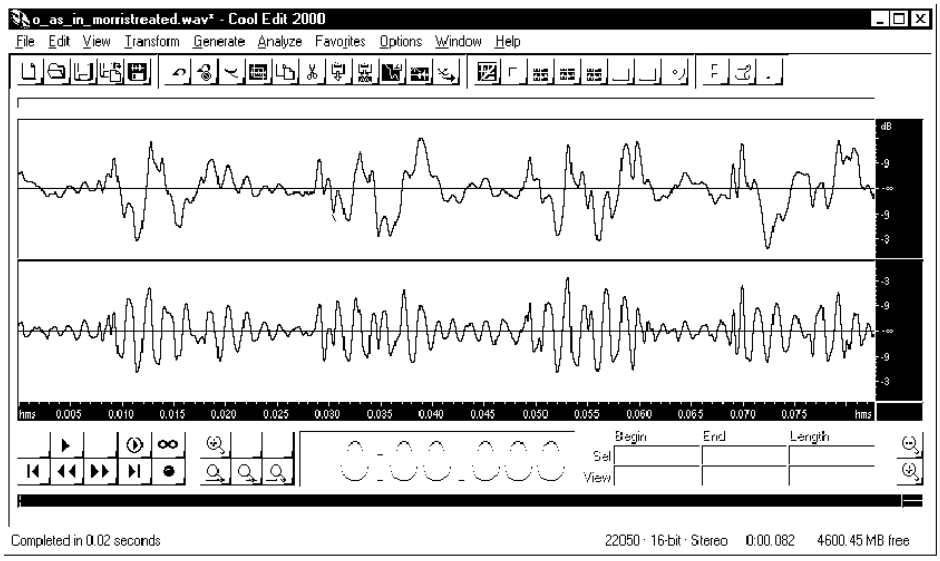


Figure 8

What this means is that in the case of the Alpha at least, the information is already there in the electromagneticradiation.

But just to check that we are not fooling ourselves, let us compare the microphone-derived phoneme with a spoken phoneme.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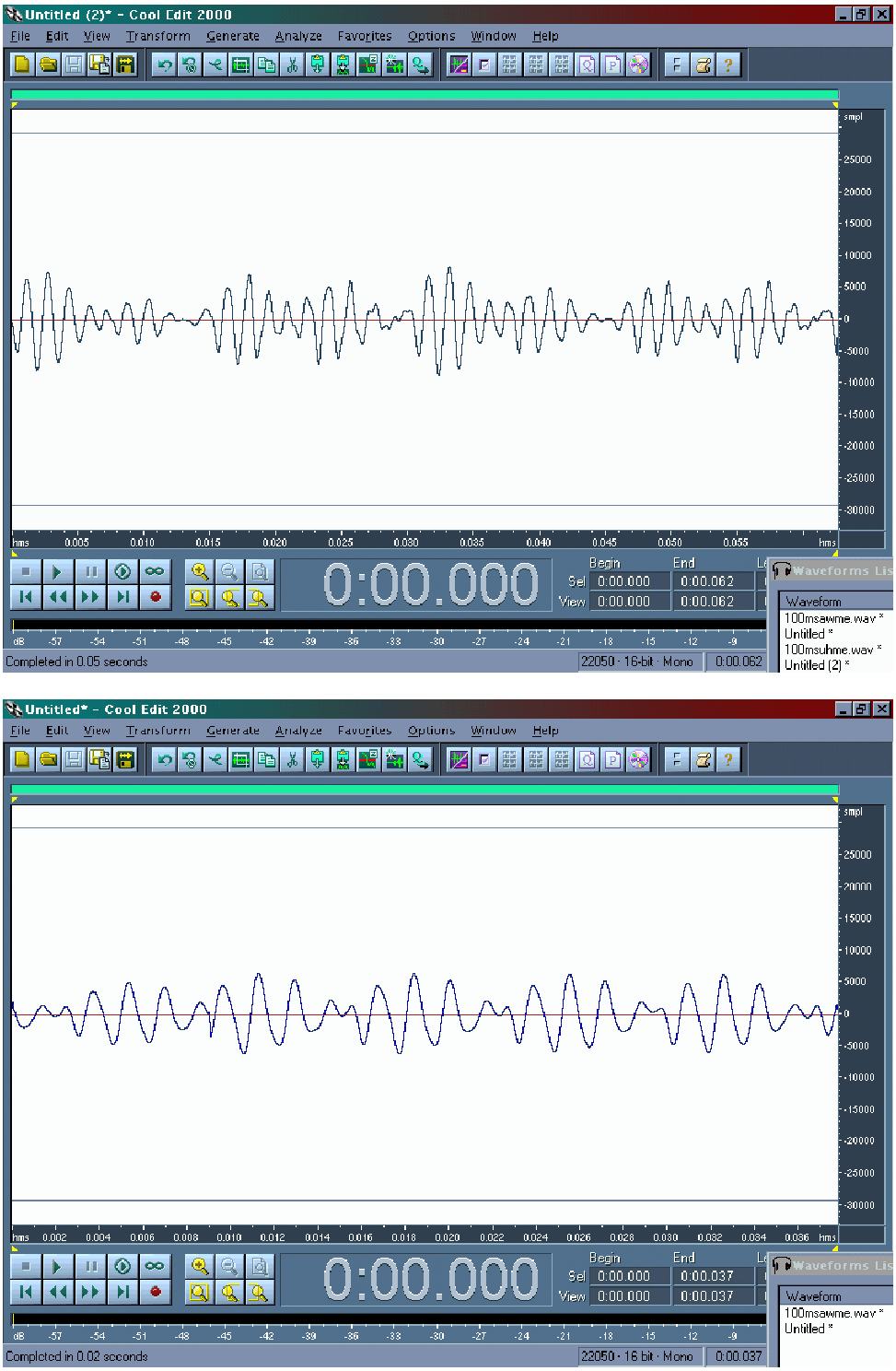

