the penultimate line of the first column (after the word "But . . . "). On page 80, first column, line 27 should read" . . . . . don't have perfect enough transducers to do the . . . ." On page 81, first column, line 5 should read " . . . . did produce essentially coherent . . . . ". Also on page 81 "Magnapan" should be spelt "Magnepan", reference 13 should be deleted, and there should be a note stating that the article was based on a paper presented to the Boston Audio Society (USA) in July 1976. Apologies for these errors.

LONG DISTANCE U.H.F. RECEPTION

I AM one of a number of enthusiasts, both professional and unconnected with radio communication, who are experimenting with consistent long distance u.h.f. reception particularly of television signals and using very high gain receiving systems. We have experimented with arrays of high gain Yagi aerials and have now begun to investigate the characteristics of parabolic reflectors. Unfortunately we are finding it almost impossible to find practical down-to-earth articles on the subject in print and wonder if any of your many thousands of readers around the globe would like to exchange details of experiments, among which are optimum size of dish, optimum focus to diameter ratio, height above ground level, optimum low noise amplifier configuration, etc.

So far with a temporary 25ft diameter dish a few feet above ground we have confirmed the precise focusing effect and very high gain of a parabola but it has been a matter of many hours of tedious experiment. Also tried was diversity at separated sites of reception over a 180 mile path, with the result that the further the separation of aerials the better, at least up to 3 miles so far. Along the coast where we have been experimenting the signal levels of the distant 500kW television transmitter in Cornwall vary tremendously depending on the tropospheric propagation, ranging from a couple of microvolts to tens of millivolts over even short periods of reception, i.e. 24 hours. We would like to hear of similar attempts at long distance reception of u.h.f. signals on the basis of exchange of ideas and results. Someone somewhere must be spending countless hours experimenting on a similar basis.

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USEFUL CALCULATOR TRICKS

BEING an owner of the CBM 4190 electronic calculator, I have discovered a couple of useful tricks which this excellent machine will do and which are not mentioned in the rather brief CBM handbook.

1. The "integration" function can be used not only to find the area *under* a curve, but also the area *inside* a loop, i.e. a cyclic integral can be evaluated.

This is done simply by entering in the *x* and *y* co-ordinates of a number of points round the loop, in the same way as in the area-under-the-curve method. However, the first point entered must be entered again at the end of the sequence, to complete the loop. The first point can be anywhere on the loop, and the points can be entered either clockwise or anti-clockwise.

This facility will be found extremely useful for calculating the "work done" in pressure-volume diagrams, and for finding the hysteresis loss from B-H and similar curves.

2. A conversion from decimal to degrees-minutes-seconds format is normally performed by entering the decimal number and using F,8. However, even when many numbers need to be converted, the F,8 only needs to be used once, at the beginning of the sequence. This is done as follows: Enter the first number and press F,8. This converts the first number. Now simply enter the other numbers, pressing only the = key after each one.

The only apparent problems with this method are that numbers like .25 must be entered as 0.25, and negative numbers are not permissible at all.

It is worth mentioning that converting 34-24-36 (degrees-minutes-seconds format) into degrees Centigrade gives an interesting answer of the order of 10[illegible]. This is of course completely useless for most applications.

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AUDIBLE AMPLIFIER DISTORTION

PETER BAXANDALL and Peter Walker clearly set much store by transfer distortion assessments of an amplifier's audible performance. ("Audible amplifier distortion is not a mystery", November 1977 issue). But, despite the subjective experiments Mr Baxandall has devised to ascertain, to his satisfaction, that interaction of sub-threshold distortion with signal does not take place as a result of the complex (and poorly-understood) process of the auditory response, the validity of this technique (in terms of *listening* to the difference signal as opposed to measuring it) rests firmly on the assumption that such interaction does not occur.

The study of binaural beats has clearly shown, however, that this can indeed take place. The threshold of hearing is a psychological rather than physical phenomenon: binaural beat research has indicated that our brains can detect and process sounds down to at least 20dB below threshold. Consequently we have to be careful to define precisely what we mean by "hearing" a sound. It's altogether safer, perhaps, to talk in terms of perceiving sounds when we are conscious of them (which is the meaning in which we normally use "hearing") and monitoring sounds (for want of a better term) when we detect and process them at levels below threshold.

Of course, the fact that we do "monitor" sound and that under certain circumstances it can interact with super-threshold sounds such that their perception is altered does not necessarily mean that sub-threshold distortion in audio amplifiers produces audible degradation of music signals. What it does do, however, is throw a somewhat jaundiced light on Mr Baxandall's conclusion that the "true significance" of amplifiers producing total silence in transfer distortion tests is, "quite inescapably, that such amplifiers are subjectively perfect." You may well believe this to be so, Mr Baxandall, and time may prove you correct but, as yet, the response to your flat assertions can only be — "non sequitur."

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Reference

1. Oster, G. "Auditory Beats in the Brain," *Scientific American*, 229, No. 4 (October 1973), pp 94-102. Offprint No. 1282.

AUDIO is a prolific breeder of folklore, so a reminder of the need for rationalism is always timely; we stand on the slippery slope of superstition once we abandon our belief that audio phenomena are matters of physics, not magic. Mr Peter Baxandall (November 1977, p.63) provides just such a necessary reminder, but unfortunately throws out the baby with the bath water.

The wires going to an electric bell are part of an oscillation-determining circuit involving milli-microsecond transients (they cause radio interference) and it is by no means obviously absurd to suppose that the high-frequency impedence of the wires could affect the action of the bell to an extent that can be heard. On the contrary, it needs calculation based on the mechanisms supposed to be acting before it can be concluded whether or not a significant effect is likely; and even then the conclusion is vulnerable to whether all relevant mechanisms have been correctly identified.

Moreover in audio we are largely deprived of quantitative limits until we have a comprehensive theory of how the ear and brain act. If such a theory exists I have yet to hear of it, and the history of audio might be described as a century of underestimating the sensitivity of perception by the human ear.

It is of course tautologically correct that if linearity and frequency response are the sole significant properties, then all amplifiers will sound alike if they have identical frequency response and are tested under conditions which include "avoidance of overloading". The difficulty is to define, without logical circularity, when all forms of "overload" (i.e. non-linearity) have been avoided, as they were not in early class-B transistor amplifiers, or more recent slew-rate limited ones, that passed all the distortion tests that were initially thought sufficient. In each case our ears told us what we only afterwards learnt how to measure.

Leinonen and Otala[1] have reported measurements on a power amplifier which passed with flying colours total harmonic distortion, SMPTE and CCIF intermodulation and dynamic intermodulation tests but showed unexpectedly large frequency-transference of energy in the noise-intermodulation test. This finding may be connected with the opinion of some listeners, accused in consequence of claiming to have "golden ears", that the subjective performance of this amplifier leaves something to be desired.

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Reference

1. Leinonen, E., and Otala, M., "Correlations of Audio Distortion", AES 56th Convention, preprint 1223 (G-1), March 1-4, 1977; Fig. 9.