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for Noise and Vibration Control

INDUSTRIAL DEAFNESS

A Review of the Information Available to the Ordinary Reasonable and Prudent Employer Prior to 1972

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"the overall test is still the conduct of the reasonable and prudent employer, taking positive thought for the safety of his workers in the light of what he knows or ought to know; where there is a recognised and general practice which has been followed for a substantial period in similar circumstances without mishap, he is entitled to follow it, unless in the light of common sense or newer knowledge it is clearly bad; but, where there is developing knowledge, he must keep reasonably abreast of it and not be too slow to apply it; and where he has in fact greater than average knowledge of the risks, he may be thereby obliged to take more than the average or standard precautions. He must weight up the risk in terms of the likelihood of injury occurring and the potential consequences if it does; and he must balance against this the probable effectiveness of the precautions that can be taken to meet it and the expense and inconvenience they involve. If he is found to have fallen below the standard to be properly expected of a reasonable and prudent employer in these respects, he is negligent".

Mr. Justice Swanwick
Stokes -v- Guest Keen and Nettlefold
Bolts and Nuts Limited
1968, 1 Weekly Law Reports 1983.

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PREFACE

It seems a common sense conclusion that excessive noise exposure ought to cause loss of hearing and knowledge of a factual, albeit only qualitative, link extends back beyond living memory. But in establishing negligence in a Common Law claim for damages, in this case for industrial deafness, it is not merely sufficient to demonstrate that a risk existed. It is necessary to show that the particular risk was appreciated, and moreover that practical remedies existed within industry at the relevant time or over the relevant period in question.

The knowledge and equipment for putting practical hearing conservation programmes into effect in industry in the United Kingdom has only really developed since the Second World War. That development culminated in April 1972 with the publication of the Department of Employment "Code of Practice for Reducing the Exposure of Employed Persons to Noise".

The publication of this Code was accorded immediate and widespread publicity. The numbers of trade magazines and journals, plus other advertising literature, began to increase substantially at about the same time. This may have been partly as a result of publication of the Code, but seems to have been mainly in anticipation of the implementation of the Health and Safety at Work etc. Act 1974. The overall result was to bring the hazards of excessive noise exposure and the resulting hearing loss to the attention of virtually everyone connected with industry.

The period up to April 1972 is relevant in establishing liability in the majority of claims now arising for occupational hearing loss. With the exception of a few very early numbers which could not be located, all issues of safety, occupational health and industrial medical periodicals published in the United Kingdom up to this date have been searched. In addition, the Annual Reports of H.M. Chief Inspector of Factories, Reports of Parliamentary Debates (Hansard), The Times newspaper and the Annual Reports of the Trades Union Congress have been searched from the 1920's. Dates and information relevant to the development or marketing of equipment have been elicited from the major suppliers, and included in the review where appropriate.

The present review has been restricted to purely factual matters and sometimes technical criticism. Issues relating to possible negligence have been excluded from comment as these remain legal matters for the Courts to decide.

Every care has been taken to check the accuracy of facts and dates mentioned in this review. In many instances, reliance must be placed on contemporary reports, and occasionally these may prove to have been inaccurate. Suspected errors have been pointed out in the text, but responsibility cannot be accepted for quotations where the original source proves to be at fault.

Finally, the author would like to acknowledge the assistance freely given over the past two and a half years by the staffs of libraries, companies, institutions and associations and other persons too numerous to mention individually. This review would not have been possible without their willing co-operation.

W. I. Acton.
January, 1981.

1.0 INTRODUCTION

The cause and effect relationship between excessive noise exposure and industrial deafness has been known for a very long time. The Old Testament biblical reference to blacksmiths suffering ringing in their ears has been interpreted by some as indicating tinnitus due to excessive noise exposure. An authenticated causal link was put forward in the writings of Ramazini who noted in 1713 that millers and coppersmiths and those "dwelling near the Nile in Egypt" became hard of hearing due to noise exposure. There have been similar references in medical journals since at least 1831 when Dr. Fosbroke described the symptoms of "blacksmiths' deafness" in The Lancet and concluded it was "a consequence of their employment". Further references appeared in increasing numbers in the learned journals and text books which confirmed the cause and effect relationship between noise exposure and hearing loss, but these were generally written by doctors for doctors, or by scientists for scientists. Even references in the Annual Reports of H.M. Chief Inspector of Factories from as long ago as 1908 were only likely to have been read by interested parties and perhaps large employers at that time. The suggestion made in that report for fabricating ear plugs from cotton wool and vaseline, or cotton wool and plasticine, is hardly likely to have been acceptable at a time when middle ear disease was commonplace among the working classes and there was a natural reaction against putting anything in the ears.

Issues of negligence in Common Law claims for compensation for occupational hearing loss are settled by considering what the employer knew, or ought to have known, and what practices and remedies he took, or ought to have taken over the relevant period in question. This is reflected by the literature and sources of information which may have been available to safety officers and industrial management in general on the subject of remedies and means of protecting exposed personnel from the effects of excessive noise exposure.

The present review has, with the exception of a few missing numbers and some very early editions, covered all issues of safety, occupational health and nursing,and industrial medical periodicals published in the United Kingdom up to the number reporting the publication of the Department of Employment "Code of Practice for Reducing the Exposure of Employed Persons to Noise", which appeared in April 1972. This code received immediate and widespread publicity, and the number of relevant publications and amount of advertising literature began to mushroom at about this time following the appearance of the Robens Report and in anticipation of the Health and Safety at Work Act. It seems improbable that anyone connected with industry could justifiably plead ignorance of the effects of excessive noise exposure after this period, and in any case it would have been impracticable to keep the review within reasonable bounds.

In addition, publications circulating within industry which may have contained relevant information were surveyed, perhaps not quite so thoroughly, with the assistance of libraries and trade associations. Major suppliers of equipment were approached and almost all willingly provided information relevant to the development, manufacture and marketing of their products, and this has been included in the text where appropriate. Regretably, replies were not received from some of the smaller and "fringe" suppliers, and "informed" estimates can only be made in these cases. Journals published abroad and information relating to foreign equipment which would not normally have been available outside learned institutions have not been included.

The literature search involved looking not only for formal articles or papers, but also for advertisements and announcements of products such as ear protection, sound level meters, etc. The publications searched are listed below, and unless otherwise stated, the search was completed. Fuller information about publishers, dates, and so on is given in an appendix to this review.

Accidents

Annals of Occupational Hygiene

British Journal of Commerce Safety

British Journal of Industrial Medicine

British Journal of Industrial Safety

British Journal of Occupational Safety

H.M. Chief Inspector of Factories Annual Report (from 1920)

How Factory Accidents Happen

Industrial Accident Prevention Bulletin

Industrial Accidents

Industrial Health and Safety

Industrial Safety

Industrial Safety Bulletin

Journal for Industrial Nurses

Journal of The Institution of Industrial Safety Officers.

National Industrial Safety Study Conference Proceedings

Occupational Health

Occupational Safety and Health

Occupational Safety and Health Supplement

Occupational Safety Bulletin

Official Reports of Parliamentary Debates (Hansard) (from 1920)

Proceedings of the Royal Society of Medicine (from the inauguration of the Section of Occupational Medicine in 1964)

Protection

Safe Times

Safety

Safety and Rescue

Safety Equipment and Industrial Clothing

Safety First

Safety Record

The Times (from 1920)

Trades Union Congress Annual Report (from 1925)

Transactions of the Association of Industrial Medical Officers

Transactions of the Society of Occupational Medicine

Uniforms and Industrial Clothing

Very little concern was shown about industrial noise prior to the Second World War. Occasional mentions were included in the Annual Reports of H.M. Chief Inspector of Factories. These listed sources of noise, but tended to adopt the attitude that "Most industrial noise sources are inevitable" (1934 Annual Report). Directions for fabricating ear plugs were given, but a similar attitude to their usage prevailed with comments such as "Men are apt to regard the deafness as inevitable" (1908 Annual Report) and "Only in comparatively few cases do the workers appear conscious of any inconvenience sufficient to justify the wearing

of ear protectors" (1934 Annual Report). The subject appears to have been raised once only in the House of Commons by a Member who submitted an oral followed by a written question in 1936. The Times newspaper was preoccupied with community noise, and in particular that of motor vehicles. Only three minor references to excessive noise exposure being the cause of deafness were found.

The first safety magazine ("Safety First") was published by the National Safety First Association (the forerunner of the Royal Society for the Prevention of Accidents) in 1925. This, and all other pre-War journals incorporating the word "safety", were preoccupied with matters of life and limb, and to a large extent with road safety. The insidious occupational hazards, including noise, were not given any consideration whatsoever in journals of this type prior to 1947.

The first everyday references to be found were published in 1947. An article "Noise in the Factory" was published in The Times Review of Industry in February of that year, although the parent newspaper carried no reports until 1955. The former article concentrated on the scientific approach to noise measurement and reduction. A short paragraph headed "Ear Defenders" was relegated to the end, but this did not discuss the practicability or availability of these devices at that time. The text of a paper "Noise Abatement in Industry" originally presented to the National Safety Congress was published in the Autumn 1947 issue of The British Journal of Industrial Safety, and questions arising and the author's answers were printed in the next issue. This again concentrated on noise measurement and reduction, although some practical examples were quoted. Only "nuisance" effects were discussed and the question of ear protection was not raised.

Articles then appeared from time to time in safety, industrial and business magazines as well as the more specialist occupational medical and associated journals. A twenty page article printed in a periodical called "Scope" in October 1953 is mentioned because it has received considerable attention in the evidence given in cases heard in the High Court. This publication was the forerunner of "Business Systems and Equipment", and specialised in the business machinery field. It is understood that circulation was made by direct mail gratis to selected recipients. Interest in the subject began to increase and a turning point occurred around about 1968 when a number of articles appeared in fairly quick succession in "Industrial Safety".

The first reference to a purpose-made ear plug was in the British Medical Journal of 1883. The pressure by which this was retained in the ear could be "regulated by a screw". Commercial production of another ear plug, the Mallock-Armstrong, commenced in about 1914, and the same company first produced ear muffs just after the end of the Second World War. The present generation of ear plugs were first marketed in late 1950, and ear muffs in 1958. The first disposable ear plugs became available in the United Kingdom in December 1961.

The Mallock-Armstrong Company first advertised their ear muffs in an aeronautical journal (probably Aircraft Engineering) soon after the Second World War. This was a specialised field because of the obvious noise hazards associated with the development of jet engines, and need for engine testers and air-crew to be protected. An isolated advertisement for "Sonex" ear plugs appeared in the Summer 1951 issue of the British Journal of Industrial Safety. There were no further advertisments for ear protection in this journal for another twelve years. "Lee Sonic Ear Valv" ear plugs were advertised in the January 1957 edition of Accidents published by the Factory Inspectorate. This advertisment stressed the welfare benefits to be gained from wearing ear plugs but did not mention possible hearing damage. Sporadic advertising appeared in safety journals during the 1960's, but it was not until about 1968 that specialised advertisements for ear protection began to appear regularly.

The first posters for display in industry appear to have been published by Messrs Billesholms (now known as Bilsom International) just prior to March 1964. These were supplied to customers purchasing their glass down disposable ear plug material. The British Safety Council published its own poster in March, 1964.

2.0 THE STATE OF KNOWLEDGE

2.1 Annual Reports of H.M. Factory Inspectorate.

The most relevant literature for determining the state of knowledge are official documents, and in this case those published by H.M. Factory Inspectorate, who were the predecessors of the Health and Safety Executive.

