IN CONFIDENCE

This is a draft of the judgment to be handed down on Friday 23rd September at 10.30 am. It is confidential to Counsel and Solicitors, but the substance may be communicated to clients not more than 3 before the giving of judgment. The official version of the judgment will be available from the shorthand writers once it has been approved by the judge.

The court is likely to wish to hand down its judgment in an approved final form. Counsel should therefore submit any list of typing corrections and other obvious errors in writing (Nil returns are required) to Mrs Alison Blunsden so that changes can be incorporated, if the judge accepts them, in the handed down judgment.

Case No: 3YU02780

IN THE COUNTY COURT AT LIVERPOOL

Date: 01/09/2016

Before :

HIS HONOUR JUDGE GRAHAM WOOD QC

- -

Between :

MARK ROSS **Claimant**

- and –

LYJON CO. LIMITED **Defendant**

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- -

Mr M Redfern QC and Mr P. Grundy (instructed by **Roberts Jackson, solicitors**) for the **Claimant**

Mr D. Platt QC and Mr P. Morton (instructed by **Clyde & Co, solicitors**) for the **Defendant**

Hearing dates: 22nd – 25th August 2016

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APPROVED JUDGMENT

If this draft Judgment has been emailed to you it is to be treated as 'read-only'. You should send any suggested amendments as a separate Word document.

His Honour Judge Graham Wood QC:

Introduction

1. Mr Mark Ross has pursued a claim for occupational deafness against his three former employers. Two of those employers have compromised their involvement in the claim. One of them, the present Second Defendant, (to whom I shall refer mainly in this judgment as the Defendant) admits that during the currency of his employment the Claimant was exposed to harmful levels of noise, and that they were in breach of duty. They do not accept, however, that his hearing sustained any damage as a result of such noise exposure, and thus medical causation is disputed.

2. Put simply, it is said that notwithstanding a compelling audiogram taken in 2011 prior to the commencement of any proceedings which was characteristic of noise induced hearing loss (NIHL) for an averagely susceptible individual, and thus supportive, the existence of a subsequently discovered audiogram demonstrating near normal hearing thresholds from 1993 shortly after his employment with the Defendant terminated, indicates that no damage was sustained during the relevant period of employment (1979 to 1992). The Claimant challenges such an assertion on the basis either that such an audiogram was unreliable, or alternatively, and more expansively, damage to hearing can be latent, that is demonstrating no immediate effects or disability.

3. It is this issue which this Court has been called upon to determine, principally on the basis of expert evidence from two highly eminent audiologists, both leaders in their field, together with the original medical expert, an experienced otolaryngologist. Evidence was heard over three days, with submissions following on the fourth, after which I reserved judgment because of the complexities of the arguments, and the need to reflect upon numerous research articles and the extracts relied upon by the parties.

Background and non-expert evidence

4. There are three relevant periods of employment in which the three original defendants have been implicated. However, there is no clear start and stop dates for any of these, and information has been derived from the tax records. The picture which has emerged, and which is not, it would seem, under challenge, is that between 1974 and 1998 for various periods, Mr Ross was employed by the First Defendant. Five of these years took place after

1993. For most of the 1980s the Claimant was employed by the Second Defendant, and thus working in the period before the 1993 audiogram. The most recent employment involved the Third Defendant between 1998 and 2003.

5. Mr Ross is an electrician by trade. Throughout his working life he has been engaged in contract work in heavy industrial settings at factories in the North West of England. In some of this work factories were being decommissioned, and there were intensive periods in which he was involved in and around heavy machinery which was still being operated, including generators, turbines, boilers and compressors. He was also involved in operating some tools himself, but where construction work was taking place, he was working in an environment where typical construction machinery was operated, including jackhammers, JCBs, air drills etc. There is no doubt that in all his employments there was the *potential* for significant amounts of noise exposure.

6. Mr Ross believes that his working day was 12 hours, and that he would frequently work seven days per week as required in his contracts. However, this would appear to be partially contradicted by accounts which he made to a health screening medical expert in 1987 (bundle page 238) and a history of moderately heavy drinking over several days per week provided to a similar doctor in 1993 (at the time of the relevant first audiogram).

7. The Claimant accepted that he had a poor memory of some of the finer details in relation to his earlier employments. One example of this was the use of hearing protection. Whilst his statement gave the impression that it was only the employment with the Third Defendant in which adequate ear protection was provided, in the course of his evidence it emerged that occasionally with the Defendant effective helmets with built-in ear defenders could be acquired, although this was not very often. Otherwise, the protection could not be used with the helmets because the ears were not adequately covered.

8. In his statement, the Claimant portrayed his employment with the First and the Second Defendant as being by far the noisiest, although a history appears to have been acquired by Mr Zeitoun, the otolaryngologist who provided an expert report, that when working with the Third Defendant it was necessary to shout to communicate, a feature not present with the First or Second Defendants.

9. The Claimant's description of the onset of his hearing difficulty, is, as one often sees in these cases, associated with the perception of others that he was requiring the television louder, or would not always respond when spoken to. He was unaware of any problem himself until recently, save for his tinnitus, which was in the form of a high-pitched whine first noticed a number of years ago in quiet conditions. However, on returning home from work for up to 2 hours he would experience a ringing in his ears. His tinnitus is now permanent and annoying.

10. When the Claimant was first referred to a doctor in anticipation of this claim, a number of medical records were obtained. In addition to the 1993 audiogram, which appears to have been commissioned as part of BUPA screening at the time that the Claimant was re-engaged by the First Defendant, there was a record of further screening in 1987, which included audiometry. This revealed that the Claimant had satisfactory hearing, although the thresholds were not provided. Thus in the middle of his employment with the Defendant there was no evidence of any contemporaneous hearing loss.

Expert Evidence

11. Mr Zeitoun provided his medico-legal report as long ago as February 2011. It was based upon audiometry by a colleague which demonstrated by air conduction readings an average hearing loss in the right ear of 21.7 dB, and in the left ear of 23.3 dB. The binaural hearing loss was 22 dB applying the appropriate calculation, and allowing for an age correction on ISO 7029 (the Lutman and Davies correction) which amounted to 11.8 dB, the residual loss was 10.2 dB.

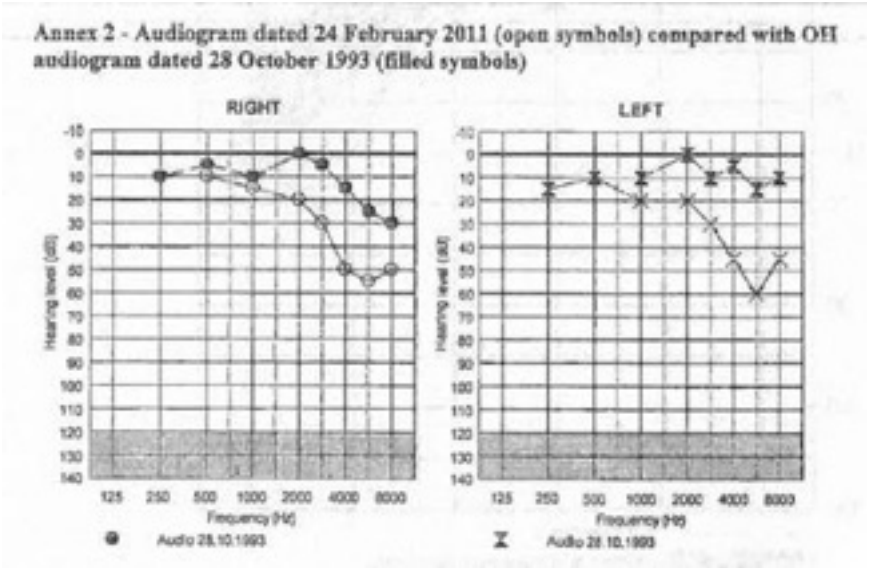
12. On the basis of a history of noise exposure over many years of employment with all three defendants, and excluding any other possible cause of his hearing loss from recreational pursuits or otherwise, Mr Zeitoun was satisfied from the audiometric presentation on the audiogram which showed bulges at the 4 kHz frequency on the right and 6 kHz on the left, that the proper diagnosis for the additional non-age element was one of NIHL. It is noted that in addition to a description of employment with the Third Defendant at paragraph 3.1.2 (see paragraph 8 above), he does not appear to have included the additional five or six years during which the Claimant worked for the First Defendant on a second occasion between 1992/3 and 1998.