Figure 9

Here, the top trace is the EVP 'O' phoneme from the microphone, the word being heard as 'Morris'. The second trace is the best match and is the spoken phoneme 'U' as in mutter, while the spoken phoneme 'O' as in Morris is the bottom trace. So it would seem that we have a word that is heard as 'Morris', but which is spoken with an accent which tends to move the 'o' vowel closer to a 'u' vowel. Thus the actual EVP word (neglecting its meaning attribute) would be 'Murris'.

We are generally unmindful of the fact that even in normal speech the word that we hear is often based on sound that is only an approximation. The 'o' phoneme as in 'pod' is (in the American usage, which you can download from IPA, 2002), a phoneme that sounds to Europeans more like a long 'a' as in the middle vowel in 'banana'. And one must allow a similar latitude when evaluating EVP, indeed, even more so - for few (if any) of the utterances display evidence of elocution lessons! Instead, one may observe poor grammar, regional accents, symptoms of age, quavering and apparent distress. As mentioned, one is generally dealing with meaningful inexactitudes.

Given a certain degree of approximation, the physical evidence of the waveforms and spectra for EVP as produced by the Alpha is substantially the same as that for normal speech. In the author's estimation, after many hundreds of experiments, it is not possible to provide a complete and satisfactory explanation of how EVP works, the intention here having been simply to introduce the reader to the main characteristics of the Alpha device.

Conclusion: *The Alpha produces EVP utterances through the electromagnetic spectrum, not by the presence of some invisible entity in the room transforming local acoustic energy.*

APPENDIX

A listening exercise conducted by Charl Vorster

Selection and Training

The research was conducted in an informal manner and use was made of colleagues and friends who showed an interest in the nature of the research. Being able to reach consensus on the content of the recording was deemed the highest level of achievement.