The Annual Report of H.M. Chief Inspector of Factories and Workshops for 1908 reported a cause and effect relationship: "It is generally known that men employed in certain trades are liable to have their sense of hearing seriously impaired, if not entirely destroyed in course of time, as a result of long-continued exposure to loud noise. One well-known instance is that of boiler-maker's deafness.... Other occupations in which deafness, brought on by the conditions of employment, is also prevalent, are the hammering of metal sheets and cylinders, use of pneumatic tools, beetling of cloth, engine driving and firing of guns". The report went on to admit that "it is clear that the nature of the changes brought about in the hearing apparatus are very imperfectly understood". A later paragraph in the same report recommended the use of ear plugs fashioned from vaseline and cotton wool, or plasticine and cotton wool. However, it was admitted that "were the wearing of such plugs practicable.... it is believed (they would) prevent the onset of the deafness..... Material for scientific test of the matter has not been possible..... I wish it were possible that the wearing of the ear plugs described could be done under medical supervision, as the only point which calls for a note of caution in recommending their use generally is the possible consequences which might ensue were portions of the plug to be broken off and left in the auditory canal". The use of such types of ear plug would not be countenanced at the present time on grounds of hygiene. It must have been even less desirable in 1908 when, according to Medical Research Council and other reports, middle ear disease and other disorders of the ears were common.

In the 1927 Report of H.M. Chief Inspector of Factories (Command 3144, 1928), the Senior Medical Inspector reported the results of speaking and whispering test undertaken on 1,011 cotton weavers. "Nerve deafness or noise deafness alone was present in 6.7% of all examined and in 19.4% of those who had worked for 21 years and over". The inspector commented "This survey has points of interest, but seeing that a comparison with the general community cannot be made, no safe deduction can be drawn. It is not unlikely that if a similar examination of dwellers in large cities were made, a high percentage would be found to be suffering from some degree of deafness due to the din of modern city life". No suggestions were made for possible remedies for the noise exposure.

The 1929 report (Command 3633, 1930) was also apprehensive: "The information available on effect of noise is very indefinite; and very prolonged, and detailed scientific investigation would probably be necessary to establish any definite results as to its effect on individuals". The attitudes of both employees and managers in disregarding noise were mentioned also. "In general, there are no complaints from the workers. They tell me they never notice the noise after the first week in the factory and they do not find they are deaf to outside noises.. As far as I have enquired, I have not found in this district any factories where efforts have been made to minimise the volume of noise. The managers, and others receiving no complaints rarely consider the question". The section on noise in industry was concluded with four examples of attempts at noise control using absorbent material or partitioning.

A section of one chapter was devoted to "Noise in Industry" in the 1934 Annual Report (Command 4931, 1935). A list of "characteristic noise- producing agencies" was given, including textiles, steel fabrication by traditional methods and wood working machinery. The report spoke of "the amazing tolerance which the

workers have acquired" to noise. Deafness was mentioned only in relation to boilermakers and shipyard workers. Greater attention was given to "numerous complaints received from residents in the neighbourhood of factories", and six examples of noise reduction were quoted. On the subject of protection, "it was observed during the year that in only a few cases were ear defenders supplied to the workpeople". The attitude of the Factory Inspectorate to industrial noise was summarised at the end of the chapter as follows:-

> "(1) Most industrial noises are inevitable and cannot be eliminated at the source.
>
> (2) Only in comparatively few cases do the workers appear conscious of any inconvenience sufficient to justify the wearing of ear protectors. Any attempt at compulsion must be viewed in the light of known tremendous difficulty in getting workers to wear goggles to protect their eyes from dust or flying fragments.
>
> (3) The isolation of noise by constructional methods may well be regarded as so expensive as to preclude adoption, except for special work-places, until employers receive the stimulus of definite proof that noise is injurious to the employees or conducive to greater efficiency or improved output."

Brief references were made to noise in the 1936 (Command 5514, 1937), 1950 (Command 8445, 1952) and 1953 (Command 9330, 1954) reports, but in all cases the welfare of exposed persons was the main cause for concern. The possible hazardous effects of noise were not mentioned in any of these reports. The 1954 report (Command 9605, 1955) noted that "Anxiety has been felt for some time in very noisy industries about the possibility of impairment of hearing", and two situations where noise levels had been reduced in industry were briefly described. Again in 1955 (Command 8, 1956) some examples of noise reduction were quoted, but there was no mention of possible hazardous effects. The year 1957 saw the publication of a separate report of the Chief Inspector of Factories on Industrial Health (Command 558, 1958), and this mentioned briefly and for the first time that "both the Medical Research Council and the Department of Scientific and Industrial Research are giving consideration" to the subject of noise in industry.

No further mention of noise appears to have been made in annual reports until 1962 (Command 2129, 1963) when the allocation of funds for the joint Medical Research Council and National Physical Laboratory research project "into the effects of industrial noise on workers' hearing" was announced. It was reported that the research programme was "expected to occupy at least three years ....the research team will examine certain particularly noisy industries or processes and the effects on the workers employed in them". (In fact, the work was not publicly reported until March 1970, although some preliminary findings had been available as National Physical Laboratory scientific reports a couple of years earlier.) The part played by H.M. Factory Inspectorate in identifying suitable factories for a pilot investigation was mentioned. The same report also noted that the Ministry had also given evidence to the Committee on the Problem of Noise (the Wilson Committee), and that work had been put in hand to prepare a booklet "Noise and the Worker" which would "discuss practical measures which can be taken to mitigate the danger to hearing arising from excess industrial noise". This booklet was published in the Safety, Health and Welfare series in June 1963.

The publication of the Final Report of the Committee on the Problem of Noise and of the booklet "Noise and the Worker" were noted in the 1963 Annual Report of H.M. Chief Inspector of Factories on Industrial Health (Command 2444, 1964). In addition, a leaflet (Form 2124) also with the title "Noise and the Worker" was being distributed free of charge "to factory occupiers who seem to have a noise

problem". Progress with the joint Medical Research Council and National Physical Laboratory investigation was reported.

Noise and occupational deafness were discussed at some length and in three separate parts of the 1965 reports. The main report (Command 3080, 1966) predicted that "the reduction of noise will undoubtedly assume great importance in the future" and went on "It is most desirable that workers should be protected against excessive noise levels". The Report of the Chief Inspector of Factories on Industrial Health (Command 3081, 1966) contained sections headed "Positive action by industry to reduce noise levels" and "Occupational deafness". The former section very briefly described a number of examples of noise control in industry. The latter indicated that the relationship between noise exposure and loss of hearing was still not understood: "The exact nature of the damage is not known, nor is the relationship, if any, between temporary and permanent deafness .... The whole subject bristles with difficulties, including those of measuring noise and of measuring hearing loss, and not least of the difficulties is the lack of fundamental knowledge at the present time of the physiology of the inner ear and the actual nature of the acoustic trauma which noise produces. A further difficulty is that hearing loss which normally accompanies the process of growing older, is at the moment practically indistinguishable from occupational deafness.... The problem was examined in detail by the Wilson Committee whose report was published in 1963.... they advocated research and indicated some of the lines this should take. At present a very great deal of research is being conducted by various bodies."

The same report reproduced the hearing damage risk criterion published in the booklet "Noise and the Worker" in 1963. Although this had been expressed in terms of the old American Standard octave bands based on musical octaves, it was equivalent to about 89 dB(A) in modern terms. The reference to noise ended "when it is impossible to reduce noise to safe levels by environmental control, workers should be protected by ear-defenders. There are two main types - ear-plugs and ear-muffs - and both require to be carefully fitted".

Both the 1966 and 1967 annual reports contained sections headed "Noise in Industry" which gave examples where noise control had been achieved in certain processes or in specific industries. The 1966 report (Command 3359, 1967) repeated the quotation about ear-defenders given in the paragraph above. The 1967 report (Command 3745, 1968) said, in respect of textile machinery: "the possibility of minimising noise at the design stage has been discussed with the machine makers but it is clear that much research is required".

The 1969 annual report (Command 4461, 1970) was the first to devote a complete chapter to the subject of "Noise in Industry", with a further table in the Appendix summarising noise measurements made in 239 factories. It is evident from this that the Factory Inspectorate had only just, as a matter of policy, begun to consider the problem of noise throughout industry in general: "During 1968, 25 relatively simple noise measuring instruments were issued to Inspectors, distributed over the country, who had attended a special course on noise measurement at Southampton University (in September 1968). They were told that when they found a machine, a process or a factory which sounded noisy, they should make such measurements as they usefully could. They recorded 419 sets of measurements in 239 factories. An indication of these very tentative first results is given in Appendix 1".

Later, the report went on "The Burns/Robinson report has now authoritatively indicated the relationship between certain levels of noise and hearing loss, confirming many of the values which workers in the field had come to rely on. The difficult task that remains is to work out a practical programme which will reduce the risk of industrial workers being exposed to levels now known to be likely to result in hearing loss". (Note: although the Burns/Robinson report was

not publicly available until March 1970, it was dated May 1969 and must have been available within official government circles from at least that time).

It is evident from this report that the Inspectorate considered that industry was not taking the problem of noise seriously enough: ".... the most immediately effective expedient is personal protection. For most existing industrial exposures to noise there are available differing types of ear defenders which will reduce the intensity of noise received by the ear to a level which will ensure no damage whatsoever. Many commercial companies, as well as the armed services .... have provided suitable ear defenders for their employees, and have simultaneously developed education programmes by films, film strips, lectures and leaflets to illustrate the importance of protecting the ears from damage and the effectiveness of ear defenders to achieve this. It is to be hoped that many more companies will follow this lead".

A later paragraph of the same report began "It is clear that if industry is to come to grips with the issue of excessive noise a good deal more will need to be discovered about preventing noise at source, and much will have to be done to make both sides of industry aware of the problems and of their responsibilities .... . But industry must help itself. The Inspectorate can do no more than point the way and industry itself must diligently seek methods of preventing exposure to excessive noise by all means available. Already some firms have made great strides, and to their credit have made available their methods and the facts upon which they are based to other firms. Industry should follow this lead given by the most progressive firms".

The 1970 report (Command 4758, 1971) again contained a general section on noise, but noted deficiencies in the then available measuring instruments as follows: "Difficulties exist in measuring impulse noise and in integrating measurements of fluctuating noise in order to relate the effects of noise of this character with those of steady noise. Similar problems arise in the case of workers who move from place to place in the course of their work". Revision of the booklet "Noise and the Worker" to provide up to date information on noise measurement and the use of hearing protectors was noted (The revised booklet appeared during 1971).

The 1971 Annual Report (Command 5098, 1972) did not appear until September 1972; that is after the publication of the Code of Practice. However, it only contained a single line reference to noise, to the effect that the preliminary survey in foundries was being continued.

The publication of the Code of Practice was reported in the 1972 Annual Report, (Command 5398, 1973) which also noted that "Headquarters staff giving specialist advice on noise problems and noise control has now been increased to four engineers.... . Every division has specially trained and equipped Nominated Inspectors for Noise ..... and precision sound-level meters will soon be available in every district." Factory Inspectorate activity seems to have been restricted to "the problems of measuring noise doses" and completing "a special programme of visits to 1000 factories known to have a noise problem".

Early reports of the Chief Inspector were generally concerned with cause and effect relationships between noise and hearing loss, and several reports were merely couched in terms of the welfare of persons exposed to noise. The 1908 report proposed the use of ear plugs, but admitted that these measures had not been tried out and their efficiency was an unknown quantity. It is now generally appreciated that it would be most undesirable to put substances of the type recommended into the ears. Although the 1934 report devoted several pages to noise, the attitude of the Factory Inspectorate may be summed up as acceptance of the fact that nothing could be done about the situation. The 1962 report, published in September 1963, marked a turning point in the emphasis of these reports. The

joint Medical Research Council and National Physical Laboratory investigation into the relationship between noise exposure and loss of hearing had been announced, and the reports began to consider in practical terms what could be done to reduce personal noise exposures. The 1969 report, published in September 1970, made it quite clear that in spite of the progress which had been made, the Inspectorate considered that industry in general was not doing enough to help itself.