13. The Claimant's expert had examined the GP records. Unfortunately, as he accepted in cross examination, he had not been able to see the audiogram from 1993. This was either because it had not been included, or it had been overlooked by him. He had not retained the bundle of records with which he had been supplied in 2011.

14. He was first questioned about the 1993 audiogram in a letter from the Defendant's solicitor dated 11th June 2014. In short he was asked to confirm that this audiogram did not demonstrate any evidence of hearing disability or features of NIHL, and that accordingly any loss suffered by the Claimant must have arisen subsequently. Mr Zeitoun responded to these questions on 20th June 2014 and accepted that this 1993 audiogram was what might have been expected for a 35-year-old male at the 50th percentile, that is of average susceptibility, and that it did not demonstrate any features of the effect of noise. Whilst he accepted that there could be subsequent deterioration in hearing once an individual had been removed from

a noisy environment, this could not explain the disparity with the subsequent audiogram, as any deterioration would not be significant.

15. Although the thresholds of the 1993 audiometry were not plotted on a diagram, the court was supplied with an audiogram depiction which does provide the relevant configuration, together with a comparison of the 1993 readings and the 2011 audiogram.



16. Mr Zeitoun's conclusion, upon which he was subsequently questioned by Mr Platt QC, was in relation to his reply number 7 (June 2014), where he stated "*if the audiogram of 1993 is a true representation of Mr Ross's hearing at the time, Mr Ross has not suffered noise induced hearing loss prior to that audiogram*". He confirmed this in a subsequent paragraph, and whilst qualifying his response by reference to the need to establish the accuracy of the audiometry in 1993, he repeated that "*if this matter is confirmed, then a diagnosis of noise induced hearing loss prior to 1993 cannot be made in Mr Ross's case*."

17. In cross-examination he explained that he was giving a conventional view about the way that hearing loss was diagnosed, but it did not follow in the absence of a hearing threshold loss in 1993, that there had been no damage from previous noise exposure because of the potential for implication of the cochlea.

18. He provided a far more detailed response in December 2015 to additional questions by the Claimant's solicitors who were preparing to deal with an application to strike out the claim against the Defendant on the basis of the earlier audiogram. Mr Zeitoun denied any prior discussion with the Claimant's solicitors before providing his replies. He maintained his concession that establishment of the accuracy of the 1993 audiogram would call into question a diagnosis of NIHL. However, if the 2011 audiogram was to be taken as accurate (and this was never doubted) and there had been a history of exposure to noise both before and after 1993, considerable uncertainty would be cast upon the accuracy of the 1993 audiogram. The

2011 audiogram would represent the cumulative effect of noise exposure over the entire working history. On the other hand, if there had been no exposure after 1993, but only exposure prior to 1993 it would be impossible to explain the audiometric presentation 18 years later as attributable to such earlier exposure. The large difference between those audiograms would be inconsistent with such a conclusion.

19. In answer to further questions from Mr Platt QC, in the 1993 audiogram, and in the light of the history given, Mr Zeitoun would have expected to see some evidence of a notch if there had been huge noise exposure as described by the Claimant. Again, this was on the assumption that the audiogram was accurate.

20. Mr Zeitoun's concern was to identify the noise imission level (NIL) with the assistance of acoustic engineering evidence. Unfortunately, that was never achieved. He had maintained his own assessment on the basis of the history given that it was likely to have been no less than 100 dB(A) as a NIL. In making his diagnosis in 2011 he had applied the Coles, Lutman and Buffin criteria from 2000.

21. Mr Zeitoun participated in joint discussions with Professor Lutman on the question of the audiogram accuracy in May of this year. He expressed "extreme caution" in relying on the 1993 audiogram, a position which he accepted under questioning had become stronger. However, whilst casting doubt on the accuracy, he did accept that in the 1993 audiogram if the Claimant had been in the 75th percentile, i.e. less susceptible to ageing deterioration than the average, some of the thresholds recorded would not have been largely different to those which might have been expected on the assumption that his total exposure dose (NIL) was 100 dB(A) apportioned as to 50% before 1993 and 50% after 1993.

22. He pointed out that in relatively young people the effect of noise exposure could be masked, where the hearing loss was small, particularly where the lower thresholds appeared elevated, perhaps inaccurately, disguising the effect of the notch or bulge. It was for this reason that very accurate audiometry was necessary in order to demonstrate diagnostic factors for noise exposure.

23. In terms of the efficacy of the BUPA test, Mr Zeitoun was concerned about the absence of a soundproof booth, which had been confirmed in correspondence to the Claimant's solicitors, and the possibility of ambient noise. However, he accepted under cross examination that these were factors which would have had the effect of making the hearing thresholds worse, rather than better, because the sounds tested would not have been heard. On the other hand, there were other features which would produce the opposite result, for instance visual signals from the operator who may be within the sight of the subject, an audible click from the testing machine if it had mechanical components, or the absence of any irregular intervals between the sounds tested. This would mean that the subject could predict when a sound was being emitted, which in turn would lead to a belief that he had

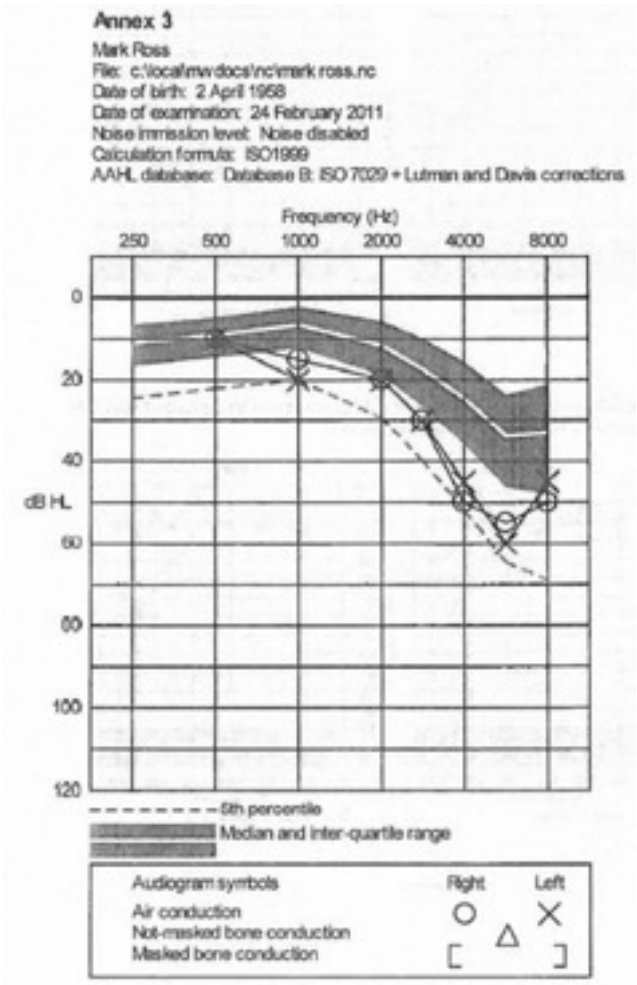
heard the noise when he had not. Mr Zeitoun emphasised the need to ensure that the test was compliant with the strictures of BSA (the British Society of Audiology) and he gave as an example the checklist which he provided to his own audiologist which had 11 separate components to be confirmed, before the test could be regarded as accurate. Whilst Mr Zeitoun stopped short of suggesting that the test was probably inaccurate, without the confirmation of the noise levels with the Claimant's prior employments (i.e. before 1993) it was his belief, that in the light of the history of noise exposure and the subsequent audiogram, it could not be relied upon.

24. He accepted that there had been a test in 1987 of the Claimant's hearing, which suggested that it was satisfactory.

25. Mr Zeitoun went on to agree with counsel that if the 1993 audiogram was assumed to be accurate, then the subsequent deterioration could probably only be explained by idiopathic factors (that is non-noise related) or a significant disparity between the noise exposure before and after 1993. Of course he was not questioned other than briefly in passing about the significance of cochlear damage which might not be picked up on the audiogram, as this was a matter subsequently dealt with between Professor Moore and Professor Lutman.

