

**University of Greenwich**

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**From the Selected Works of Edmund Wigan**

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## Report of a Discussion on "The measurement of sound levels"

Edmund Ramsay Wigan, *BBC Research Department*  
R Auger, *Pye Records*

## Report of a Discussion on "The Measurement of Sound Levels"

E. R. Wigan\* and R. Auger†

At a meeting held on 9th December 1964, Mr. E. R. Wigan and Mr. R. Auger discussed the relative merits of the Peak Programme Meter and the Volume Indicator or VU meter.

Mr. Wigan introduced a film made to demonstrate the difference between the PPM and the VU meter. He pointed out that the film was designed to examine purely technical considerations and was not intended, originally, for showing to a learned society or in public.

The film first illustrated how the VU meter scale (linear in volts) cramped the user's ability to control low-level signals; because the scale gave some 30 per cent of its length to signals of greater volume than the nominal datum point (0dB), signals weaker than -15dB had to be registered out of the initial 10 per cent of the scale length. In contrast, the B.B.C. Peak Programme Meter had a uniformly readable decibel scale of range 20dB or more. The response of both meters to pulses of pure tone of varying duration was then compared.

Both meters read identically when pulses of tone, or of equal amplitude, had long persistence (e.g. greater than 150 milliseconds) but when the width of the tone pulse was reduced the VU meter reading fell almost in proportion to the pulse width. This demonstrated the failure of the VU meter to register short term peaks in signal amplitude. The danger of relying upon the VU meter for the control of transmitter or recording modulation was shown using more realistic programme material. To bring the point home, the meter response to speech and music signals was shown on the film. In this sequence, all signal peaks were artificially limited to a nearly constant voltage; the VU deflections were seen to reflect the time width rather than the peak value of the signals and showed no correlation with the virtually constant Peak Programme Meter deflections.

The film then showed the same programme material presented to the two meters with no signal-

peak limitation; this again showed that the meter indications did not correspond. It was further shown that a very rough correspondence could be *imposed* but only by increasing the level of the input to the VU meter; even then the correction in input level was shown to vary with programme content—for instance, male and female voices require different corrections ranging over several decibels. A similar discrepancy was found with musical items; the film established that no specific correction could be relied upon to make the VU readings correspond with the actual peak transmitter or recording modulation.

Mr. Auger, in commenting on the film, pointed out that from a design engineer's point of view, the VU meter in general left much to be desired but that it was very useful for certain types of work. He felt that the VU meter shown in the film had too much overshoot and was too quick. Possibly some of the differences noted in the film arose from this point. For example, the difference in the readings between the man's voice and the woman's voice might have been because the man was a few inches farther from the microphone than the woman. Thus, with the woman, more transients would be present and he felt that the VU meter used was over-sensitive to them. Again the light orchestra gave some deflection whereas a jazz band gave only a small deflection, probably because the jazz track was heavily compressed with a dynamic range of 2dB.

Mr. Auger then discussed his use of VU meters in the manufacture of records and compared and contrasted this to the use of PPM meters in the B.B.C.

A film was then shown illustrating the type of work carried out by Mr. Auger in making popular records.

Mr. Auger thanked I.T.N. and Mr. Norman King for their co-operation in making the demonstration film. He pointed out that the meter in the film corresponded more nearly to the excursions on the B.B.C. programme meter. The average modulation was high and the use of the VU meter assisted in maintaining this. He then pointed out that the fact

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†Pye Records Ltd.

that the VU meter was cheap and easy to install, led to its widespread adoption in the United States.

The meeting was then opened for a general discussion.

### Discussion

*Mr. Rennie of R.C.A.* At the present time there are a number of programmes being made in England for export abroad and programmes made abroad for England. I have heard people say that they use a particular sort of volume indicating device because the people for whom they make the programmes use the same device and they, therefore, get a similar loudness pattern. What is the feeling of the lecturers on the international aspect and to what extent are the two meters used?