2.2 Other Official and Similar Documents

The first known official document to mention noise hazards was the Report of the Departmental Committee on Compensation for Industrial Diseases (the Samuel Committee) published in 1907 (Command 3495, H.M.S.O.). This dismissed "Boilermakers' deafness" briefly as follows: "This is unquestionably an injury due to employment, and is widely prevalent among men working in the incessant noise of the shipbuilding yard or the boilermakers' shop. It does not however prevent a man from continuing his trade and it cannot therefore give rise to claims for compensation on the grounds of incapacitation" under the Workman's Compensation Acts.

The thirteenth Annual Report of the Industrial Health Research Board (CROWDEN 1933) included a report of "An investigation of the hearing of those exposed to the noise of riveting". Further details have not been obtained.

Two reports by WESTON and ADAMS published by the Industrial Health Research Board (Report No. 65, 1932 and No. 70, 1935) were concerned with the effects of noise on the work performance of weavers. The noise-reduced condition for the experiments was achieved by the use of Mallock-Armstrong ear plugs. Occupational hearing loss or the true purpose of the plugs were not mentioned in the reports, but the first report in particular is interesting as it commented upon the weavers' reactions to noise and the use of the ear plugs. Acclimatisation to, and acceptance of the noise was reported to be the "almost invariable" reaction, and at the end of the experiment only six out of ten subjects were in any way favourably disposed towards the plugs.

H.M. Factory Inspectorate published a quarterly journal "Industrial Accidents" in 1933, and the title was changed to "How Factory Accidents Happen" in 1937. Publication was suspended with the outbreak of the Second World War, and resumed between 1949 and 1973 with the title "Accidents, how they happen and how to prevent them". These journals never mentioned the hazards of excessive noise exposure, except perhaps as a contributory factor to accidents by masking warning shouts.

A Ministry of Works report published in 1944 "Sound Insulation and Acoustics" (Post War Building Studies No. 14, H.M.S.O.) was primarly concerned with two facets of noise; firstly the means of controlling annoyance and nuisance both from outside noise and through sound transmission within buildings by means of sound insulation; and secondly with the means of improving the acoustics within auditoria and similar spaces. The scope of the report specifically excluded occupational hearing loss: "We have not been able to consider the problem of noise and industrial health" (paragraph 11). Nevertheless, there were two further brief references to the subject: "Cases have been quoted of certain noisy industries having a permanent effect on the hearing of operatives" (paragraph 259) and "It is understood that noise in factories is the cause not only of reduced efficiency but also in some cases of permanent deafness." (paragraph 300). No reference was made to practical remedies to reduce personal exposure in industry.

A Medical Research Council supported study of the hearing of workers in certain noisy engineering factories is mentioned in the Report of the Council for the year 1951-52 (Command 8876, 1953). This work forms the basis of an article published by Johnston in 1953 (British Journal of Industrial Medicine, 10, 41).

This was essentially a cause and effect type of investigation carried out in three named companies in the Midlands engaged in heavy engineering including boilermaking, drop forging and screw heading. Johnston noted "If a group of men have worked in a loud but steady noise for the same number of years the effects on the hearing of the men will vary widely. Thus it is not possible to give a precise level of noise above which hearing will be impaired". The "Prevention of Occupational Deafness" was mentioned towards the end of the paper and Johnston discussed the practical difficulties and shortcomings associated with the types of ear protection then available. For instance, experimental test of one muff-type of ear defender primarily designed for use of guncrews "showed that considerable aural fatigue from noise occurred when the defender was worn". In other words, it did not provide very adequate protection. Ear plugs were liable to "irritate the meatal skin (ear canal), particularly in hot and dusty trades" and the risk of infection was mentioned. Johnston concluded that further development of ear protection was desirable. He also commented upon the acceptance of hearing loss as part of the job, and the reluctance of persons exposed to all forms of hazards to use protective equipment, including ear defenders.

A government committee set up to investigate the conditions in the drop forging industry reported in 1953 (Ministry of Labour and National Service 1953). Paragraph 17 is reproduced in full as follows, and is self explanatory:

> "Some members of the Committee suggested that an investigation as to deafness among the forge workers, particularly the hammer men, would be worthwhile. We have had insufficient time to carry out this suggestion in any detail but enquiries have been made through the Employers' Association. The information received is not sufficient upon which to form a final opinion but we feel justified in saying that we have insufficient evidence to support a view held in some quarters that there is an amount of deafness among these workers in excess of the general population. There is probably a reason for more complete enquiry by properly qualified investigators.
>
> In this industry as in many other industries there is some anxiety about the effect of production noise on hearing and working conditions; in our view these aspects merit full investigation."

Appendix 1A headed "Buildings" contained the one sentence paragraph "Attention should also be given to the ever present problem of sound absorption".

A Government "white paper" published in March 1955 (Minister of Labour and National Service, 1955) outlined proposed action on certain recommendations adopted by the International Labour Conference in 1953. Paragraph 2 of Recommendation No. 97 called for measures by employers to eliminate or reduce harmful noise or vibrations. Whilst this was accepted in principle the Government did "not consider it practicable to legislate in the present state of knowledge on the subject and are therefore unable to accept an obligation to ensure the application of employers of this particular provision".

A survey into industrial health in Halifax sponsored by the Ministry of Labour and reported in 1958 (H.M.S.O.) identified noise as a national problem, and "liable to affect the health of workers adversely".

A factory building study entitled "Noise in Factories" by Aldersey Williams was published in 1960 by the Building Research Station (H.M.S.O.). This booklet was aimed at the designers of new factory buildings, and a large proportion of the contents deal with noise control at source, by machine layouts, enclosures, sound absorbent materials, screens, etc. Occupational hearing loss was described, a tentative hearing damage risk criterion put forward and the noise levels associated with some common industrial processes given. The final section dealt

briefly with ear protection. Ear plugs and ear muffs were described and illustrated, and mean attenuation figures given. The need to fit the correct size of ear plug was mentioned, as was the need for an educational programme to overcome employee reluctance to wear ear protection, although the problems associated with organising and running hearing conservation programmes were generally not discussed. Because of the terms of reference of the Committee which prepared this report, it seems likely that any advertising and publicity associated with its publication would have been directed towards architects and developers, rather than the occupiers of existing premises.

A three day symposium on the "Control of Noise" was held at the National Physical Laboratory in June 1961 and the proceedings published by H.M.S.O. in the following year. The nature of the papers presented was wide ranging, and included aircraft, traffic and community as well as industrial noise. Out of a total of 24 papers, one dealt with hearing damage risk, one with the methodology of audiometry and another with the development of ear protectors. The papers throughout were generally of a research nature, and contained little practical advice of immediate value to factory occupiers, although there were obvious long term implications. This was reflected in the attendance list, which showed a large proportion of delegates from government and research and other learned institutions. Excluding the aircraft industry and suppliers of noise control equipment, only 84 of the 323 delegates were from production industry representing some 50 companies. Reviews or other mention of the publication of the proceedings were generally not found during the search of the other literature, and the publication is not likely to have come to the notice of many occupiers of factories.

Two very significant documents were published in 1963. In June, the (then) Ministry of Labour booklet "Noise and the Worker" appeared, and in July the Final Report of the Committee on the Problem of Noise (the Wilson Committee Report). Both received fairly widespread publicity.

The (then) Ministry of Labour booklet "Noise and the Worker" was not a technical treatise. An early and important section is headed "Have you a Noise Problem?", and reads as follows:-

> "A convenient test of hearing impairment is whether workers can hear and understand everyday speech under everyday (quiet) conditions. If they begin to find this difficult it may well be that they are being exposed to excessive noise. This effect may not, however, show itself for some considerable time.
>
> The following points should also be considered:
>
> 1. Do workers find it difficult to hear each other speak while they are at work in a noisy environment?
>
> 2. Have workers complained of head noises or ringing in the ears after working in noise for several hours?
>
> 3. Have workers who have been exposed to very high noise levels for short periods experienced temporary deafness, severe enough for them to seek medical advice?
>
> 4. Have workers exposed for longer periods complained of a loss of hearing that has had the effect of muffling speech and certain other sounds? Have they been told by their families that they are becoming deaf?

5. Has there been a higher labour turnover in workshops or sections where there is a lot of noise?

6. Has management formed the opinion that noise is affecting production?

If the answer to several of these questions is 'yes'there may well be a problem of excessive noise....."

Later, under the heading "The Danger Levels of Noise", it gave a criterion above which damage to the hearing is likely to occur. Although this was expressed in terms of the old American Standard octave bands based on musical octaves, the figures were equivalent to about 89 dB(A) in modern terms. The principles of noise control, both at source and in transmission were discussed. Reduction of personal exposures by modified working arrangements was suggested, and ear plugs and ear muffs were given as available forms of personal protection. The practical problems associated with using ear protection were not discussed. Monitoring audiometry was advised for those persons likely to be exposed to noise levels approaching or above the damage risk criterion, even though they may have been issued with ear protectors.

A second edition of the booklet was printed in 1968 and contained references to noise in shops, offices and to noise affecting the community. A number of advertisements for ear protection and noise control equipment both preceded and followed the text. A revised edition published in 1971 evidently anticipated the Department of Employment Code of Practice, as it was written in terms of "A-weighted" sound level (i.e. dB(A)),with a basic 8-hour damage risk criterion of 90 dB(A) and a trading relationship for shorter periods based on the equal energy principle. The same list of six check questions was retained, except that the reference to "several" was replaced by "If the answer to any of these questions is 'yes'...."

The original publication of "Noise and the Worker" was accompanied by a four page leaflet of the same title (Ministry of Labour Form 2124). The 1963 Annual Report of H.M. Chief Inspector of Factories on Industrial Health reported that this was "distributed free of charge by H.M. Factory Inspectors to factory occupiers who seem to have a noise problem". The printers code on the reprint of this leaflet shows 7,000 copies, although Bryan and Tempest (1970), without referencing the source of their information, wrote that "Apparently 20,000 such leaflets were printed and are understood to have been distributed 'in a somewhat haphazard way' by the Factory Inspectorate offices to firms employing more than 250 persons".

The Final Report of the Committee on the Problem of Noise (Command 2056, 1963), popularly known as the Wilson Committee Report, appeared one month later in July 1963. This was primarily concerned with community and aircraft noise, although the final chapter (number 13) was devoted to "Occupational Exposure to High Levels of Noise". This discussed the temporary and permanent effects on the hearing of exposure to high levels of noise, but admitted that "our knowledge is very inadequate" (Paragraph 509). Criteria from three separate sources were mentioned at which measures to protect the hearing should be taken (Paragraph 521), and all were equivalent to approximately 90 dB(A) in modern terms. Where noise represents a hazard to hearing there are two courses open: to reduce the noise to levels which are safe or to protect the ears. Cotton wool is of little value, and ear plugs and ear muffs were given as satisfactory forms of protection, although the practical problems associated with their usage were not discussed. The Committee did "not consider that the present knowledge of this complex problem provides a sufficient basis for legislation". Some of the relevant shortcomings in the knowledge were then discussed (Paragraph 534). They "concluded that research should be undertaken to provide the basic knowledge..... which would enable detailed studies to be carried out, industry by industry, to show where noise hazards exist and how they could be reduced ..... " (Paragraph 535).