26. On being questioned about matters relevant to hearing disability and the threshold loss, Mr Zeitoun was asked a number of questions about his methodology in calculating the binaural hearing loss and making allowance for the age correction, or age associated hearing loss. (AAHL). He told the court that he had been following the traditional approach, which had emanated from the Black Book published in 1990 when determining disability, assuming that the Claimant was of average susceptibility to AAHL which put him at the 50th percentile. He acknowledged that the 2000 Coles Lutman Buffin Guidelines (which have been extracted and copied in the court bundle) did not directly address the question of compensation, although Professor Lutman appears to have utilised the figures derived from the notch calculation (page 4 in his report) which arrived at an average over 1, 2 and 3 kHz with a far less generous age correction (.5 dB). Further, he did not accept the yet still less generous approach which followed the more recently published guidelines in 2016 which had been adopted by Professor Lutman as an alternative when he arrived at a binaural loss of 2.7 dB, which Mr Zeitoun was prepared to accept amounted to a mild loss.

27. Whichever guidelines were used, he had taken the 50th percentile for the age associated element, which he believed was appropriate. In his view further support for this was derived from the 2000 guidelines, and in particular note 10, which stressed that occasionally it was appropriate to use .5 kHz and 8 kHz, instead of 1 kHz and 8 kHz as the anchor points, where the difference between the actual hearing threshold at 1 kHz and the expected threshold was 10 dB or more, albeit that related to diagnosis. The differences are depicted on the audiogram which was referred to in court where the shaded area sets out the expected hearing loss without noise exposure at different centiles.



28. In any event, the difference between his calculation, and that of Professor Lutman, depended upon whether or not Mr Ross was averagely susceptible (50th percentile) or more susceptible than average (25th percentile).

29. Professor Brian Moore, on behalf of the Claimant, dealt with what has been described as the "latency" issue, although he has shied away from adopting such a description in his evidence. He is currently Emeritus Professor of auditory perception in the Department of Experimental Psychology at Cambridge University, and his background was not in audiology as such, but psychology. His experience and expertise lies in the field of auditory perception. He has an impressive curriculum vitae and has published widely in his field. He describes the kind of work in which he has been involved as being multidisciplinary, incorporating elements of the physical sciences, as well as psychology and audiology. Professor Moore has recently started to give evidence in a medico-legal context, but only on behalf of claimants. His expertise was not called into question by the Defendant.

30. He provided his first report in June 2015, principally as a response to Professor Lutman, addressing the question as to whether or not in the light of a history of noise

exposure, with a supportive audiogram in 2011, a diagnosis of NIHL could still be made, notwithstanding the audiometric results from 1993.

31. Professor Moore had available the report of Mr Zeitoun, as well as that of Professor Lutman, and various responses to questions from the other experts, together with the statement of Mr Ross. When dealing with the history of noise exposure, he too appears to have missed out six years, between 1993 and 1998, in other words the second period of employment with the First Defendant, seemingly relying on the summary provided by Mr Zeitoun. It was not suggested that this was a material omission, because his assumption has been that the Claimant was exposed to constant levels of noise throughout his various employments. In any event, he was not calling into question the 1993 audiogram which was assumed by him to be accurate.

32. In outline, his evidence was that whilst the obvious effect of noise exposure would be damage to the outer hair cells within the cochlea, where such damage was usually identifiable by the thresholds revealed on audiometry, it did not necessarily follow that hair cell damage would give rise to a noticeable loss in hearing when detecting sound. He relied on a number of animal studies to demonstrate that mild damage could be caused to the outer hair cells without any measurable change in the thresholds. Because damage to the auditory system built up gradually, reflecting the cumulative energy received by the ears, there will be a time before the damage is evident.

33. Professor Moore provided a joint report in conjunction with Professor Lutman in which a substantial measure of agreement was reached over the processes involved when the human ear is subjected to noise exposure, and the different types of damage which would be caused to the inner hair cells and outer hair cells. They agreed that there had been research published, particularly in relation to animal studies, which suggested that early noise exposure could have an effect on ageing, although there were epidemiological studies in relation to humans carried out on a longitudinal basis which cast doubt on any firm conclusions. They agreed that the Burns and Robinson work confirmed that noise was likely to develop in the earlier years, with later periods having less of an effect, although there were significant individual variations. However, the total damage to the auditory system was related to the total or accumulated energy over the period of exposure. As far as the tinnitus was concerned, it was more likely than not that any period of exposure increased the probability of the Claimant having tinnitus, or at least increased the severity of his tinnitus.

34. They disagreed on the latent effects of noise exposure. Professor Moore maintained his view that it was appropriate to take an evidence based approach, and that although animal studies were imperfect models, there was sufficient research information to show that there were similarities in the way that the human ear behaved. If there had been a damaging effect on the auditory system, it would only take a small amount of extra damage to have a measurable effect.

35. In terms of the development of NIHL, Professor Moore believed that at the time it was measurable, the damage reflected that over the entire period of exposure, not just exposure immediately prior to it becoming apparent. The susceptibility of an individual to noise exposure could not change markedly over time.

36. In relation to tinnitus, despite its late onset, Professor Moore believed that whatever had caused the hearing damage would have contributed to the tinnitus, and thus it could be referable to the earlier period of employment with this Defendant.

37. Under cross-examination he accepted the proposition that the usual pattern for damage as a result of noise exposure is that the worst damage would occur at the start of the process, with a flattening off thereafter, although at the end of a period of exposure it is the cumulative effect which is significant, enabling an attribution of any damage to be made equally over that period. However, he argued that this was not a universal pattern, and that some individuals would not necessarily demonstrate such early damage.

38. In any event, the mechanism for such damage which still left the hair cells intact, and with no obvious impairment of the ability to detect sounds generated in the audiometric measurement process, was one whereby the structural integrity and efficiency of the outer hair cell in amplifying sound was diminished. This could be because the stereocilia at the tips of the outer hair cells were affected or because damage to the ribbon synapses to the inner hair cells was caused, which would lead to interference between those cells and the neurons making up the auditory nerve, which would in turn lead to degeneration of the neurons. None of this might be picked up by an audiogram, but it could lead to problems in understanding speech, particularly in the presence of background noise.

39. As I have indicated, Professor Moore's conclusion was based for the most part upon the so-called mouse studies, led in particular by Sharon Kujawa and colleagues. He was asked about one of these papers, *Acceleration of age-related hearing loss by early noise exposure: evidence of a misspent youth,* **Sharon Kujawa** and **Charles Lieberman** (Journal of Neuroscience) [February 2006]. This was an earlier paper relating to mouse studies which sought to demonstrate that there could be substantial and ongoing deterioration of cochlear neural responses even where there was no evidence of noise induced hearing loss immediately after noise exposure, thus suggesting that early noise exposure rendered the inner ear significantly more vulnerable to ageing.

40. Professor Moore accepted that if a comparison was made with the human ear, an adjustment would have to be made; he was not convinced that the adjustment would have to be as high as 14 dB, which would make the experimental noise exposure for the mice one that was bound to cause irreversible damage. He made a comparison with young people who

are exposed to very loud noise in nightclubs where any damage may not be detectable on an audiometric basis.

41. He was questioned about a further study on mice which had not been included in his bundle of authorities: **Catherine Fernandez** and others, *Ageing after noise exposure: acceleration of synaptopathy in "recovered" ears*, published in the Journal of Neuroscience (May 2015). This was a study which compared cochlear ageing after two types of noise exposure, one of which produced permanent synaptic damage without hair cell loss and another which produced neither hair cell loss nor synaptopathy. Higher levels of noise at 100 dB were shown to produce some temporary threshold shift which recovered, but where synaptic and cell damage was shown as the animals aged, whereas a lower level at 91 dB whilst producing a transient threshold effect, had no long-term effect as the animal aged. The conclusion of the study was that a single synaptopathic exposure (i.e. the 100 dB) could accelerate cochlear ageing.

42. Professor Moore accepted the conclusion of this study, but pointed out that he was not contending for an acceleration of the ageing process, nor is this a case of simple addition of noise damage to the usual ageing process. His point was that synaptic and neuronal damage was being caused by noise exposure which had no audiometric effect, and no real disability save perhaps for speech discrimination in noise, and it was the additional noise exposure which pushed the Claimant over the edge, so to speak, when the outer hair cells were noticeably damaged and showed up on audiometry. In this respect the agreement reached with him and Professor Lutman as set out in paragraph 8 of the joint statement was pertinent: animal studies showed that sometimes the exposure to intense sounds while producing damage to the outer hair cells was not always sufficient to affect the threshold for detecting sounds.