*Mr. Auger.* I am not qualified to talk on the film side but in the disc industry the programmes are exported to other countries in the form of tape. Local people cut their own discs and market them. The disc industry almost universally uses the VU meter because, unfortunately for Britain, the Ampex machine has flooded the international market. The only machines competing with Ampex are the Japanese who also use VU meters. The VU meter is, therefore, international because the machines from Hollywood have VU meters.

*Mr. Davies.* From the broadcasting aspect the VU meter is universally accepted in the U.S.A. It is a rather rare animal in Europe, where there are several different designs of programme meter in use but they are all peak meters and all rather similar. France is the only country I can remember which uses the VU meter in broadcasting. In the discussions recently taking place to get some standardisation in the monitoring of sound lines used for Eurovision programmes, they are now adopting the standard meter which is the one Mr. Wigan has been showing.

When I first saw the B.B.C. film I was not convinced and did some experiments and made a demonstration tape. We did not get exactly the same results as Mr. Wigan but some of our tests were more dramatic. You press one note on a Hammond organ, which has a very low harmonic content, and you get a certain reading. You press four notes instead of one and the reading is 4dB lower on the VU than on the PPM. Furthermore, we went through our effects records to find suitable music and we found one piece where the correction factor varies through a period of 2 ft from 2-10dB. I concluded that the VU meter could be misleading. I am involved in the problems of disc recording and I have seen Mr. Auger at work. For the noise he produces he needs something which has a more open scale than the VU meter, but I would suggest that the VU

meter had a lot of overshoot on it on certain notes. You need a PPM with the same time constant coming up but a shorter time constant falling down. I have often used the E.M.I. PPM circuit which they use on their tape recorders. This is made with the endeavour to have the same rise and fall time as the VU meter. I found it was certainly not much better than the VU meter, it was spoilt by having too rapid a fall time. If one put in a larger capacitor one immediately made it line up closer to a PPM but where it fell down was where it had a half-wave rectifier. This makes it cheaper but if you do not have full-wave you must have full-wave rectification.

I think, Mr. Auger, what you have asked for is a PPM with a different scale that enables you to see the last dB clearly, a PPM which uses a VU scale with the performance of the PPM.

*Mr. Auger.* I was going to say that in all these meters, they are only tools in the hands of the programme engineers doing the job and it is possible to make a hit record using the PPM and it is just as easy to use VU meters. Probably I would like a third meter. The VU meter is a good tool used properly.

*Mr. D. Shorter.* What is wanted is a scale shape like the VU on the PPM. You have to take away the logarithmic device. This has been done in the B.B.C. when we experimented with a linear PPM. The object was to use it at a transmitter in conjunction with a modulation monitor which was linear. If you want the scale opening out at the top you take away the logarithmic device and keep the other features.

*Mr. Auger.* If it could be marketed and made standard it would have a wide acceptance.

*Mr. Wigan.* After asking the same sort of question to various people, I found that everyone agreed that the VU meter is an anomaly which has persisted.

*Mr. Crabbe.* I would like to raise a psychological point. We deplore the fact that we do not obtain the enormous dynamic range that we get from the concert hall. Would not the VU meter with the spread out top part of the scale be a disadvantage? If disc companies are all using VU meters they are looking at the top of the range; the bottom end tends to get lost. That could be one reason why we don't get the full dynamic range.

*Mr. Auger.* I have been up against this problem for some years, recording classical music for disc where we try to do the job as honestly as possible. We set the balance by placing microphones, not turning knobs, and the recording level is set to accommodate the loudest peak. We want to be careful not to overload the tape. We find good quality professional tape can accommodate the full range of the symphony orchestra. If we make sure the top peak does not go into distortion, then we tend to leave the pianissimos alone. The critical thing is this