The Ministry of Labour published a "confidential" internal circular "To all H.M. Inspectors of Factories" dated 29 May 1963 on the subject of "Noise in Industry". This mentioned the publication of both "Noise and Worker" and the Wilson Committee Report. It then went on "Inspectors should deal with any problems of noise during general inspections. They should be careful not to give practical advice beyond that contained in the booklet .....", which was, of course, of fairly limited scope.

The Department of Scientific and Industrial Research (D.S.I.R.) published its own booklet "Noise in Industry" in 1964 written by D.E. BROADBENT, who was then Director of the Medical Research Council Applied Psychology Research Unit. This booklet was wider in scope than "Noise and the Worker", and although it was available free, it does not appear to have "caught on" in the same way. Perhaps this was because it was not sold "over the counter" and postal application was necessary to obtain copies. Copies are rarely seen now. The three effects of noise in industry were given as annoyance, damage to hearing and reduction in working efficiency. The hearing damage risk criterion given in the first edition of "Noise and the Worker" was repeated. It suggested that measuring the noise was the first step, then noise control at source, vibration isolation, enclosure of noise sources, absorbent treatment of walls and ceilings, and finally ear plugs and ear muffs as remedies. Apart from the difficulties of fitting ear plugs, the practical problems likely to be associated with the use of ear protection were not mentioned. Audiometry was recommended where exposed personnel had to rely on ear protection.

A further report was published in 1966 by the Joint Standing Committee on Health, Safety and Welfare in the Drop Forging Industry. This again only made a brief reference to noise, which is reproduced in full as follows:-

> "Table 3, Appendix VII, shows that in 15% of the forges surveyed some attempt has been made to provide protection against noise. The Committee is aware that there is at present no proven technical method of reducing noise other than by ear defenders, to which there is great operator resistance.
>
> This does not mean, however, that the problem is being neglected either from the point of view of the persons employed, or, in these days of increasing congestion of population, from the point of view of neighbours of the forge. On the contrary considerable research has already been undertaken by the Drop Forge Research Association, and the Trade Association is represented on the Noise Panel of the Confederation of British Industry".

British Standard 4078 "Cartridge-operated fixing tools", first published in 1966, drew attention to the potential noise hazard to users of this particular type of tool. Although there were other British Standards on acoustics and the specification of measuring instruments, this is thought to be the only Standard published during the relevant time period which mentioned hearing hazard.

The Chief Safety Officer of the Ministry of Technology prepared a Code of Practice in 1968 for use within Ministry of Technology establishments. It applied to Crown Servants, employed by or seconded to the Ministry of Technology only. It has never been openly published, although copies have become available in more recent years. The basic 8-hour criterion was 90 dB(A), with a trading relationship for shorter dutations close to, but not quite co-incidental with, the equal energy principle. Suitable hearing conservation procedures were described in some detail. Mean attenuation values for Royal Air Force and certain commercially available forms of ear protection were appended to the Code.

The Department of the Environment Advisory Leaflet Number 72 "Noise Control on

Building Sites" was first published in 1968, with second and third editions in 1972 and 1976 respectively. Copies of the first or second editions have not been obtained, but the third edition contains a brief paragraph "Protecting mens' hearing", which gives an eight-hour hearing damage risk criterion of 90 dB(A), and suggests the use of ear plugs and ear muffs as available means of protection. Advisory Leaflet Number 80 "Health Risks in Construction" which was first published in 1971 with a second edition in 1975 contains in its second edition a very brief mention of noise and cross-references the earlier leaflet number 72.

The Industrial Injuries Advisory Council in 1969 (Industrial Noise and its effect on hearing, Command 4145, H.M.S.O.) concluded that, while important and difficult problems still remained, the stage had been reached as a result of the joint Medical Research Council and National Physical Laboratory Study, when a formal investigation of the question of prescription of occupational hearing loss as an industrial disease could be undertaken.

The report of the joint Medical Research Council and National Physical Laboratory study appeared publicly in March 1970 as "Hearing and Noise in Industry" by BURNS and ROBINSON (H.M.S.O.). The report itself was dated May 1969, and it is thought to have been submitted to the Secretary of State for Social Services late in 1968. In fact, preliminary results had been available since July 1968 as a National Physical Laboratory report but circulation was limited more or less to scientific and medical institutions. Burns and Robinson evolved a system of predicting the hearing losses likely to be sustained from dB(A) levels and time using an energy basis. The unit of exposure was termed the noise immission level. Whilst the report facilitated the specification of acceptable levels of noise exposure it did not propose any quantitative value for a hearing damage risk criterion, neither did it make any proposals for hearing conservation measures.

A Noise Advisory Council document (70) 16 headed "Industrial Noise" reviewed the legislation and official government publications available in 1970 on the subjects of both internal factory and community noise from industry. The work and proposals of then active committees was mentioned, as well as the proposed preparation of the document now known as the Department of Employment Code of Practice, which was published in April 1972. A copy of the chapter and appendix on noise from the Annual Report of the Chief Inspector of Factories for 1969 was appended. The essence of this chapter was that, in the opinion of the Inspectorate, industry was not doing enough to help itself. The document from the Noise Advisory Council was type-written and it does not appear to have been intended for formal publication.

The Factory Inspectorate produced Technical Data Note 12 "Notes for the guidance of designers on the reduction of machinery noise" in 1970. This pamphlet described in general terms the principles of noise control without specific reference to hearing damage risk.

Technical Data Note 31 published in April 1972 by the Factory Inspectorate dealt with "Noise in weaving sheds: a short survey". This compared measured noise levels from textile machinery with hearing damage risk criteria. It discussed the provision and use of ear protectors, and made cynical observations about, firstly, the low number of firms in the textile industry who had issued ear protection, and secondly the lack of co-operation on the part of employees where ear protectors were available.

The publication of the Department of Employment "Code of Practice for Reducing the exposure of employed persons to noise" was launched with a press conference held on 17 April 1972. The Press Notice which was released by the Department of Employment at the time was couched in terms of "what needs to be done", and speaks of "many firms (which) have taken little concrete action to tackle the problem". A single sided leaflet headed "NOISE a code of practice"(Reference SHW 22)

accompanied the publication. This stressed the joint part that workers should play: they should "readily co-operate in noise control measures" and "always wear ear protection where it is provided".

2.3 Parliamentary Debates

The Official Reports of Parliamentary Debates (Hansard) were searched from 1920 by looking for a range of "key" words in the Annual General Index. Minor difficulties were encountered as responsibility for industrial noise and occupational deafness passed between Government departments during the period, and the titles of those departments also changed from time to time. However, it seems that the search was more or less complete as all references obtained from other sources were also located by this procedure.

Most parliamentary debates and questions have centred on traffic or other community noise and, after the Second World War, on aircraft noise also. The following debates and questions are relevant to industrial noise and occupational deafness.

In the first reference located in 1928, the Minister of Health refused a request to set up "a Committee to investigate the effects of noise upon the health and efficiency of the people" with the reply "As at present advised, my right hon. Friend does not think that there will be advantage in the setting up of a Committee of this kind". (Parliamentary Debates 217, 859, 1928).

On 30 July 1936 Mr W. Roberts asked the Home Secretary "whether any progress has been made in the direction of eliminating unnecessary noise in factories and workshops?". The reply referred the questioner to the annual report of the Chief Inspector of Factories for 1934 and the annual report of the Industrial Health Research Board which was investigating the "effects of noise on the worker". (Parliamentary Debates 315, 1708, 1935-36).

A written answer to a similar question on 19 January 1937 said "that they have not received any further report on the subject from the Industrial Health Research Board, but that investigations are still proceeding. I understand that great difficulty is being experienced in finding suitable opportunities or methods for detecting and measuring any effects which noise may have on the workers". (Parliamentary Debates (written answers) 319, 40, 1936-37).

Another request for "a committee to inquire into the detrimental effect of unnecessary noise on the health of people" was dismissed with a written answer on 14 June 1937 as follows: "Research into the effect of noise on workers carried out by the Industrial Health Research Board of the Medical Research Council, on which reports have been published, shows that it is very difficult to detect and measure any specific effects of noise on health..... As at present advised, I do not think the subject lends itself to investigation by a committee as suggested." (Parliamentary Debates (written answers) 325, 41, 1936-37).

Parliament was obviously preoccupied with other matters during the period of the Second World War and the immediate post-War recovery years. The situation is reflected in a comment made by Mr. H. Nicholls on 6 May 1952 when the Minster of Labour was asked whether factory inspectors have advisory powers in connection with the abatement of industrial noise interfering with the sleep of persons living in the immediate vicinity of factories. Mr. Nicholls' comment was as follows: "Is the Minister aware that if there were powers the Factory Inspectorate is so much below establishment that it would be doubtful if they could give attention to the matter?" (Parliamentary Debates, 500, 167, 1951-52).

The first parliamentary recognition of occupational deafness was made on 31st March 1953 when Dr. Stross asked the Minister of Labour "whether he has noted

that about half the number of men employed in chipping, riveting, stamping, plating and heading became deafened to speech at more than three feet after 20 years exposure to the noise created at their work; and what steps are being taken to protect them from this type of deafness". The Parliamentary Secretary to the Ministry of Labour (Mr. Harold Watkinson) replied:

> "My Department is aware of the recent report of a committee of the Medical Research Council on the medical and surgical problems of deafness and that exposure over many years to noise above certain intensities may cause deterioration in hearing. Much research is being carried out into this question and, as announced by my hon. Friend the Parliamentary Secretary to the Ministry of Works on 24 March, a committee has been set up jointly by the Department of Scientific and Industrial Research and the Medical Research Council* which will consider, among other things, the effect of noise in relation to human efficiency.
>
> The harmful effects of noise on the individual can be reduced to some extent by the wearing of protective ear coverings and by eliminating injurious noise at its source by improved designs of machines and their mountings and the sound insulation of walls and ceilings; but the subject has been found to bristle with practical difficulties".

Dr Stross:

> "Is the hon. Gentleman aware that protective ear coverings appear to be very much in their infancy, and that there is not a satisfactory type available? Could he tell me if specific research is to be conducted into finding the right type of protective ear covering for these men?"

Mr Watkinson:

> "Yes, that is so".

(Parliamentary Debates 513, 1011, 1952-53)

On Friday 2nd December 1955, Sir Lionel Heald, opened a debate with the Private Member's Motion:-

> "That this House notes with concern the detrimental effect of noise and vibration on the health, wellbeing and efficiency of the nation; and urges Her Majesty's Government to give careful attention to the importance of research and education in this field, and to the need for more effective measures for the protection of the public".

The debate which ensued was far ranging, but a large proportion was concerned with noise nuisance, road transport, airports and aircraft. The general acceptance of occupational hearing loss as an inevitable result of working in noisy industries was noted, as was the lack of any legislation or regulation to

*Note: The Parliamentary Secretary to the Ministry of Labour was referring to the Report of the Medical Research Council for the year 1951-1952 (Command 8876, 1953). The particular study mentioned formed the basis of a paper by JOHNSTON "A field study of occupational deafness", British Journal of Industrial Medicine, 10, 41, 1953.

control noise levels within industry. No government departments or establishments, including the National Physical Laboratory, were concerned with the matter, and neither were the Trades Union Congress, or the British Employers' Federation (the forerunner of the Confederation of British Industry). The Joint Under-Secretary of State for the Home Department, replying for the Government, noted that "Her Majesty's inspectors of factories do, however, in the course of their duties, encourage employers to keep noise to a minimum". The debate was curtailed when the House became no longer quorate. (Parliamentary Debates 546, 2665, 1955-56)

Sir Lionel Heald raised the matter of noise again on 12 March 1956 when he asked the Minister of Health when he expected to receive a report from the Committee on Individual Efficiency in Industry which was last referred to in an answer given on 31 March 1953. The Minister replied that "The primary task of this Committee is to suggest and stimulate research on all matters affecting the technical efficiency of the individual in industry. The Committee has not published any reports, but I understand that it considered the subject of noise at its meeting last month and concluded that the evidence available did not justify it treating research on this subject as a matter of primary urgency in relation to other commitments of greater importance from the point of view of industrial productivity .... " (Parliamentary Debates, 550, 17, 1955-56).