43. He was also referred to a number of other papers involving adult studies, and in particular longitudinal studies, that is where the subjects have been examined over a prolonged period of time to determine effects. The first of these was a paper by **Gates** and others published in Hearing Research (141, June 2000) entitled *Longitudinal threshold changes in older men with audiometric notches*. It was a study which followed a cohort of 203 subjects over 15 years and was intended to determine whether or not those who had manifested notches from a previous history of noise exposure were likely to suffer increased or worsening age deterioration after being removed from such exposure. The conclusion was that the noise damaged ear, particularly at the 2 kHz frequency rather than 4 kHz, appeared to deteriorate more quickly than the non-noise damaged ear long after exposure to noise had ceased. Professor Moore did not agree that the study was of limited assistance because it was based upon a selection of those with notches in audiometry, rather than simply a previous history of noise exposure. In any event, the explanation for less damage at 4 kHz was that this frequency had already been affected by noise.

44. A later study, by **Ulf Rosenhall** from the Department of Clinical Neuroscience in the Karolinska Institute in Stockholm, published in Noise and Health [2003] entitled *The influence of ageing on noise induced hearing loss*, was raised. This was also longitudinal, and purported to establish that a lifetime of exposure to noise had both an additive effect on ageing deterioration and a supra additive effect depending upon which frequency was implicated. Further, whilst the incidence of tinnitus increased in old age, but not as much as hearing loss, there was no simple correlation between previous noise exposure and late onset tinnitus. Professor Moore agreed that there was significant individual variability, but this study did not exclude such a relationship.

45. The study upon which the Defendant placed most reliance was by **Christina Hederstierna** and **Ulf Rosenhall** from the same Institute published in Noise and Health [2016] entitled *Age-related hearing decline in individuals with and without occupational noise* exposure. It was a comparison longitudinal study of over 1000 subjects, male and female, between the ages of 70 and 75 which sought to demonstrate that there were no significant differences between the noise exposed and non-noise exposed subjects in terms of the deterioration of hearing by the ageing process. In his contribution to the joint report, Professor Moore believed that no firm conclusions could be drawn from this study since the group with greater noise exposure was only marginally different in terms of the threshold presentation from that with no noise exposure.

46. The final research paper to which Professor Moore was referred was by **Fu Shing Lee** and others published in Ear and Hearing [2005] entitled Longitudinal study of pure tone thresholds in older persons. The cohort in question ranged from 60 to 81 years who were visited over approximately 11 years. Those who had been exposed to noise were identified. Amongst the conclusions it was reported that noise history did not have a significant effect on the rate of threshold changes.

47. It was suggested to Professor Moore that this study and the others confirmed the conventional view that noise exposure did not accelerate the ageing process, but simply provided an additive component. Professor Moore's response was again that he was not advocating the acceleration of the ageing process, but only damage that was occurring without obvious effect, and he provided an analogy of a car battery which at the beginning of its life might be fully charged with 15V. There would come a time when the charge would reduce to closer to 12V with no effect on performance, but when further deterioration reducing the voltage to 11.5 meant that the car would not start. So it was with the human ear, when further exposure superimposed upon a cochlea with neuronal damage would have the effect of creating a hearing disability.

48. In re-examination, Professor Moore was referred to the concept of the cochlear reserve, whereby an individual could be exposed to noise for a period of time without suffering any noticeable effect except at very high frequencies, or even damage, because the cochlea has spare capacity applying to both the inner hair cells and the outer hair cells. It is only when the

outer hair cells are lost, implicating the amplification process, that an effect begins to be noticed on the audiograms.

49. With the court's indulgence, Professor Moore in re-examination was also referred to some further papers which had most recently been published. For the most part these related to the question of speech discrimination, which was a non-detectable aspect on the audiogram. The first of these was a paper by **Lynn Alvord** from the Audiology and Speech Pathology service, in Chicago Illinois, entitled *Cochlea dysfunction in "normal hearing" patients with history of noise exposure [1983]*. The patients in this study had normal audiometric measurements despite a history of noise exposure but the cochlear integrity was assessed by reference to the discrimination of high-frequency words in noise. It was concluded that those who had such a history exhibited statistically poorer discrimination than those who did not. Professor Moore believed that this was highly relevant because it identified the damage that could occur without evidence on the audiogram.

50. The second was a paper by **Holtegaard**, from the Technical University of Denmark, entitled *Signs of noise induced neural degeneration in humans*. The publication was in 2015, but its source is not obvious. Again it focused on the higher speech discrimination thresholds in a control group and a noise exposed group that did not demonstrate on pure tone audiometry any hearing impairment. The testing included auditory brainstem responses and established that the noise exposed group fared worse in terms of speech recognition in noise than the control group, with the results suggesting that noise exposure affected supra threshold processing in humans before pure tone sensitivity. Professor Moore expressed the view that this study, and the previous study by Alvord were based upon a different understanding of underlying causes of speech recognition problems where there were normal audiograms, although researchers remain unclear as to how the precise nature of the damage was being caused.

51. The final paper referred to in re-examination was in a similar vein, and a recent study by **Hope** and others published in the Journal of Laryngology and Otology, [2013] *Effects of chronic noise exposure on speech in noise perception in the presence of normal audiometry* . It involved the assessment of ten noise exposed Royal Air Force aircrew pilots with noise exposure, and a control group without noise exposure. The subjects in both groups had normal pure tone audiometry. One of the relevant findings was that the noise exposed group had elevated speech in noise thresholds compared to the non-exposed group.

52. Professor Moore said this reinforced the conclusions from the other papers that damage not revealed on the audiograms could be occurring which reflected the way in which the outer hair cells operated. He had himself contributed to the discussion with an article published in the International Journal of Audiology in July of this year [2016], entitled *A review of the perceptual effects of hearing loss for frequencies above 3 kHz*. In the article he had made the point that there was evidence to support greater self-reported hearing difficulty

in speech discrimination and to detect envelope fluctuation in sounds, notwithstanding a normal audiogram.

53. Professor Lutman had been instructed on behalf of the Defendant in addition to the previous ENT expert, Mr Welch, to address the question, principally, of damage from noise exposure not detectable on audiograms arising at a later stage. Because of the way in which the action has been case managed, involvement of Mr Welch was excluded, and therefore Professor Lutman also addressed the question of the reliability of the 1993 audiogram, and the "medical" question generally.

54. Of course he is not a doctor, but as those with experience of occupational deafness are well aware, he is a world renowned and eminent audiologist, who is the author of numerous papers on the subject, and the originator, with others, of guidelines for both diagnostic and disability evaluation purposes of noise exposure damage. Unlike Professor Moore he has given evidence regularly in the courts, dividing his work between both Claimant and Defendant. His CV does not require further elaboration.

55. When he first reported, he had been provided with material which included the report of Mr Zeitoun. He also had the medical records incorporating the 1993 audiogram, as well as the BUPA screening from 1987 which revealed that there had been audiometry, with no results given, save that they were normal. This report was partially redacted, for reasons which have not been made known to the court.

56. Professor Lutman appears to have followed the same work chronology as both Professor Moore and Mr Zeitoun, that is missing out the repeated additional years with the First Defendant from 1992 onwards until the Third Defendant became involved. Using Mr Zeitoun's hearing thresholds, he provided a tabulation based upon the 2000 CLB guidelines which calculated the bulge by reference to certain anchor points which made allowance by adjustment for age associated hearing loss. By this method he agreed with Mr Zeitoun that the Claimant "*demonstrates noise induced hearing loss on the balance of probabilities*". Whilst noting that the material from the occupational health records was sparse and difficult to associate with the Claimant, nevertheless he observed the 1993 audiogram showed more or less normal hearing in the thresholds which were within expected ranges save at 8 kHz, making allowance for the Claimant's age at the time. This led the professor to conclude that any noise induced hearing loss evident on the 2011 audiogram, must have occurred after 1993. He did not have Professor Moore's opinion at this stage, but disagreed with any concept of delayed onset of hearing loss and tinnitus, as might have been implied from the opinion expressed by Mr Zeitoun. He pointed out that hearing loss generally progresses more rapidly at first, developing more slowly at a later stage, although the deleterious effect might be equally measured over the period of exposure. Insofar as there was noise related component in the 2011 audiogram, it was superimposed upon a worse than average age related component. (see audiogram set out at paragraph 27 above).

57. He agreed with Mr Zeitoun that the tinnitus was properly classified as mild, although he did not attribute it to the period of employment with the Defendant.

58. Professor Lutman went on to answer a number of questions which were put to him by the Claimant's solicitors. His replies, for the most part, were incorporated into the two separate joint reports in which he was engaged, one with Mr Zeitoun, on the question of the 1993 audiogram, and the degree of hearing disability, and one with Professor Moore on "latency" as it has been described.