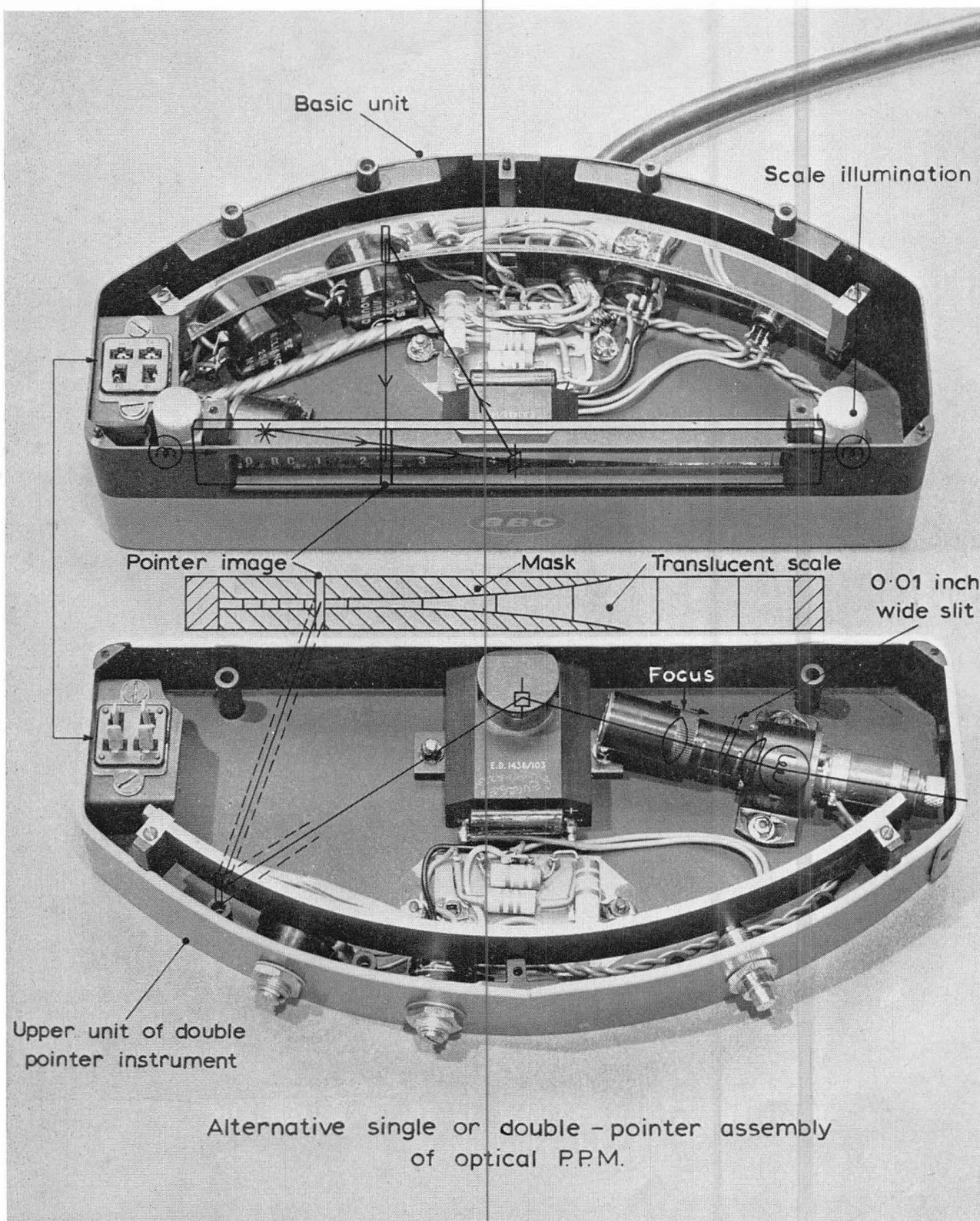


Fig. 1

apparent dynamic range which has something to do with the studio acoustics. In a studio which is reverberant, the dynamic range appears to be much less. The Albert Hall sounds like open air. Kingsway Hall is superlative for making records.

*Mr. Wigan.* The B.B.C. does not fiddle with the control but you have to deal with the emergency operation. The general effect of the control instructions is that they are largely settled by the maximum the system will handle. We can handle 100 per cent modulation at the transmitter but the transmitter won't stand any more. The signal is not controlled in general. If you want an effective crescendo you can pull the level down below before, but it is not artificially varied in general. There is one more point. When the film was being processed it was reported that there was a 6dB rise of signal from beginning to end. Well, there wasn't on the PPM, but I was speaking faster towards the end which is why. The VU information was ignored when the film was made. No correction was made but the VU meter read 6dB higher at the end.