On 18th February 1959, Mr. Marquand asked the Minister of Labour:

> "(1) What studies of the effect of noise in factories and workshops are being made by the Factory Inspectorate; and what further research into this matter he intends to undertake;
>
> (2) What representations have been made to him by organisations of workers or of employers about the effect of noise upon the health of industrial workers".

Mr. Wood (in reply)

> "No representations of this kind have been made to me and the Factory Inspectorate is not making such studies. The problem of noise is of interest to my Department and several others. The question of developing research work in this field is being considered by the Inter-departmental Committee on the Co-ordination of Occupational Health Research of which an officer in my Department is chairman".

(Parliamentary Debates (written answers), 600, 49, 1958-59).

In a reply to a similar written question from Mr. Marquand, the Misister of Health, on 18 February 1959, stated that "surveys are being undertaken to define the normal deterioration of hearing which occurs with age and the extent to which this may be modified by exposure to industrial noise"* (Parliamentary Debates (written answers), 600, 65, 1958-59)

On 14 December 1959, Mr. Nabarro asked the Minister of Health "whether he is aware of the growing damage to human efficiency, the bad effects upon health ... caused by unregulated noise.... and whether he will establish a committee ....to

*Note: The former part of the reply referred to the presbyacusis studies of Hinchcliffe. As far as it is known, no specific studies of the effects of industrial noise on hearing were made at that time.

inquire into all sources of noise.... and to make legislative reccommendations." A further question from Mr. Ronald Bell asked "what action he proposes to take to deal with the growing menace to health of mind and body caused by noise of all kinds; and what research under his control is being conducted into it". The Minister replied that "The Government have decided to set up a committee* to examine the nature, sources and effects of the problem of noise and to advise what further measures can be taken to mitigate it". (Parliamentary Debates 615, 1018, 1959-60). Further references to the Committee were made in written answers on 22 February 1960 and 13 April 1960 (Parliamentary Debates (written answers), 618, 4, 1959-60, and 621, 134, 1959-60).

The second reading of the Noise Abatement Bill on 4th March 1960, although concerned with community noise and noise nuisance, contained brief reference to hearing damage and compensation for occupational hearing loss in Italy and certain American States. (Parliamentary Debates 618, 1598 and 618, 1599, 1959-60)

The question of prescription of deafness under the Industrial Injuries Act was first raised by Mr. Prentice in a question on 1 February 1960. The Minister of Pensions and National Insurance replied that he had "no such proposals". (Parliamentary Debates, 616, 610, 1959-60). A further question by Mr. Prentice on 20 June 1960 asking "what research is being conducted .... into occupational deafness, with a view to its possible prescription as an industrial disease" received the short reply "None". (Parliamentary Debates, 625, 12, 1959-60). Yet another question by Mr. Prentice on 28 November 1960 on the same subject received the reply "None, Sir, though I understand that the Industrial Injuries Advisory Council has been keeping this disease under review as part of its normal duties". (Parliamentary Debates, 631, 2, 1960-61).

The same matter was raised by Mr. Stonehouse on 6 February 1961 who asked the Minister"if he will amend the Regulations under the Industrial Injuries Act to enable deafness caused by industrial conditions to qualify for benefit". The answer was simply "No". (Parliamentary Debates 634, 21, 1960-61) A written reply to Mr. Prentice on 16 June 1961 was somewhat longer although still negative. (Parliamentary Debates (written answers), 642, 81, 1960-61). Mr Prentice attempted to pursue the matter further on 17 July 1961 with an oral question, and received an evasive response from the Minister (Parliamentary Debates, 644, 863, 1960-61). A direct question by Mr. F. Noel-Baker asking the "Minister of Pensions and National Insurance whether he will now prescribe industrial deafness" received the written answer "No" on 24 July 1961. (Parliamentary Debates (written answers) 645, 12, 1960-61).

Slightly different tactics by Mr. Mawby received a more encouraging written reply on 29 January 1962. He "asked the Minister of Pensions and National Insurance whether he will use his powers ..... to promote research into occupational deafness". The full reply was as follows:-

> "The Industrial Injuries Advisory Council, which is studying occupational deafness from the standpoint of possible prescription under the Industrial Injuries Act, has asked me to initiate research to help it in its further consideration of this matter. The Government have now decided to use their powers under Section 73 of the Industrial Injuries Act to finance a major scheme of research. The work has been planned by and will be carried out jointly by the Department of Scientific and Industrial Research

*Note: This Committee was to be the well know Committee on the Problem of Noise under the chairmanship of Sir Alan Wilson.

> and the Medical Research Council. The project is primarily aimed at obtaining reliable information about the effects of industrial noise on hearing, with special reference to those physical features of noise responsible for damage to hearing, but it is also designed to study preventive measures in industry, which are the concern of my right hon. Friend the Minister of Labour."

(Parliamentary Debates (written answers), 652, 55, 1961-62). A similar question by Mr. Dugdale received a written answer on 31 January 1962 referring him to the above (Parliamentary Debates (written answers), 652, 102, 1961-62).

Another direct question by Mr. F. Noel-Baker on 5 February 1962 asking for prescription of industrial deafness received the curt reply "No". After a supplementary question, the Minister of Pensions and National Insurance referred to the written answer of 29 January and added "Until that inquiry has been pursued, action of the sort which the hon. Gentleman suggests by his Question would be quite inappropriate"(Parliamentary Debates, 653, 20, 1961-62).

Mr. Prentice asked about the progress of the research programme into the problems of occupational deafness on 19 February 1963 (Parliamentary Debates, 654, 5, 1961-62), on 9 July 1962 (Parliamentary Debates (written answers), 662, 97, 1961-62), and again on 22 June 1964 (Parliamentary Debates, 697, 29, 1963-64). On each occasion the Minister declined to anticipate the completion of the programme.

In a debate on occupational hygiène services on 26 November 1964, Mrs. M. McKay drew attention to noise in industry and said "Loss of hearing from industrial causes is now regarded as one of the two major causes of accidents and dangers in the factory". (Parliamentary Debates, 702, 1696, 1964-65).

The progress of the research programme and the possible prescription of occupational deafness were pursued in questions by Mr. Varley on 14 December 1964 (Parliamentary Debates (written answers), 704, 9, 1964-65), by Mrs. McKay on 9 May 1966 (Parliamentary Debates (written answers), 728, 17, 1966-67) and on 18 July 1967 (Parliamentary Debates (written answers), 750, 230, 1966-67), and by Mr. Oakes on 1 April 1968 (Parliamentary Debates (written answers), 762, 45, 1967-68).

The wider issues of controlling personal noise exposures and other hearing conservation measures were raised in a written answer to a question by Mr. Oakes on 29 January 1969. This read as follows:-

> "The protection of employed persons against the harmful effects of noise is one of the matters dealt with in the general proposals for new safety, health and welfare legislation at present under consideration. The possible provisions my right hon. Friend has in mind include a ban on continuous exposure to noise above a specified level; a general requirement to reduce noise as far as reasonably practicable; and where workers are unavoidably exposed to noise above a specified level, a requirement to provide them with ear defenders. It is also proposed that there should be power to make regulations about noise. The question of medical examinations will be considered further in the light of the forthcoming report of the survey on occupational deafness carried out by the Medical Research Council and the National Physical Laboratory for the Department of Health and Social Security."

(Parliamentary Debates (written answers), 776, 345, 1968-68). This was reinforced with a reply to a question by Mr. Archer on 31 March 1969. The Secretary of State for Employment and Productivity revealed that the report of the survey on

occupational deafness carried out by the Medical Research Council and National Physical Laboratory had been received, and went on "Her Majesty's Factory Inspectorate continues to provide advice to industry on methods of noise reduction; the specialist staff has been strengthened for this purpose, a number of Inspectors throughout the divisions have been equipped with measuring instruments and selected Inspectors given specialised training' (Parliamentary Debates 781, 13, 1968-69).

Further questions were tabled by Mr. Archer on 14 April 1969 on the effects of noise on health (Parliamentary Debates, 781, 764, 1968-69), and on 16 April 1969 he asked the Minister of Technology "whether he will take steps to encourage research into the elimination or reduction of noise from industrial processes.." He was given the reply that"Work on problems of industrial noise is already in progress at several of the Ministry's establishments" (Parliamentary Debates 781, 1130, 1968-69).

The question of prescription of occupational deafness was raised on several further occasions, by Mr. Oakes on 29 January 1969 (Parliamentary Debates (written answers) 776, 345, 1968-69) and on 13 May 1969 (Parliamentary Debates (written answers), 783, 207, 1968-69), by Mr. Marks on 22 October 1969 (Parliamentary Debates (written answers), 788, 270, 1968-69), by Mr. Oakes on 3 November 1969 (Parliamentary Debates, 790, 647, 1969-70), by Mr. Archer on 9 February 1970 (Parliamentary Debates 795, 908, 1969-70), by Mr.Oakes on 26 October 1971 (Parliamentary Debates (written answers), 823, 291, 1971-72), by Dr. Summerskill on 20 December 1971 (Parliamentary Debates, 828, 262, 1971-72), and by Mr. Clinton Davis on 17 January 1972 (Parliamentary Debates, 829, 97, 1971-72). In each instance, a reply was given to the effect that the matter was under consideration by the Industrial Injuries Advisory Council.

Questions about occupational deafness, without reference to prescription were also raised by Mr. Pavitt on 23 April 1970 (Parliamentary Debates (written answers), 800, 130, 1969-70), by Mr. Golding on 26 November 1970 (Parliamentary Debates (written answers), 807, 198, 1970-71), and on 12 January 1971 (Parliamentary Debates (written answers), 809, 12, 1970-71), by Mr. Peter Archer on 25 March 1971 (Parliamentary Debates (written answers) 814,187, 1970-71) and by Mr. Oakes on 26 October 1971 (Parliamentary Debates (written answers), 823, 302, 1970-71). Again, in each instance, the reply indicated that the matter was under consideration by the Industrial Injuries Advisory Council.

On 3 February 1972, a reply to Mr. Lomas revealed that a sub-committee of the Industrial Health Advisory Committee "has been set up to consider what action should be taken to prevent the loss of hearing by employed persons due to industrial noise. This sub-committee is to make its first report to the main Committee next month" (Parliamentary Debates (written answers), 830, 175, 1971-72). On 2 March 1972, Mr. M. McNair-Wilson "asked the Secretary of State for Employment whether he will now introduce legislation to control noise levels in factories and other places of work". In reply the Secretary of State said that the "Industrial Health Advisory Committee is meeting on 14 March to consider, among other matters, a draft code of practice for reducing the exposure of employed person to noise" (Parliamentary Debates, 832, 720, 1971-72). In reply to a further question from Mr. McNair-Wilson on 13 April 1972, the Secretary of State said that "the Committee approved the code of practice. It is to be published on Monday 17 April" (Parliamentary Debates (written answers), 834, 222, 1971-72).

In summary, it can be said that Parliament generally disregarded industrial noise prior to the Second World War, and requests made in 1928 and 1937 for a committee of inquiry were rejected. Parliament was obviously preoccupied with other matters during the War and immediate post-War years, and the subject was not mentioned again until 1953. A Ministerial reply in 1956 stated that research on this subject was not considered "a matter of primary urgency". Nevertheless, the setting

up of a committee of inquiry was announced in December 1959. The question of prescription of occupational deafness under the Industrial Injuries Act was first raised in 1960. Occupational deafness as a medical or social condition, or its possible prescription then virtually preoccupied members until 1972. The only exception was a brief period in 1969 when questions were asked about controlling personal noise exposures and protecting exposed persons. Questions pertaining to the preparation or publication of the Code of Practice were not tabled until February 1972.