59. In relation to the joint report with Mr Zeitoun, he expressed the opinion that the 1993 audiogram was entirely plausible bearing in mind the Claimant's age at the time, and he had no reason to doubt its efficacy. Because some hearing thresholds had been recorded down to zero, he did not believe that ambient noise would have been a problem. In fact, there was no evidence that the audiometry had been obtained other than in an entirely proper and professional fashion. It provided invaluable evidence and could not be disregarded.

60. On the question of evaluation of any disability, and the amount of noise induced hearing loss demonstrated by the 2011 audiogram, Professor Lutman adopted two approaches. The first was to utilise the tabulation in his first report, which arrived at the notch configurations using the 2000 guidelines and followed a shortcut method which gave an estimated hearing loss of only .5 dB. He indicated that his recent preference was to make a more detailed analysis using the 2016 guidelines to which he had contributed. This involves taking the average binaural hearing loss over 1,2 and 3 kHz, making the appropriate calculation, and subtracting the modified age associated hearing loss. This involves an assessment as to the percentile into which the Claimant fitted. As can be seen from the audiogram figures that have been plotted on his chart, (see above), he concluded that by taking 1 and 8 kHz, as the frequency is less likely to be damaged by noise, he was able to fit the Claimant into the 25th percentile, which made him more susceptible to damage by ageing than the average. Thus the age component of 19.3 dB was to be subtracted from 22 dB, leaving a binaural loss of only 2.7 dB. Both this approach, and the calculation become crucial in the event that the Claimant establishes causation, and his hearing loss falls to be evaluated, because it is substantially less than the figure provided by Mr Zeitoun, who has taken the Claimant at the 50th centile.

61. As indicated, Professor Lutman then became involved with Professor Moore in arriving at a consensus, if possible, on their respective evidence. I have outlined above at paragraph 33 above the areas of agreement. As far as disagreement was concerned, Professor Lutman on the question of whether or not there could be latent effects of noise exposure, referred to the received wisdom from expert and consensus groups that there were no such measurable latent effects. It was not possible to compare animal studies, which in any event were restricted in their scope because of the nature of the noise exposure inflicted, significantly different to prolonged noise exposure for humans, and such human studies as existed, in particular the

Hederstiarna paper provided strong empirical evidence of there being no distinction in the effect of noise on ageing between a noise exposed and non-noise exposed group on a longitudinal study.

62. In relation to the development of NIHL over time, he believed that the argument that prior noise exposure contributed to noise induced hearing loss with subsequent noise exposure was logically inconsistent with the evident pattern of the progression of hearing loss. If the loss had not occurred as a result of exposure to noise with the Defendant (because of the 1993 audiogram), the 2011 result could only be explained by subsequent noise exposure, or was idiopathic, insofar as sensorineural hearing loss of unknown origin was common in the general population, and such loss could mimic NIHL.

63. In his oral evidence, Professor Lutman explained why he had abandoned the "rough justice" assessment of 50% for the AAHL component, when quantifying the damage from NIHL, or the shortcut method which had followed from the 2000 guideline figures. A realistic assessment had to be made by reference to the 1 and 8 kHz anchor points. He simply did not believe that the 50th percentile was the best fit for the Claimant. He thought that 2.7 dB as calculated would have had only a very slight impact on the Claimant's hearing.

64. As far as latency was concerned, he believed that the argument being advanced by Professor Moore that there were other causes for hearing diminution in the loss of outer hair cells had been known for over 50 years and it was not new science.

65. Mr Redfern QC cross-examined Professor Lutman about the history of noise exposure and he agreed that it was at a level likely to cause loss. If it was established that the Claimant had worked 12 hours a day seven days a week, it was likely to have been a very significant noise exposure. He did not accept that the existence of a notch and noise exposure led to an irresistible conclusion of NIHL, because of the MRC data (to which he had contributed) which indicated that a large number of individuals (approximately 30%) might present with a notch at the implicated frequencies, but without any history of noise exposure. He accepted that he had not referred to any alternative causation, but often there would have to be a conclusion that the hearing damage was of unknown origin. Despite the history, the 1993 audiogram made it implausible that he had sustained damage to his hearing prior to 1993.

66. Professor Lutman rejected the suggestion of the use of the cochlear reserve in the initial years as an explanation for the absence of measurable damage in the 1993 audiogram. Whilst he accepted that there was a reserve in the cochlea, this would have been used up in the very early years. Further, given that he had been exposed to noise at that point for over 16 years, he would have expected only a very small amount of damage to develop subsequently if that had been the case. It is generally accepted that the damage to hearing from noise is done in the early years.

67. The professor was referred to his evidence which was given in the **Parkes** case (the Nottinghamshire and Derbyshire textile deafness litigation heard before His Honour Judge Inglis in 2007). It is worth noting the full section at paragraph 123 of his judgment:

> *"What I was trying to convey is really there is a cascade of events. When a person has been exposed to noise, different frequency regions will be pushed a little bit along that cascade of events by different amounts. So, when a person gets older, even though they may not be exposed to noise any more, this will continue to push the cascade of events further in the direction of impairment. So there may be hair cell loss at lower frequencies which have not yet shown up in the audiogram which will be aggravated by the effects of age and then will show up later in life. Whereas if a person had not been exposed to noise, they would have ended up in a better position than that."*

68. He pointed out that he was giving evidence in the context of a claim for hearing damage at levels below the then accepted maximum of 90 dB(A), (at the relevant time), where medical examiners would require clear evidence to make a diagnosis, not least in the shape of the audiogram. He accepted that in that case he did not mention mimicry nor did he say that the audiogram could be attributable to alternative causation. He did not see the present case as one involving such a cascade.

69. Professor Lutman also agreed with Mr Redfern QC that a 90 dB(A) exposure over 12 hours would be equivalent to 92 dB(A), and over a 24 year period this would amount to a total NIL approaching 104 dB(A) on the basis of the NPL tables.

70. He was asked about some of the papers relied upon by Professor Moore, in particular the more recent studies. The **Alvord** paper was questionable because of absence of details of the noise exposure. In **Holtegaard** there were two groups, and one concern was that the non-control group consisted mainly of professional musicians. In the **Hope** paper it was noted that the noise exposed subjects were Chinook RAF pilots who were likely to have been exposed to very high levels of noise which were not typical.

71. Professor Lutman agreed that he and Professor Moore had collaborated on some research in relation to speech recognition, although they did not agree on the overall conclusions. He believed that the results could be explained on the basis of the audiometric results from such research, and it was unnecessary to look for any hidden features.

72. He refuted the suggestions of Mr Zeitoun that any noise could have been generated from the switch mechanism of the tester, because in his understanding, since time immemorial the switches have been automatic. He accepted that it was necessary to guard against regular temporal sequence. Those two features were the only ones which might have

created a more favourable impression of the hearing thresholds. Otherwise, ambient noise, or the absence of a soundproof booth would have made the results worse.

73. In re-examination, Professor Lutman re-emphasised the importance of the **Hedierstana** study, which provided stronger statistical consideration than **Gates**. It was his view that the longitudinal studies confirmed that the prospect of damage occurring in the first period but not appearing until the second period was theory rather than something which was borne out in the evidence. He was referred to a further research paper, namely *Speech reception in quiet and noisy conditions by individuals with noise induced hearing loss in relation to their tone audiogram*, by **Guido Smoorenburg**, published in the Journal for Acoustic Science in January 1992. This research focused on the way in which speech was perceived and understood in both noisy and non-noisy environments by reference to the threshold losses over various frequencies. The pure tone average at 2 and 4 kHz was considered to be an adequate predictor of the speech threshold in noise, which was the primary factor in hearing handicap. This was reflected in some of the work which he had undertaken with Professor Moore, which also focused on whether or not the absence of any significant hearing loss at 1, 2 and 3 kHz but with loss at higher frequencies could lead to difficulties with speech discrimination. His own conclusion was that as long as those lower frequencies were satisfactory, an additional 15 dB at high frequencies made little difference

The respective submissions

74. Both counsel helpfully reduced their submissions into writing, which were supplemented in the course of oral submissions.

75. On behalf of the Defendant, it is argued that the lack of engineering evidence amounts to a fundamental flaw in the Claimant's case. Although there was an admission of breach of duty made, this is limited in its scope, and amounts to no more than an acceptance that there would have been times during the relevant employment when the Claimant was exposed to hazardous levels of noise. It does not amount to an admission as to the totality of the noise exposure, nor indeed that the noise levels achieved a dose or energy level which would lend support to a conclusion that damage was bound to be sustained in the ears of an averagely susceptible individual. It was open to the Claimant to rely upon such engineering evidence, after making appropriate application in the course of case management, but he chose not to do so.