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After Mr. Wigan's film and Mr. Auger's response had been discussed by the Meeting, Mr. Wigan delivered a lecture supported by a short film and slides. Some of these are illustrated. In the lecture the statistical parameters of the programme signal were discussed, i.e. the "bunching" of high and low signal voltages. The lecturer pointed out that the bunching tended to occur in terms, not of the signal voltage but its *logarithm*, i.e. in decibels relative to an arbitrary maximum. A short film demonstrated the bunching; in this an optical version of the PPM pointer-instrument was used; see Fig. 1.

Fig. 1 showed an experimental form of the instrument. The second optical "pointer" could be made red by inserting a colour-filter, while the oblique projection allowed the red and white pointers to pass "through" each other when required. The flat scale was, for the most part, linear (4dB per division) and was visible 10 or 20 feet away as the light from all parts of the scale was directed to the eye of any centrally-placed observer; this allowed simple torch bulbs to be used as projection-lamps which had a long life. Behind the flat scale, a mask cut down the height of the bar of light (acting as a pointer) when the signal level was low and increased it dramatically when the deflection approached danger-level (a reading of 6dB).

The short film demonstrated that in didactic speech (as in a News Reading) the bunching of voltage-peaks was limited within a narrow range in comparison with the wide range in a dramatic passage of Offenbach.

The histograms (Fig. 2 taken with permission from B.B.C. Monograph-16) of a variety of programme items were then discussed. The "bi-modal", that is, double-humped histogram shape associated with drama, whether in speech or music, was pointed out together with the similarities of speech histogram, no matter what the country of origin.

The lecturer remarked that the histogram (Fig. 3) of many days of programme reflected the sum total of programme content which varied from day to day; in the case illustrated the high right-hand peak corresponded to the strong predominance of light music in programmes even in 1961—since then there had been a further increase. It was remarked that the average peak-reading was very nearly 4 divisions on the PPM-scale.

In winding up his remarks Mr. Wigan thanked the B.B.C. Research Department for the slides and the loan of his first film; I.T.N. was to be thanked for making the other film.