A preliminary screening process showed up an apparent tone deafness (at certain frequencies) in respect of one of the volunteers, which left a panel of three. Within the rather limited time available, these three subjects were systematically trained to fine tune their hearing by exposing them, firstly, to a variety of recorded interviews of two people in normal conversation. These recordings varied in terms of the nature of the voices, tempo of speech and language (English and Afrikaans). The quality of the recordings was progressively downgraded in respect of clarity, volume and interfering sounds. As the quality worsened, the panel indicated differences in respect of what they heard and understood. Some time was spent on reaching reasonable levels of consensus, before the quality was further downgraded.

The panel eventually listened to recordings of conversations by radio (CB) and the same procedure was followed. A significant correlation, as could be expected, was found between the degree of consensus between the panel members and the quality of the recordings listened to: The poorer the quality the less the degree of consensus. Eventually the panel moved on to listen to actual EVP recordings.

Procedure

Each member of the panel, independently, listened to the particular recording in his own time and with as much repetition as he wanted. The member then wrote down what he could decipher and graded the individual words in a sentence in respect of their clarity to him. The three sentences produced by the members of the panel were then typed in three vertical columns next to each other and the identical words underlined and counted to determine the percentage of agreement that existed between the members. As could be expected, a higher degree of consensus was achieved when the words were either graded as I or 2, than with 4 or 5. (See Table 1). In the final instance the members discussed their perceived sentences to see whether they could find more common ground on what they had heard. Thus a final, combined, sentence was formulated additionally.

1	Absolute Clarity
2	Fairly Clear
3	Slightly Unclear
4	Unclear
5	Very Unclear.

Table 1

Although relatively high percentages of consensus were sometimes reached in respect of single words, the general level of consensus concerning a full sentence, or sentences, varied between 10% and 75%, due to recording characteristics such as a high tempo of utterances, low volumes and the presence of overlapping noise. In more than one instance the panel, to their surprise, also discovered that recordings were actually changing as they were being listened to!

In Table 2 is an example (original recording in Afrikaans) of our best results obtained. An English translation is provided in Table 3.

Subject A	**Subject B**	**Subject C**
jy, jy redigeer.(2)	jy reguleer (2)	jy regeer (3)
dis bedrieery. (i)	dis bedrieery (i)	daar's bedneery (i)
hierdie bande (i)	hierdie bande (i)	hierdie hande (1)
moet(l)	moet(l)	moet(l)
behoue bly.(4)	behoue . . . (4)	(5)
dinknet(2)	inknet(3)	blinknet(2)
aanaldie(i)	aanaldie(l)	aanaldie(i)
vreugde.(l)	vreugde(l)	vreugde(2)

Table 2

English Translation

Subject A	**Subject B**	**Subject C**
you edit	you regulate	you rule
its fraudulent	its fraudulent	there's fraud
these tapes	these tapes	these hands
must	Must	must
be preserved	... preserved	.....
just think	just ink	just shine
of all the	of all the	of all the
joy	Joy	joy

Table 3

The panel was in agreement that they were listening to a male voice with a tenor quality. The first column showed the highest number of words, namely 15, and was thus used as the basis for the calculation of accuracy. A total of nine words were identical in all three columns, giving an over all percentage of *56.25%* for accuracy. If the first two listeners (i.e. the first two columns) are compared, a total of 12 words appeared to be identical, giving an accuracy percentage of 75%.

Within the context in which the message was received, the content seemed surprisingly meaningful. At the time of the above recording the researcher was in the habit of dubbing only the most audible recordings received onto a storage tape and deleting the rest. Within this context the received message seemingly quite clearly said: "You edit. This is fraudulent. These tapes must be preserved. Just think of all the joy." This could make perfect sense within the context mentioned.

As mentioned above, the panel consisted of colleagues who volunteered their assistance amidst heavy professional commitments and only a minimum of time was spent in training them in respect of listening skills. It is hypothesised that a panel of three to five members with sufficient training could be able to maintain relatively high levels of accuracy in listening to recorded messages, especially if the quality of the latter could also be improved to provide relatively clear, audible reproductions with minimum levels of masking or interfering noise. Ideal candidates for a listening panel would seemingly be individuals with prior exposure to radio communications (e.g. ham operators) and a fluency in the language in which the research is being undertaken.

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