76. When this is taken into account in the context of the other evidence, including the unreliability of various aspects of the Claimant's account as to (a) his assertion that he would always work overtime up to 7 days a week and 12 hours per day set against the BUPA health screening records (b) the likely provision of some hearing protection during the course of the relevant employment and (c) the absence of any reported symptoms of hearing difficulties at the time, apart from a whooshing sound which was entirely consistent with temporary

threshold shift, as well as the conflict in Mr Zeitoun's recorded employment history for the Claimant, the case falls short of establishing a sufficiently robust basis for this court to make any inference that there was bound to be a hearing loss which would undermine the integrity of the 1993 audiogram. Further, it could not be overlooked that in 1987 the Claimant reported no problems of hearing difficulties, and audiometric testing confirmed this.

77. Insofar as reliance may be placed upon the decision of **Keefe v Isle of Man Steam Packet Company, [2010] EWCA Civ 683**, where the Court of Appeal accepted the approach of the first instance judge to infer breach of duty in the absence of any evidence from the Defendant as to actual noise levels, it was to be noted that this was a case solely concerned with the question of breach of duty, whereas the question to be resolved in the present case was one of causation.

78. In relation to the audiogram itself, it is accepted by Mr Zeitoun and Professor Lutman that it is plausible for the age-related thresholds at the 50th percentile. Accordingly, it cannot be ignored. Insofar as Mr Zeitoun has called the audiogram into question, he has lost objectivity because of his shifting position and has indulged in litigation bias, whereby his position became harder as the issues crystalized.

79. There was no evidence of any of the defaults in the audiometric process which are relied upon by the Claimant's expert, which might suggest that its readings could not be accepted. Further, if the court examines the readings at 1 kHz and 8 kHz, even though these are not frequencies which might be affected by noise exposure to any or any great extent, there is no great difference between association with the appropriate percentile (25th), after allowance has been made for the age related component.

80. In relation to the latency argument, which assumes that the 1993 audiogram is accepted, it was submitted that on the Claimant's case, from some of the papers relied upon, it appeared to be suggested that it was not so much true latency, with early damage only becoming manifest in a later period, as the possibility of the audiogram understating speech difficulties in noise, which was really an issue relating to disability and quantum. Mr Platt QC referred to the prevailing international and governmental consensus, confirmed by longitudinal studies, that there could be no time shift as such, and that the orthodox position should be given great weight. To do otherwise, would be to overturn the established parameters on which compensation had been evaluated and paid over very many years.

81. In any event, says Mr Platt, the argument is flawed; for hearing loss to have been in existence to be carried forward, this would require evidence of loss outside the audiogram by 1993. It could not be overlooked that on the Claimant's own evidence he could not prove that he had sustained any damage represented by any difficulties, regardless whether or not this was demonstrated on the audiogram. He was not reporting difficulties in speech recognition

at the time, and his post-work complaints could not be interpreted as anything other than temporary threshold shift.

82. Whilst Professor Moore is correct to argue that the amount of damage sustained results from the totality of the sound energy over the relevant period, this is no more than a physical science argument, and does not reflect the individual variations in susceptibility, particularly where there will be some sound energy levels below 85 dB(A) which would have to be excluded. He did not offer any reason why the effects of the pre-1993 exposure had not become manifest until 2011 nor did he provide a formula as to when it might have been expected that they would have been revealed in audiometry.

83. Mr Platt asked the court to review the papers relied on and concluded that they provided no support for any theory of acceleration of ageing loss or a super additive shift after exposure had ceased. Any papers which purported to show support for the argument that speech discrimination could be affected without evidence of threshold loss were epidemiologically meaningless (**Alvord**, **Holtegaard** and **Hope**).

84. Generally, it was submitted that the Claimant's case depended upon the establishment of a noise imission level (which could not in any event be achieved) which would enable a conclusion that damage had been caused, because if this was the case it might be expected that all those who had been involved in such exposure would have a hearing loss. That was simply not the case. The Claimant's argument essentially boils down to an assertion that the 2011 audiogram was consistent with noise exposure, and because he had been exposed to noise prior to 1993 significant reliance should be attached to it. However, this ignores the fact that the audiogram is not pathognomonic of noise exposure.

85. The Defendant also relied heavily upon Professor Lutman's conclusion as to the threshold loss and his calculation of the noise related component in the event that this court were to find that some hearing damage had been sustained. Mr Platt relied upon the *de minimis* principle and the recent decision in **Carder v the University of Exeter [2016] EWCA Civ 790**, a case which concerned the material contribution to the development of asbestosis. He also referred to the county court decisions in **Hinchcliffe** and **Holloway** which appeared to reject the significance of 4 kHz in the assessment of any hearing disability. As to the quantum of the claim, reference was made to the figures provided in the skeleton argument at the outset of the hearing.

86. On behalf of the Claimant, Mr Redfern QC submitted that Mr Ross remained a good historian and an impressive witness, despite admissions of some impairment of recollection, which would be inevitable after the passage of time. The court should place considerable store by his account of noise exposure, and draw on its own experience of similar cases, notwithstanding the absence of any engineering evidence. There had been no meaningful challenge of his evidence in relation to working hours and it would have been open to the

Defendant to adduce evidence to undermine any assertion of excessive and prolonged noise exposure.

87. In respect of such exposure, and in any event, counsel relies on the breach of duty admission. It is submitted that it cannot be qualified by the Defendant and must apply to the entirety of the Claimant's employment with them. Mr Redfern reminded the court that at an earlier hearing, the Defendant, by junior counsel then appearing Mr Morton, had accepted that the Claimant had been exposed to the "*highest levels of noise*" and that he had been susceptible to NIHL. However, it was conceded that Mr Morton might have referred to "*significant levels of noise*" rather than "*highest levels of noise*". (For my part, I have no recollection as to which was correct, although I suspect that it does not make much difference.)

88. As a result of the admission of duty breach, it was open to the court to conclude that the minimal level of exposure had been 90 dB(A) over a ten-year period, with no attenuation from any hearing protection, providing a NIL of 100 dB(A).

89. As the Defendant had anticipated, the case of **Keefe** was material. If a Defendant chose not to call any evidence it faced the risk of relevant adverse findings, as Longmore LJ said in that case. In the circumstances there should be a burden on the Defendant to prove the potential for the Claimant's hearing to be damaged in conjunction with a finding that there were continuous excessive levels of noise. Further, the Defendant should have investigated the circumstances as to when and how the 1993 audiogram was carried out by contacting Dr Pickles, if appropriate, if they wanted to rely upon it as an accurate audiogram, particularly when it became clear that it had not been performed in a soundproof booth. It is accepted by their expert, as an "unusual" audiogram.

90. Otherwise there was enough evidence that the audiogram was questionable, with the possibility of visual clues, audible clicks or a lack of a varied sequence.

91. Counsel for the Claimant asks the court to prefer the expert evidence of the Claimant from Mr Zeitoun and Professor Moore. In respect of the engagement of Professor Moore and Professor Lutman in joint discussions, their agreement that the total damage to the auditory system was related to the total accumulated energy received was highly significant, the court accepts, as it should, the NIL. Where there are a number of periods of exposure with equal durations and equal noise intensities, the usual apportionment approach should be adopted by the court, because the energy principle is the predictor of the damaging effects of noise.

92. Mr Redfern reminded the court of the theories relied upon by Professor Moore as to how significant damage could occur without evidence on the audiogram and in particular the papers which demonstrated that the frequencies above 3 kHz were important for speech

discrimination in noise and speech perception generally. The development of the Claimant's tinnitus, furthermore, could not be ignored, and its association with noise exposure was well established. The description of a whooshing sound in his ears for about two hours every day was entirely consistent with noise exposed tinnitus.

93. Insofar as a hearing loss may be established, it was emphasised in submission on behalf of the Claimant that Mr Zeitoun had been following the standard approach in arriving at a binaural NIHL 10.2 dB (an approach which had been endorsed by Mr Welch, the Defendant's previous expert) and it was only the publication of very recent guidelines which suggested that there should be any different approach. The 2016 guidelines created a misfit for the Claimant, because of the loss at 6 kHz, and a 26 year exposure to noise. In short, the anchor points chosen by Professor Lutman were inappropriate, and significantly underestimated the disability. In any event, even if the low water mark of 2.7 dB is accepted, in conjunction with tinnitus this is still a measurable disability.