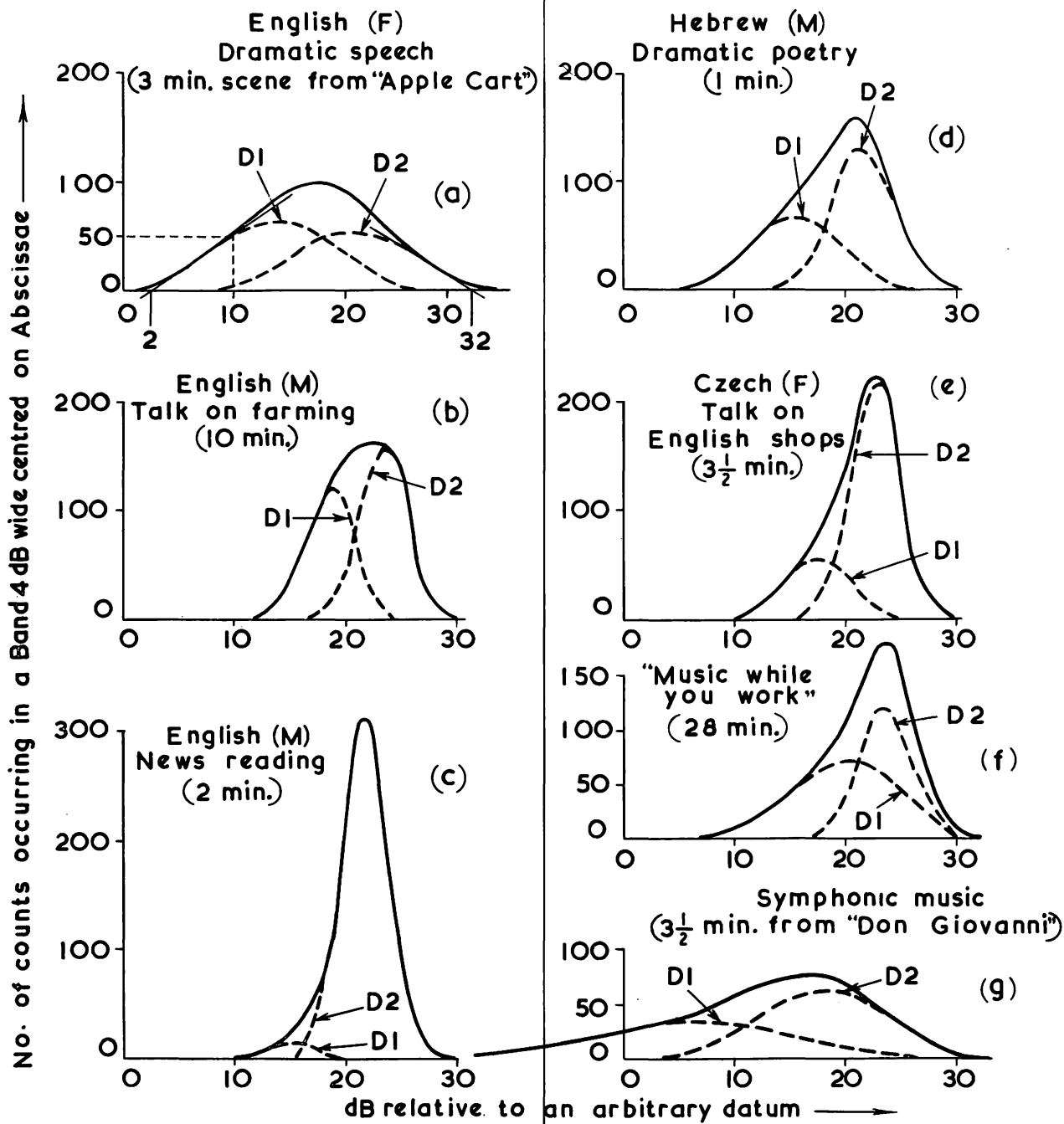
### Discussion

*Mr. Auger.* I found the last part most interesting because I have some practical television experience and the most remarkable thing is the fantastic drop of 5dB average over 10 minutes. This accounts for a lot of strange things. It is remarkable that an engineer can get used to two people talking over 10 minutes and over the next 10 minutes he can allow the average level to go down. The sound side of television is fascinating and very controversial. If this had been a commercial television play and the first 15 minutes was between two people like this and there had been a commercial break at the bottom of the 10dB drop, viewers would have been blown out of their seats. Commercials are so heavily compressed. I do not know if Mr. Wigan has any comments on the sound levels in television.

*Mr. Wigan.* Such changes are very rare but it shows why a "remembrancer", as I call it, might be useful. Mr. Auger suggested that because of a change during the programme the commercials might sound loud but they would be dealt with in the normal way. There would not be any change in output level to the listener. One B.B.C. engineer who watched the transmitted programme observed a tremendous change in level but he was not aware of it falling (even though it did).

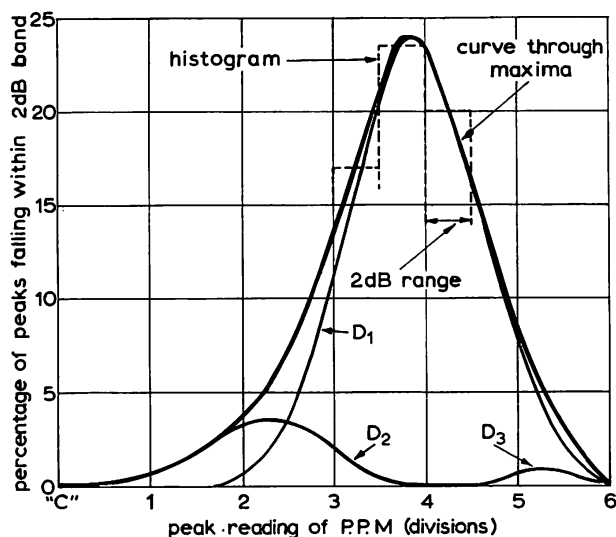
*Mr. Rowe.* I would like to ask Mr. Wigan if the PPM in the B.B.C. is used for setting the balance of sound in a dramatic programme or is it done by the artists?