2.4 The Times Newspaper

The Official Index to "The Times" was searched from 1920 by looking for a range of "key" words. One of the difficulties encountered in searching newspapers is that the editions are changed during the course of printing as fresh news is received. Occasional references to reports or articles in earlier editions of the paper were located in the index which did not appear in the micro-film edition. No way round this problem was found.

Prior to the Second World War, The Times was preoccupied with community noise, and in particular that due to motor vehicles and their horns. A voluminous letter to the Editor on 10 October 1927 (page 10c) headed "Harmful noise - protection against nerve strain" mentioned noise-deafness. The writer "was sorry to find that the harmful effects of noise have been entirely neglected" by the various Government departments he listed. The refusal of the Government to set-up "a committee to investigate the effects of noise upon health and efficiency of the people" was reported on 16 May 1928 (page 8c).

A report of a meeting of the British Medical Association on 25 July 1928 (page 11d) showed preoccupation with community noise:

> "They did not claim that this noise of modern life affected the organs of hearing, though in some occupations necessarily associated with noise these were affected. The injurious effects of noise showed themselves rather by their influence on the central nervous system through disturbance of sleep and so-called functional disturbances."

On 8 May 1934 (page 12d), Professor F.C. Bartlett of the Psychological Laboratory at Cambridge University was reported as saying during the course of a public lecture:

> "It was only in highly selected and special occupations that there was any evidence of serious damage to hearing done by noise. Boilermaker's deafness was well known.... Some other industries might produce more or less similar effects; but it could be concluded with certainty that, so far as the normal person was concerned, unless he was occupied in certain highly specific tasks, no convincing case could be made out against noise on the ground that it was likely to produce either permanent or transitory loss of efficiency in his hearing".

There was to be no further reference to occupational deafness in the main part of the Times until 1955.

The Times Review of Industry for February 1947 contained an article by E.J.EVANS entitled "Noise in the Factory". The author was from the National Physical Laboratory, and he gave a largely theoretical treatment of the properties of sound and of noise supression. The only reference to the undesirable effects of noise exposure is one sentence in the introduction:

> "In weaving sheds, for example, it is impossible to converse except

by shouting at close range, and 'boilermaker's deafness' associated with the noise in boiler works is well known".

The final and rather short paragraph was headed "ear defenders". This only speaks of the use of "ear defenders to obtain relief", and does not cover any of the practicalities of the use of ear protection or hearing conservation programmes in general. It should be borne in mind that no really satisfactory or acceptable form of hearing protection was commercially available at the time.

A report of the congress of the Royal Sanitary Institute (now the Royal Society of Health) appeared on 29 April 1955 (page 7d) under the heading "Noise dangers in industry". This noted that

> "the use of equipment producing intense noise was increasing and more workers were being exposed to injurious sound.... The best method of protection was the use of ear defenders fitted to a head-band.... Cotton wool offered no protection against present noise levels. Acoustic trauma, the result of exposure to noise of high intensity, was perhaps the most frequent danger to the ears in industry .... management had not sufficiently appreciated the possibility of greater efficiency and production being achieved through curtailment of noise".

"The Curse of Noise 1 - Research into causes and defence" was the title of an article in "The Times" on 24 October 1955 (page 9f). This was mainly concerned with noise annoyance, nuisance and noise control through planning. Only brief reference was made to occupational hearing loss and use of ear plugs, "but these are most unpopular". The Second part of the article on the following day was entirely concerned with noise from various types of aircraft and their operation.

The tabling of a motion in the House of Commons by Sir Lionel Heald, M.P. "that this House notes with concern the detrimental effect of noise and vibration on health, well being and efficiency of the nation; and urges Her Majesty's Government to give careful attention to the importance of research and education in this field, and to the need for more effective measures for the protection of the public" was reported on 26 November 1955 (page 4g). The ensuing debate was reported on 3 December 1955 (page 2g). By far the greater part of the debate was occupied with noise from aircraft and road traffic, although one member raised the question of industrial noise causing loss of hearing and suggested invoking penalties on employers who did not reduce the noise level in their premises.

A letter from R. W. Annand Chairman of the Vocational Committee of the British Association of the Hard of Hearing on 30 July 1957 (page 9e) described "New hazards in industry" due to the "ever upward surge of sound intensity in certain environments". His claim that sound levels were "often 140 decibels, and can be as much as 160" was corrected by D.M.A. Mercer of the University of Southampton in a letter on 2 August 1957 (page 7e). Mr. Annand proposed the rudiments of a hearing conservation programme and this was taken up and expanded by Dr. Challen of the Slough Industrial Health Service on 6 August 1957 (page 7d).

An article on "This deafening world" (4 October 1957, page 11f) was written by a Special Correspondent who was primarily interested in aircraft noise. This drew various comparisons between the situation in this country and that in America. The article started: "In contrast with that of the U.S., the public of this country is slow in coming to realise the enormous amount of damage to hearing and other bad effects due to noise in industry". However, the writer conceded that audiometric techniques needed development, and that a comfortable ear muff was only then in the course of development in Canada.

The Times Review of Industry for August 1958 carried two articles dealing with the effects of unwanted sound and its reduction. The first was by P.J.R. CHALLEN and D.E.HICKISH of the Slough Industrial Health Service on "Sound pressures and damage to the ear". As the title suggested, this was largely devoted to a description of the function of the human ear, and the damaging effects of excessive noise exposure. However, the last part was devoted to the outlines of a hearing conservation programme, and noise control at source and monitoring audiometry were recommended. "As a last resort, it may be necessary to provide ear protection, and the co-operation of the exposed workers must be obtained in order to ensure that the protective devices supplied are used". A table gave "typical attenuation figures" for dry cotton wool, good quality ear plugs and ear muffs with liquid seals. The source of the figures was not disclosed, and the values given were optimistic by any standards. The final sentence was significant: "Protection devices do not conserve hearing when they are stored in a clothes locker".

The second article "Control of Acoustics on the Shop Floor" by "a Special Correspondent" was written in a more journalistic style. This suggested that noise control was "largely a matter of common sense" and described two simple case histories where measures such as partitioning and changing the speed of a machine had solved noise problems. Seven advertisements from firms specialising in vibration isolation and acoustic treatment accompanied these articles. Neither the articles nor the advertisements indicated likely sources for, or the availability of, personal hearing protection.

The setting up of a parliamentary committee to inquire into the effects of noise was anticipated on 9 December 1959 (page 12d). The announcement in the House of Commons that "The Government have decided to set up a committee to examine the nature, sources and effects of the problem of noise and to advise what further measures can be taken to mitigate it" was reported on 15 December 1959 (page 4a).

A two part article was published in the business pages of The Times on 30 March (page 18d) and 1 April 1960 (page 19f) under the general title "The problem of noise in industry". In the first part "Impact on Health and Efficiency", the correspondent was preoccupied with speculating on the possible effects of high noise levels on working efficiency and output. However, "a real risk of hearing loss" was put alongside "nervous fatigue" as the result of exposure to the noise levels in heavy industry. The second part was sub-titled "Methods of dealing with it". After a noise survey, three basic methods of noise control were given: silencing, isolating and sound-proofing. The examples given were either hypothetical (e.g. "nylon gears can sometimes be used in place of metal gears"), or described case histories relating mainly to community or office noise. The final paragraph conceded the need for ear defenders in "certain occupations in industry where a dangerous noise level just cannot be reduced".

The unanimous adoption of "A resolution calling on the Government to recognise and accept industrial or occupational deafness as an industrial injury, and pay compensation for it under the National Insurance Industrial Injuries Act" by the Trades Union Congress was reported on 17 May 1960 (page 15e). The British Association, meeting later in the same year, received a paper on "the physiology of hearing" from Professor W. Burns of the Charing Cross Hospital Medical School. Much of The Times report (3 September 1960 page 10b) was concerned with the effects of various types of noise on hearing. The report concluded that

> "Occupational hearing loss only occured in certain noise conditions and in certain people. The greatest need at present, said Professor Burns, was for more research into the precise relations between the different characteristics of noise exposure and the effect on the ear. In the meantime, tentative relationships were used in deciding whether a given response to noise was on average, harmful."

An article by the Labour Correspondent on 19 December 1960 (page 15c) discussed the "Problems of deafness from noise at work", and in particular the provision of compensation. The article opened: "British people are becoming increasingly noise-conscious, but in the matter of compensating workers whose hearing suffers as a result of noise at work we are only beginning to examine the problems which many other countries have already tackled". However, the correspondent noted the difficulty that there may be in distinguishing "deafness due to persistent noise from deafness due to other causes", and he accepted the need for "extensive research work" in this area. The possible effect on the concept of the industrial injuries scheme if deafness was accepted as compensable was also discussed.

The Government announcement of the proposed joint Medical Research Council and National Physical Laboratory investigation into occupational hearing loss was reported on 30 January 1962 (page 6g). The commencement of this investigation was noted in the Trades Union Congress annual report, which was reviewed in The Times on 20 August 1962 (page 5a). A report on the progress and methods used in the investigation was published on 23 August 1963 (page 5e), and this was the subject of a light leading article on 17 September 1963 (page 13c).

Hearing loss among infantrymen in The British Army serving in Germany was reported on 16 July 1965 (page 11e). Similar hazards due to firing rifles and pistols, especially on indoor ranges, and due to 12 bore shot-guns were pointed out on 18 April 1966 (page 7c). Both reports emphasised the need to protect the hearing against the noise of firearms.

A photograph on 18 April 1966 (page 17) showed the interior of the National Physical Laboratory mobile audiometric laboratory being used in the investigation of occupational hearing loss.

A report of a meeting held at the Royal Society in London concluded that "Noise levels in British industry were going up", and "a fairly large amount of deafness was developing in factories" (11 March 1967, page 7e). Different aspects of the meeting were reported in The Observer on 12 March 1967. The hazards of rock and roll music were mentioned on 15 January 1968 (page 4a). Possible regulation of permitted noise exposure was the subject of a parliamentary question reported on 30 January 1969 (page 6c). An under-secretary for Employment and Productivity in reply deferred consideration of the matter until the report of the joint Medical Research Council and National Physical Laboratory investigation had been received.

A series of three articles under the general heading "The Noise Around Us" appeared from 17 to 19 March 1970. The third part on 19 March (page 11e) was sub-titled "The Danger to Health of Excessive Noise". Community, entertainment and occupational noise exposure were confused throughout the article, but weavers, pile-driver operators and coppersmiths were quoted as three occupations which carried the risk of noise-induced hearing loss. Some of the reported effects were anecdotal, and it was evident that their authenticity had not been properly checked which detracts from the value of the article. As a particular example, "a noise machine which, when pointed at a man, can homogenize him to the consistency of face cream", is clearly within the realms of science fiction.

A potential hearing hazard from a local authority owned motor mower was reported on 18 September 1970 (page 2h). The question of hearing hazard from pop groups was raised in a letter to the Editor on 28 January 1971 (page 13d) and again in an article on 27 November 1971 (page 20c).

The judgment in the case of Berry-v-Stone Manganese Marine Ltd. was given the status of a Law Report in The Times of 7 December 1971 (page 8f). This was the first successful Common Law claim for personal injuries in respect of occupational

hearing loss caused by negligence on the part of an employer in allowing an employee to be exposed to hazardous levels of noise. This judgment was reported in The Guardian and The Daily Telegraph also.