Discussion

94. The Defendant's representatives correctly identify that the alternative submissions of the Claimant are contradictory. However, it seems to me that this is an approach which the Claimant is entitled to take, proposing alternative scenarios against a background of what is alleged to be constant and consistent noise exposure over a period of almost 26 years. As I have already remarked in exchanges with counsel, the absence of engineering evidence requires a greater degree of hypothesis in the analysis of the issues. Where there has been an admission of breach of duty, it might not be expected that acoustic engineering evidence was necessary. However, it is axiomatic, and certainly confirmed by those with judicial experience of this type of case, that an assessment of the overall noise dose, with a comparison between the likely cumulative sound energy levels between respective periods of employment would be of great assistance. Whilst not determinative of causation, there is a wealth of statistical evidence available, to which one of the professional witnesses in this case has contributed, which enables an estimate of the likelihood of hearing damage across a variation of susceptibilities. Such evidence would always require a cautious approach, even more so in a case (unlike this one), where there is no audiometric evidence of any sensorineural loss notwithstanding noisy employment, but it is a useful adjunct with supportive audiometric evidence.

95. I remain concerned at the qualification provided by Mr Platt QC to the admission of breach of duty that this amounts to no more than an acceptance that "*on occasions*" noise levels would have exceeded safe parameters whereby the Defendant would be liable for negligence or breach of statutory duty in principle. It is unfortunate that the admission was not further defined in the course of case management, but in my judgment it must be taken to amount to more than simply an occasional or transient failure to keep noise levels within acceptable limits. In the context of a straightforward accident at work, an admission of breach of duty sits comfortably with a causation challenge. It is less comfortable in an occupational

deafness case, because the causation issue is complex and incorporates a number of considerations including individual susceptibility. For this reason, the only meaningful consequence of an admission of breach of duty must be that the Defendant accepts that the Claimant was exposed to harmful levels of noise which *were capable of damaging the hearing of a susceptible individual*. This, it seems to me, covers the entirety of the Claimant's employment with this Defendant, as it ought to, without qualification, leaving open the question of medical causation.

96. Nevertheless, it is appropriate that the first question which this Court must ask is whether or not the 1993 audiogram is an accurate representation of the Claimant's hearing loss at the time. If it was not, logically there would be no need to consider the second question, that is whether or not there can be a latent defect from noise exposure. The only issue which would then arise, because of the Defendant's concession that the 2011 audiogram is a compatible one, would be the extent of any hearing disability by reference to the appropriate AAHL. However, for reasons which will become apparent, it is appropriate that the question is addressed regardless of the answer to the first question.

The 1993 audiogram

97. On the first question, it seems to me that there is no shifting of the burden of proof. In other words, it is not incumbent upon the Defendant to satisfy me that the 1993 audiogram is accurate. The audiogram is included in a compendium of the medical records, the accuracy of which would normally be self-proving, in the absence of any significant contradictory material. Thus, the burden remains on the Claimant to establish on a balance of probabilities, in the light of all the evidence which includes the 2011 audiogram, and his own testimony of noise exposure, whether his audiometric presentation 18 years earlier could not have been accurate, and therefore could effectively be ignored, discounted, or otherwise explained away by some appropriate artefact.

98. Of course the corollary of a determination that the 1993 audiogram was probably accurate, would be that the sensorineural loss depicted in the 2011 audiogram represented idiopathic features notwithstanding excessive noise exposure post 1993 (for which the Claimant has in any event been compensated) or that in some way the noise levels in the later years was significantly higher than those in the earlier years.

99. The Claimant seeks to challenge the 1993 audiogram on two bases. It seems to me that his primary argument is that the history of exposure to excessive levels of noise which are admittedly in breach of duty, and thus at least 90 DB(A) and likely to damage an averagely susceptible individual, together with evidence at the end of the Claimant's various employments of consistent hearing damage is sufficiently compelling to discount the recorded thresholds in 1993 as inaccurate. His secondary argument is that the evidence of the circumstances in which the audiogram was taken (i.e. not in a soundproof booth) is

suggestive of a haphazard approach to testing by which there could be no confidence in other aspects of the process.

100. The difficulty with the primary argument is that it is circular. A submission that the noise levels and 2011 audiogram undermine the 1993 audiogram, overlooks the fact that the 1993 audiogram undermines the 2011 diagnosis of NIHL at least sustained in the earlier years, and raises a presumption, that even if the noise levels were admittedly excessive, the Claimant was a robust and non-susceptible individual. I agree with the submission of the Defendant through counsel that the audiogram is not pathognomonic of NIHL simply because it demonstrates a sensorineural hearing loss with a notch and 4 or 6 kHz and subsequent recovery at higher frequencies. The perceived and unchallenged wisdom is that a significant percentage of those presenting with sensorineural hearing loss may have idiopathic causes other than noise exposure. Of course a compelling history of noise exposure is likely to reduce such a percentage, but the audiogram remains persuasive rather than conclusive.

101. In my judgment if there was evidence of the sound energy generated in the period of employment prior to 1993 which would enable a prediction to be made of the likely damage up to a very high percentile, then the Claimant's argument might carry a little more weight but it would not be decisive. (Insofar as reliance is placed on the admission of breach of duty, in my judgment there was no shifting of burden here, as might be suggested in the **Keefe** case; unlike that case, the central issue here was one of causation and I agree with the Defendant's submission that it can be distinguished.). It depends upon the effectiveness of a challenge to the accuracy of the audiogram by reference to the way in which it was carried out, and here it seems to me that the Claimant's argument runs into further and potentially insuperable difficulties. There is simply no evidence that the audiogram carried out by BUPA and referred to by Dr Pickles did not properly measure hearing thresholds. The most common faults, which are now disapproved of by the BSA guidelines, involve the removal of ambient noise either from external traffic, ineffective headphones, or the absence of a booth. However, these faults are likely to increase the thresholds, that is to show the hearing to be worse than it is rather than to decrease them. By referring to audible clicks from the audiometry mechanism, visual signals, or the lack of variation in the spacing of the sound pulses, the Claimant is indulging in speculation without real evidence. This court would have to conclude that a reputable private medical health organisation was providing poorly conducted medical tests on a large scale, because it is unlikely that such deficiencies would have applied only to the testing of Mr Ross's hearing.

102. There is an additional factor which undermines the Claimant's argument in relation to the 1993 audiogram challenge. There is no report of any hearing difficulties at this time. Even providing the most generous interpretation to the Claimant's evidence and attributing tinnitus, usually associated with hearing damage to a much earlier date than his statement appears to suggest (by reference to the whooshing sound relied upon by leading counsel in his submissions), the contemporary evidence would indicate that the Claimant had perfectly normal hearing consistent with the recorded thresholds. Further, although there are no audiogram figures provided, in 1987 the Claimant's hearing was tested, and his hearing was

described as "satisfcatory". On the conventional approach, it might have been expected that the accumulation of years before either the 1987 testing or the 1993 testing would have damaged the thresholds.

103. Accordingly, in my judgment the Claimant has not established, on a balance of probabilities, that the 1993 audiogram was anything other than an accurate record of the hearing thresholds at that time.

Latency of damage

104. I now turn to the second question. As I have indicated, this is a question which would have required answering even if the Claimant had been successful on the first question. It is apparent, not least from the comments of leading counsel for the Defendant and the number of insurance representatives sitting at the back of the court, that an argument of latent damage, that is hearing loss without audiometric threshold measurement, has the potential to send shockwaves through the insurance industry if successful. The fear would be that the conventional method for diagnosing occupational deafness and assessing disability would be cast aside, with the possibility of an avalanche of claims based upon the simple premise that an individual had worked in a noisy environment and now has difficulty in discriminating some speech where there was a background of noise.

105. Quite apart from the fact that this judgment is being provided in the lowly county court where it would carry little persuasive authority, I should make it plain that I am not going to be drawn into making a decision which answers a generic question about occupational deafness compensation. This is especially so because on the face of it the question depends upon the non-expert interpretation of a complex medical/scientific debate which is ongoing, based upon a plethora of epidemiological studies in both humans and animals, and where there is yet to be any consensus. It is axiomatic that every case is fact specific and a decision has to be made upon the evidence presented, of which general scientific research is but a small part.