*Mr. Wigan.* The balance is done by ear. The PPM is not used to measure balance; it is not for helping aural judgement on balance at all. It is only a voltmeter to tell the man controlling the programme how the transmitter is being beaten about. It is not



Typical histograms  
 ("Normalised" to 400 counts so that all have an equal area)  
 (F) = Female voice (M) = Male voice

Fig. 2



Breakdown of light programme histogram as recorded in Sept. 1961  
(233,000 peak readings  
8,260 minutes of programme  
one weekend and 3-4 weekdays)

Fig. 3

for making judgements of loudness or balancing. I have demonstrated that neither showed loudness of sounds.

*Mr. Rowe.* Why then do you have a logarithmic scale?

*Mr. Wigan.* This is shown by histograms—analysis of speech and programme, etc. In dramatic speech it has the same sort of spread and drop of level. It is the same shape because the noise is logarithmic. It also gives a wider range which the VU meter cannot.

*Mr. Dawney.* My interest in the VU and PPM is from the equipment design point of view. I have heard different views, particularly on such a device as a magnetic recorder. When should one monitor the level? Should it be after or before equalisation? This applies particularly to magnetic recording. Some say one should monitor the head driving current, others say you should monitor the normal line input. Histograms would throw some light on this I suppose.

*Mr. Auger.* On the E.M.I. TR90 you can meter after the recording equaliser circuit and it is useful for people lining up the machine but I cannot see how you can use it for monitoring programme material.

*Mr. Houlgate.* There are two different sorts of tape recorders. One records full level at 1,000 cycles and 10,000 cycles and the other at 1,000 cycles only. You can try to apply full modulation at 10,000 cycles

but you don't, in fact, reach it. The output goes down. The only tape recorder here is where it will receive modulation properly and you have to monitor the same as a transmitter, in other words the input voltage. On Mr. Auger's disc recording, they are clever because you can overload three different parameters—acceleration, velocity or amplitude. The recording people divide modulation so that three PPM's are combined into one indicator to show whether anything was being overloaded and which end was, in fact, being overloaded. Is this not done here?

*Mr. Auger.* There is nothing here in my experience. R.C.A. are doing it in the States. They keep it to themselves and there are not many people here who understand it. Decca, their agents in this country, press their records from American cut masters. There is a problem with levels. Last year I did an enquiry into our disc cutting system. The engineers had got 2dB extra onto a 7" record and what was peak level zero VU in 1958 now I found they could squeeze an average +2dB. So we recalibrated our disc cutting and went back to zero and now we are back at +2dB again and we will have to start all over again. The limiting factor is the pick-up on the cheaper machines. We can cut discs at +2dB but we know the cheaper record players would not track it. They have cheap pick-up arms. Even on some better machines the head assembly overloads so we have all kinds of problems. At the moment we are ahead of reproducing equipment.

The vote of thanks was proposed by Mr. H. Davies.

#### References

1. B.B.C. Engineering Monograph No. 16—March 1958: "Analysis and Measurement of Programme Levels": Shorter, Mason and Wigan.
2. E.B.O. Review No. 79—June 1963—Part A (Technical): "The Relative Merits of the VU Meter and Peak Programme Meter in the Regulation of A.F. Signals in Broadcasting" E. R. Wigan.

## New Chairman for the Television Society

The Council of The Television Society is pleased to announce that Mr. Thomas Kilvington, B.Sc.(Eng.), M.I.E.E., has been elected Chairman of Council for the year 1965-66.

Mr. Kilvington is Head of Radio Planning and Provision (Internal) Branch of the Post Office and is a Fellow of The Society.