The publication of the Department of Employment Code of Practice was reported on 18 April 1972 (page 18h). This was accompanied by extracts from the press statement made the day previously by Mr. Dudley Smith, Under Secretary of State at the Department of Employment.

2.5 Other Newspapers

There have undoubtedly been many items in the other quality newspapers, but these are not indexed in the manner of The Times. For instance, a report in The Observer on 12 May 1967 of the two day meeting at the Royal Society on the subject "The origin and treatment of noise in industrial environments" was headed "Factory noise: workers could sue". Mr. J.B. Cronin, of the Faculty of Law in Southampton University is reported to have said "that employees could successfully claim for bodily injury caused by employers' negligence. Yet no employee had ever taken such action. 'I don't know what the Trade Unions have been at', Mr. Cronin said". The official transcript of the proceedings reads somewhat differently (J.B. CRONIN (1968) Noise and the Law, Philosophical Transactions of the Royal Society of London, 263, 325) "the existing law of negligence already offers adequate legal remedies for personal injuries resulting in the impairment of hearing. It is not being used and it ought to be. In passing, I suggest that the Trades Unions are not perhaps operating as smoothly as they might on behalf of their members here". Professor E.J. Richards of Southampton University "told the meeting that there was already ample evidence that many people's hearing was being permanently damaged by noisy working conditions - and as the power and size of machinery increased, the noise problem would get worse". Dr. W. Taylor of Queen's College, Dundee, said that, in jute mills, "a quarter of the loom workers suffered moderate hearing loss and were on the verge of needing hearing aids". The meeting was also reported, but not at such length, in The Times.

The Financial Times announced the publication of the report of the joint Medical Research Council and National Physical Laboratory investigation into occupational deafness on 17 March 1970.

Another article in The Observer was entitled "Falling on deaf ears" (7 February 1971). This described noise as "the Cinderella of industrial pollution", and listed a number of industries where occupational hearing loss was known to occur but where no action was being taken. This was balanced by the attitude of workers towards noise: "Many workers are inclined to accept it". Ear muffs were described as "another line of defence", but on the other side of the argument "Many workers will not wear them". The Government was urged to legislate to make ear protection compulsory.

2.6 Trades Union Congress Proceedings

An indication of the position adopted by the Trades Unions can be obtained from the Reports of the Proceedings of the Annual Congress. The index was searched from 1925 using "key" words. A search prior to this date was not possible using this system because only general headings are indexed.

No reference to noise or occupational deafness was found until 1960, although the report of that year stated that "This subject has been the subject of repeated consideration in past years". The report continued later "In December 1959 a circular was sent to all affiliated organisations asking for information about their general experience of this problem in order to enable the General Council to build up a broad picture of industries and occupations where complaints of

injury to hearing were arising". On the basis of the replies received, the General Council asked the Government to make occupational deafness a prescribed disease under the Industrial Injuries Act. The matter was referred to the Industrial Diseases Sub-Committee of the Industrial Injuries Advisory Council.

During the general session of the Congress in 1960 Mr. E. Tullock, representing the Iron, Steel and Metal Dressers Trade Society, moved the following motion:-

> "This Congress requests the Government to recognise and to accept industrial or occupational deafness as an industrial injury, and that those persons suffering from industrial or occupational deafness shall receive, according to assessment, Disablement Benefit under the National Insurance (Industrial Injuries) Act".

In proposing the motion, Mr. Tullock traced the development of the cause and effect relationship between noise and hearing loss from 1902. The motion was carried. Mr. Tullock spoke on this topic at each Congress from 1965 to 1969.

In 1961, The General Council reported having submitted evidence to the Industrial Injuries Advisory Council, and of the report of the Council which "expressed concern at the present lack of precise knowledge about many of the factors relevant to any consideration of prescription and recommended that an inquiry should be undertaken into the incidence of occupational deafness and its medical aspects". The General Council of the T.U.C. awaited the Minister's decision on the Industrial Injuries Advisory Council's recommendation.

In 1962, it was reported that "Following the General Council's representations for prescription of occupational deafness, a major inquiry is now about to be undertaken". This was to be the joint Medical Research Council and National Physical Laboratory investigation. "The General Council .... assured the Government of their active support in the conduct of the inquiry and are engaged in discussions with the Ministry of Labour on the detailed arrangements for carrying it out". Nevertheless, the Trades Union Congress were not prepared to await the out come of the investigation, which was "expected to take at least three years to complete.... The General Council have made it clear that they will continue to press for a formal reference (on the question of prescription of occupational deafness as an industrial disease) at the earliest opportunity".

Arrangements for the joint investigations, and a delay in commencing the survey due to technical difficulties were reported in 1963. There was no reference to noise or occupational deafness in the 1964 Annual Report.

In 1965, it was reported that "the inquiry, which was expected to take at least three years to complete, is still proceeding". The General Council had "pointed out to the Minister that it is now five years since they asked for occupational deafness to be referred to the Industrial Injuries Advisory Council, and they have reiterated the need for an early decision on prescription." Mr. Tullock spoke in favour of pressing the Government for prescription.

The inquiry into occupational deafness had not been completed in 1966, but "It is understood that a report of the three years' work completed up to July 1966 will shortly be given to the Minister". It was reported that the "General Council will be reviewing the position following the survey team's report to the Minister later in the year". Mr. Tullock moved the following:

> "This Congress greatly deplores the long delay by H.M. Government in deciding whether industrial or occupational deafness should be compensatable (sic) under the National Insurance (Industrial Injuries) Act, and strongly urges the Government to make a very early decision upon this most important subject."

Speaking in support of the motion, Mr. Tullock listed a number of countries where occupational deafness was the subject of legislation. The motion was carried. It is known that this legislation was not enforced in many of the countries mentioned by Mr. Tullock.

Delays in the preparation of the interim Medical Research Council report and difficulties in making arrangements to meet the Minister were reported at length in 1967. Concern was expressed that "no positive recommendations (for prescription) had yet been made.... The General Council were well aware of the practical difficulties involved in prescription", but as other countries had overcome these problems, it saw no reason "why Britain should be more backward". The General Council suggested "that there should be a definite list of prescribed occupations known to carry a serious noise hazard". In addition to asking for prescription of occupational deafness, the General Council had also "asked the Minister of Labour for amendment of the Factories Act to include a general statutory provision requiring control of noise." Mr. Tullock spoke in favour of pressing "for recognition of occupational deafness at the earliest possible moment".

Concern about further delays and the results of representations to the Minister of Social Security were reported in 1968. Mr. Tullock, again speaking from the floor, said "The whole attitude of the research project and team .... seems to be directed to proving that occupational deafness does not exist, at least not for the purposes of compensation". He again spoke of "more than a score of countries" which have accepted occupation deafness as compensable.

By 1969, the final report of the joint Medical Research Council and National Physical Laboratory inquiry had been referred by the Secretary of State to the Industrial Diseases sub-committee of the Industrial Injuries Advisory Council. The Trades Union Congress were clearly unhappy about the time the process was taking, as the final sentence in the Annual Report reads "The General Council have again made clear to the Secretary of State the strength of the widespread dissatisfaction at the continuing delay and have reiterated the need for an early decision". Mr. Tullock thanked the General Council and the Social Insurance Committee for their efforts.

No reference was found in the 1970 Annual Report. The 1971 Report contained a short paragraph headed "Control of Noise in Industry" which is quoted in full below:-

> "In addition to their efforts to secure prescription of occupational deafness as an industrial disease under the Industrial Injuries Act, the General Council have continued to press for preventive action to protect workers against the harmful effects of noise. The Industrial Health Advisory Committee is at present considering this matter. The General Council members have made it clear that while they are not opposed to a Code of Practice, any Code must be backed by effective legislation. The preparation of this legislation should not be deferred pending the Robens Committee's Report."

The 1971 Annual Report returned to the subject of prescription of occupational deafness, which had been referred by the Secretary of State for Social Services to the Industrial Injuries Advisory Council for consideration. "The General Council had submitted detailed evidence in support of their repeated claims for prescription". Further dissatisfaction at the continuing delay was expressed with "The General Council have repeatedly declared their conviction that prescription is long overdue, and will continue to press for an early decision".

The publication of the Department of Employment Code of Practice was reported in

1972, although there was a slight error in the date of publication (this should have been April and not May 1972). After a review of the contents of the Code, the Report continued:

> "The code does not have the force of legislation, and is not founded on any legislation. Its standing is persuasive only, and it is not sufficient on its own to ensure that the dangers of noise emission are minimised. Courts may take account of the code in determining common law action claims but the code would have no force in regard to breaches of the Factories Act.
>
> The General Council are continuing to press for appropriate legislation, including the setting up of a fixed maximum sound level."

The lack of a decision by the Industrial Injuries Advisory Council on the prescription of occupational deafness as an industrial disease was also reported. This was again taken up by Mr. Tullock, who urged the General Council to continue to press for prescription.

Note: The Industrial Injuries Advisory Council reported in October 1973 (Command 5461, H.M.S.O.), and recommended that noise deafness should be prescribed as an industrial disease linked to at least twenty years exposure to pneumatic tools, or drop forges or hammers in either the metal manufacturing or the shipbuilding or shiprepairing industries. The recommendation was implemented in October 1974 (Leaflet NI 207, Department of Health and Social Security, October 1974) when occupational deafness was added to the list of prescribed industrial diseases with effect from 3 February 1975. The scope of the scheme was extended from 3 Septemebr 1979 (Leaflet NI 207, Department of Health and Social Security, September 1979).

2.7 Industrial Medical and Nursing Journals

There are four journals in this category which have been published in this country during the relevant period. The British Journal of Industrial Medicine dates from 1944, and the Transactions of the Association of Industrial Medical Officers from 1951, although its name was changed to Transactions of the Society of Occupational Medicine with the 1967 volume. A Section of Occupational Medicine of the Royal Society of Medicine was inaugurated in 1964, although the Proceedings of the parent Society date from much earlier. The Journal for Industrial Nurses commenced publication in 1949 and became Occupational Health in 1963. As might be expected, papers appeared in these journals perhaps some ten years before the safety journals and second class literature. Many of the earlier papers were of a research nature and can best be described as confirming the cause and effect relationship between noise exposure and loss of hearing.

The first relevant paper to appear in the British Journal of Industrial Medicine (SMILEY, J.A., Br. J. industr. Med. 8, 265) in 1951 was primarily concerned with "The hazards of rope making". It mentioned the problem of noise, but the author showed a total lack of appreciation of the subject by speaking of noise levels, "being of the order of 150 to 200 decibels" (a one atmosphere change in pressure is equivalent to 194.1 decibels), not needing to supply hearing protection to those people who had already sustained hearing losses, and only recruiting those who were already deaf for exposure to the noise.

A paper by JOHNSTON in 1953 (Br. J. indust. Med. 10.41) "A field study of occupational deafness" was based on a report made to the Medical Research Council's Committee on the Medical and Surgical problems of deafness and was mentioned in the Medical Research Council Annual Report for the year 1951-52

(Command 8876, 1953). This was primarily concerned with the incidence and effects of noise on the hearing in three traditionally noise hazardous industries, namely boiler making, drop forging, and screw heading. Adaptation and the ability to communicate in high levels of noise were noted, and the occurrence or otherwise of tinnitus, vertigo and other conditions were investigated. Under the heading "Prevention of Occupational Deafness" the author discussed the inadequacy of available ear "protection", both from the points of view of its failure to protect the hearing and the problems of discomfort, hygiene and ear disease. He noted the reluctance of work people to accept any form of ear protection, and concluded with the need for further development of protection suitable for use in industry.