106. Accordingly the question which falls to be answered has a very narrow compass indeed. Has this particular Claimant satisfied me on a balance of probabilities that notwithstanding the absence of any hearing threshold loss in 1993 at the end of his employment with the Defendant, he had nevertheless sustained some damage to his hearing which became evident in later years and which was not related to the ordinary ageing process?

107. It seems to me that there is far more common ground between the eminent professors on the scientific understanding than might be evident in the way in which this case has been approached. The mechanism of damage to the cochlea is a complex one involving a number of aspects, both cellular and neuronal. As I understand it, the hair cells are the vessels for the

reception of sound but they do not themselves transmit signals to the brain. This involves the efficient working of the neurons. However, the component parts of the outer hair cells can become damaged in a way which would still make the hair cells function, but not as effectively in transmission. This is because the synapses are affected. There is evidence that when an individual responds to pure tones any damage is not detectable. In animals the testing appears to involve some sort of brainstem analysis. In humans it has been by conventional means, where the damage is evident at high thresholds only. The conclusion of the research evidence at best is that loud noise has the potential to cause damage to the cochlear function, particularly at those frequencies where speech discrimination in background noise becomes difficult, but which would not be picked up by conventional audiogram.

108. The conclusion is adequately summarised in the joint report of both Professor Lutman and Professor Moore which contains a substantial measure of agreement, and in particular the following paragraph at 17:

> *"..there are theoretical arguments and limited data that there may be certain latent effects. It is well established from animal studies noise exposure may cause quite substantial damage to hair cells in the inner ear without causing any hearing loss, as gauged by the audiogram. It has also been shown in recent animal studies (mice) that exposure to high levels of noise can damage the synapses between inner hair cells and neurons directly; it can lead to degeneration of neurons in the auditory nerve without measurable effects as gauged by the audiogram. Such degeneration of neurons may continue for months or years after the noise exposure has ceased. Also, further loss of hair cells/synapses/neurons due to ageing might have a greater impact on those who have already lost hair cells/synapses/neurons due to noise exposure. Studies of ageing animals have partially but not consistently supported this theory."*

109. In the circumstances, I have not considered it necessary to embark upon an analysis as to the relative weight which could be attached to the so-called mouse studies, as opposed to the longitudinal studies. The science is evolving and it may well be that in years to come the nature of the damage is better understood. Instead I have considered the effect of the evidence of Professor Moore and whether or not it can be used to support the proposition advanced by the Claimant, that is to answer favourably the question which I have posed above. In this respect, I accept that Professor Moore is not relying on latency as such, or even an acceleration of the ageing process. His analogy of the failing car battery was very helpful. I understand him to say that when the damage occurs to the structures, the hair cells become vulnerable and thus far more susceptible to further damage from additional noise exposure.

110. It is noteworthy that Professor Moore proceeds with his theory on the basis that the 1993 audiogram is correct. He accepted that it was unusual not to have any recorded threshold loss after over 10 years of exposure to excessive noise, although one explanation might have been an unusually large cochlear reserve. I did not interpret him to be advancing this explanation with any enthusiasm, and insofar as Professor Lutman disagrees, I prefer the

evidence of the latter that a 16-year cochlear reserve was highly unlikely, and if this had been the case then one would not have expected any further deterioration of note after 1993. Instead, the Claimant's expert, after conceding that if there had been no noise exposure after 1993 he could not say one way or the other whether there would have been any hearing deterioration other than perhaps attributable to age, based his conclusion that there was attributable damage to the earlier period of employment on the premise that the equal energy principle applied to the entire period.

111. In my judgment, this conclusion carries with it one fundamental flaw. It makes an assumption that is not supported by compelling evidence of constant levels of noise throughout of the Claimant's entire working history. In other words, it would flounder if it was established that subsequent noise levels after 1993 were far greater (and this is one of the scenarios postulated by the Defendant). This is the same difficulty which arises when addressing the first question as to the accuracy of the 1993 audiogram, and that is the attribution of damage becomes more speculative without compelling engineering evidence.

112. Even if such compelling evidence existed, in my judgment the Claimant would still face a difficulty, which presupposes that the conclusions from the research, supported by Professor Moore, can be taken at the highest, which is that synaptic damage not revealed on the thresholds, is taking place. There is simply no evidence that this has happened in the Claimant's case. In the absence of any reported hearing difficulties prior to 1993, whether by reference to pure tone difficulties or speech discrimination, this court would be embarking upon a further highly speculative exercise if it were to conclude that synaptic damage had been occurring, which meant that the Claimant was far more vulnerable to hair cell damage in the later years. I do not believe that the research literature lends itself to such a robust conclusion that damage is bound to happen. At its highest, it raises the *possibility* that in circumstances where there is an adequately supported tapestry of evidence, with appropriate means of measurement, damage could occur to the nerve structures which could not be detected by pure tone audiometry. I am afraid that the Claimant comes nowhere near establishing that an adequately supported tapestry of evidence exists here on a balance of probabilities even if the research was interpreted favourably.

113. It seems to me that both Professor Lutman and Professor Moore have been engaged respectively in an honest intellectual interpretation of the research literature and it is unnecessary for this court to determine which of the theories is preferred. As I have indicated, this case must be decided on a balance of probabilities. I conclude that whilst there was a possibility of latent damage occurring to the nerve structures in the cochlea not detectable on the 1993 audiogram, this falls significantly below being a probability in the light of all the evidence which has been made available to the court. It is unnecessary to make any further determination, or to provide any generic ruling on the wider scientific question although it does appear unlikely that there will be any sufficient consensus on that question, or means by which such damage could be measured for some time to come.

Assessment of hearing loss

114. Whilst the Claimant has failed to establish causation and thus he is not entitled to be compensated for the hearing loss depicted on the 2011 audiogram, together with associated tinnitus, because some of the evidence was directed towards the appropriate method for evaluating the hearing disability, I should comment on this.

115. The issue arises from a determination as to which of the centiles is appropriate to the Claimant. Professor Lutman has adopted a less than generous approach in the sense that he has followed newly published guidelines (to which he is a significant contributor) which are intended to incorporate "best fit" by reference to certain anchor points. I accept his evidence that previous assessment guidelines (again to which he has contributed) provided a rough and ready approach taking an individual Claimant as averagely susceptible at the 50th centile.

116. It is correct in this respect that if one were to take 1 and 8 kHz the Claimant is far closer to the 25th centile for ageing, and this would have the effect of reducing the measured threshold of 1, 2 and 3 kHz. However, it is noteworthy that Mr Zeitoun, and indeed Mr Welch who provided the initial report had taken a more traditional line which appears to be founded on the black book guidance over 20 years ago, and there is some substance to Mr Zeitoun's argument that the 2016 guidelines themselves provide scope for some flexible interpretation allow individual variability. As I remarked in court, the issue as to whether or not the 4kHz threshold should be taken into account remains a controversial one, because in some respects it has an effect on the disability. It remains to be seen whether or not those involved in medico-legal work adopt the potentially less generous interpretation without applying the exceptions which appear to emanate from the more recent guidelines.

117. However, in this particular case I would have had some sympathy with the approach of Mr Zeitoun if it had been necessary to assess the disability, and to have compensated the Claimant on the basis of an approximate ten decibel threshold hearing loss over 1,2 and 3 kHz, which was indeed the preferred approach of Mr Welch.

Conclusion

118. I provide this judgment in draft form in the first instance, to allow for any typographical corrections. I invite the parties to agree any consequential orders in respect of costs which should be notified in advance of handing down.

HH Judge Graham Wood QC

Addendum

119. Since providing my judgment above in draft form, typographical corrections have been provided, and these have been incorporated. There has also been a request, communicated by email, but I consider evaluating the quantum of damages on the hypothesis that the claimant had been successful in establishing a disability.

120. Whilst I understand that the Claimant is contemplating seeking permission to appeal this decision, and if ultimately successful a decision on quantum may be necessary, I do not believe that it is appropriate in the context of my judgment to assess damages even on a hypothetical basis. My conclusion has been that the Claimant has not satisfied me that he has an assessable disability attributable to noise exposure. Accordingly, there is nothing to assess, and it would be artificial to base a figure upon Mr Zeitoun's approach outlined in paragraph 116 above. I do not believe that this conclusion is inconsistent with my observation in paragraph 117. This case is to be distinguished from those cases where the injury is easily identifiable, but breach of duty or causation remain in dispute, such as a straightforward EL case. If the Claimant is successful in both obtaining permission and having this decision overturned, doubtless the matter can be remitted to me for the assessment exercise to take place.

GW