KEATINGE and LANER (Br. J. industr. Med. 15, 273) published a study in 1958 of "Some notes on the effects of excessive noise on the hearing of a group of workers". As the title suggests, this was a cause and effect investigation, involving taking noise measurements and audiograms of men exposed to riveting noise for between one and seven years. However, the authors did note that "During the period mentioned no protective devices were in use, largely because the workers found many of the existing protectors both uncomfortable and otherwise inconvenient".

A vehicle for use as a mobile audiology unit was described in 1963 (LEE, et al, Br. J. industr. Med., 20, 57). This vehicle was designed primarily for investigations of deafness in the cotton industry by the Occupational Health Department of the University of Manchester.

A paper titled "A preliminary study of some health hazards in the plasma jet process" also appeared in 1963 (HICKISH and CHALLEN, Br. J. industr. Med. 20, 95). About half of this short paper was devoted to considering the problems of air pollution and about half to measuring noise and its effects on the hearing of three volunteer subjects. Users were "advised to wear ear protection, preferably ear muffs".

In spite of its title, "Monday morning auditory threshold in weavers" (ATHERLEY, Br. J. indust. Med. 21, 150, 1964), was an investigation into the adequacy of the normal weekend break for recovery from occupationally induced temporary hearing losses, and hence on the accuracy of Monday morning audiograms as a true measure of permanent hearing losses. However, it did serve to demonstrate that a significant hazard to the hearing existed in cotton weaving sheds.

The first paper found anwhere dealing at length with the practical problems of the use of ear protection appeared in 1966 (RICE and COLES Br. J. industr. Med. 23, 194). This gave a general review of the requirements of ear protectors, including noise reduction, comfort and other factors. The types of ear protection available at that time were reviewed, and the practical problems such as discomfort, ear infections, difficulty with communication, etc., were discussed. The authors gave average and standard deviation values for the attenuation of dry cotton wool, waxed cotton wool, glass down, V-51R ear plugs and fluid-seal ear muffs, and drew attention to the need for low values of the standard deviation. The final section discussed the "failure of ear protection" in practical conditions of use, including the resistance of personnel to wearing hearing protection in noise hazardous situations.

A paper by ATHERLEY and NOBLE in 1970 (Br. J. industr. Med. 27, 260) showed that industrial subjects who had not previously used hearing protection made more mistakes in localising the direction of a tonal noise when wearing ear muffs than without. The effects of adaptation were not investigated, but the results of another unrelated study (BAUER et al, J. acoust.Soc.Am 40, 441, 1966) were quoted

which had showed subjects usually took about three days to adapt to alterations in directional perception while one ear was constantly occluded.

Other papers in this period were concerned with audiometric surveys or techniques as follows:-

> ATHERLEY and DINGWALL-FORDYCE (1963) The reliability of repeated auditory threshold determination, (Br. J. industr. Med. 20, 231)
>
> COLES (1967) A noise attenuating enclosure for audiometer earphones, (Br. J. indust Med. 24, 41)
>
> WILMOT (1972) The meaning of modern audiological tests in relation to noise-induced deafness: a review (Br. J. industr. Med. 29, 125)
>
> HOWELL and HARTLEY (1972) Variability in audiometric recording, (Br. J. industr. Med. 29, 432).

The Transactions of the Association of Industrial Medical Officers generally reported papers presented by members at the various meetings of the Association. In consequence, the quality of papers was somewhat variable, but the Transactions do reflect the thinking of leading industrial medical officers at the appropriate time. The first paper to deal with "Noise in industry" appeared in 1955 from a consultant in a Dublin hospital. (O'BRIEN, Trans. Ass. Industr. Med. Offrs., 5, 109). This was a relatively "low key" paper, somewhat anecdotal in parts and not always scientifically accurate, which reviewed methods of noise measurement and the cause and effect relationship between noise exposure and hearing loss. It discussed the possible functions of an industrial medical officer in issuing ear protection, undertaking screening audiometry, and advising employers about the risks of noise exposure and their responsibilities in individual cases. The author repeated an American recommendation "that sound below 90 decibels as measured on a C scale of approved sound level meter should not be considered harmful regardless of the length of exposure although even at this level susceptible persons may suffer damage to their hearing".

In 1956, Dr. BLAKELY (Trans. Ass. Industr. Med. Offrs. 6, 56) of the United Kingdom Atomic Energy Authority reviewed his own experiences, and described noise measurement, ear defenders and audiometry. He suggested that "ear defenders must be worn in noise above the danger level and must reduce the level to below 90 dB in the frequencies from 200 - 8,000 c.p.s.". Presumably this was meant as an overall level between these limits, and would be the equivalent of measuring the noise on the "C" scale of a sound level meter. Graphs were presented of the attenuation to be expected from cotton wool and a type of ear muff which was not identified but appeared from the photograph to be the Nosonic Mk II. The discomfort associated with these early ear muffs was noted. Finally the role of audiometry in a hearing conservation programme was described.

A paper by BURNS in 1958 (Trans. Ass. Industr. Med. Offrs. 8, 127), who was then Professor of Physiology at Charing Cross Hospital and a leading authority on the damaging effects of noise, reviewed the "Physiological and Clinical effects of Noise". After describing the hearing mechanism, nature of noise damage, etc., the later half of the paper was devoted to hearing conservation measures such as noise measurement and assessment, audiometry, limitation of exposure and ear protection. The author evidently had some experience of the use of ear protection, as he wrote

> "ear plugs .... are cheap, inconspicuous, acoustically very effective, mildly uncomfortable to some people, and fairly easily lost or soiled with oil and similar contaminants. They must be

fitted to the wearer by a competent person."

"The external or ear muff type are heavier, more clumsy, most costly, but in general, more comfortable. The best type is that developed by the National Research Council of Canada. It is the best device of its kind, is outstandingly good acoustically, being superior to the best insert types, and relies for its effectiveness and comfort on an annular fluid-filled cushion which encloses the ear. A form of this muff is sold commercially in this country, and for many purposes is ideal. The sound attenuation at the various frequencies of these devices is known, so that the sound intensity to which the ear is actually being subjected while wearing protectors in any given sound field, can be estimated."

"In practice, as with all protective devices, persuasion and explanation are needed to secure acceptance of ear protection. Where the wear is only intermittent and the noise intensity great, ear protection is usually welcomed; but where the protection is to be worn for 8 hours per day, great resistance may be encountered. Complaints of all kinds, but basically on the score of comfort, will be made, and in these circumstances perhaps an additional effort to secure equipment of the highest possible degree of comfort would be well repaid."

The ear muffs developed by the National Research Council of Canada only became available commercially in this country in May 1958. The muffs previously available were grossly inferior in all respects.

A short paper by MAGUIRE (Trans. Ass. Industr. Med. Offrs. 8, 135, 1958) on "Noise and Vibration Control in Engineering" accompanied Professor Burns' contribution. This gave a rather academic treatment of the subject and complicated matters by introducing mathematical functions such as equivalent loudness in phons and loudness in sones. The use of these quantities soon fell out of fashion.

A further paper by BURNS in 1965 (Trans. Ass. Industr. Med. Offrs. 15, 2) "Noise as an environmental factor in industry" may be regarded as a significant step forward in bringing practical remedies to the attention of industrial medical officers. Burns gave maximum permissible levels for noise in audiometric rooms and discussed the significance of changes in the hearing level of noise exposed persons, including changes due to the natural effects of advancing age (presbyacusis). He proposed a definitive hearing damage risk criterion in terms of international standard octave bands, and although he described this as "moderately conservative", it was, in fact, the equivalent of 88 dB(A). Corrections were given for shorter exposure durations which followed the equal energy principle down to one hour per day, but thereafter allowed exposure to higher levels. This criterion and corrections were widely quoted in contemporary literature. He recommended either V-51R ear plugs or the National Research Council of Canada type of fluid-seal ear muffs which were then available commercially in this country. The values given for the attenuation provided and the safe noise exposures when using these ear protectors seem rather optimistic by modern standards.

A paper by KEYS (Trans. Ass. Industr. Med. Offrs. 15, 12, 1965), who was medical officer of Rolls Royce Ltd., followed Professor Burns paper, having been presented to the same meeting of the Society. This was titled "Noise and the Conservation of Hearing". Keys mentioned glass down, ear plugs and ear muffs as available forms of ear protection, but he was also optimistic about the measure of protection afforded by these devices. Much of the paper was taken up by a

discussion of specific working environments within his own industry, with examples of the audiograms of persons who worked there.

The name of the Society was changed to the Society of Occupational Medicine in 1967 and there was a corresponding change in the title of the Transactions.

The next contribution was in 1968 from EUINTON (Trans. Soc. Occup. Med. 18, 142) who was a Medical Inspector of Factories. This was very much a text-book treatment of sound, hearing, hearing loss, audiometry and speech, with virtually no practical significance to practising industrial medical officers apart from general interest.

The final paper within the relevant time period was by TAYLOR in 1972. (Trans. Soc. Occup. Med. 22, 37) who described his studies of the hearing and social handicap of "The weavers of Dundee". This was a very significant research paper, but again of little practical assistance to practising industrial medical officers.

The Section of Occupational Medicine of the Royal Society of Medicine held its inaugural meeting on 12 October 1964, and the meetings were reported in the Proceedings of the Society from the following year. The first meeting of interest in the present context was held on 3 March 1967 under the title "Occupational Deafness".

The first paper by HINCHCLIFFE (Proc. roy. Soc. Med. 60, 1111, 1967) "Occupational Noise-induced Hearing Loss" dealt mainly with the pathological and clinical aspects of the injury. The Control of occupational deafness rested mainly on the utilisation of personal protection. The attenuation of this was judged entirely on physical measurements of threshold shifts with and without the protector in place. The lack of field trials of the efficiency of ear protection compared with a control group was mentioned. The next paper "A pilot study of hearing loss and social handicap in female jute weavers" by TAYLOR et al (Proc. roy.Soc. Med. 60, 1117, 1967) was entirely retrospective in concept and adequately described by its title. In the final paper, KERR (Proc. roy. Soc. Med. 60, 1121, 1967) described the "Noise problems connected with the manufacture of nylon and terylene yarn" faced by himself as an industrial medical officer. Any engineering contributions to noise control had been more than offset by increases in machine speed. The solution to the problem had been ear plugs or glass-down disposable plugs, backed up by audiometry to monitor the state of hearing of noise exposed persons. Only about 30% of those exposed made use of ear protection. In discussion, a Mr. Charles Smith (Proc. roy. Soc. Med. 60, 1125, 1967) endorsed Dr. Kerr's observation of the "difficulty in persuading workers in industry to wear ear protectors".

A review of "Recent developments in ear protection" was given by COLES (Proc. roy. Soc. Med. 63, 1016, 1970) during a meeting on the subject of protective equipment. The theme of this paper was that, whilst the sound-attenuation offered by the 'best' equipment was approaching the theoretical limit, there was scope for improvements to comfort, wearability, durability, versatility and "communicability". User-resistance to various types of ear protection was mentioned.

A second meeting on "Noise-induced hearing loss" was held on 2 April 1970. The first four papers were mainly concerned with diagnosis and management of various aspects of occupational hearing loss, as follows.

ZALIN, H. Unmasking other Pathology (Proc. roy. Soc. Med. 64, 187, 1971)

WILMOT, T.J. Use of advanced audiological tests (Proc. roy. Soc. Med. 64, 190, 1971)

COLES, R.R.A and PRIEDE, V.M. Nonorganic overlay in noise-induced hearing loss (Proc. roy. Soc. Med. 64, 194, 1971)

WARD, W.D. Presbyacusis, sociocusis and occupational noise-induced hearing loss (Proc. roy. Soc. Med. 64, 200, 1971)

The fifth paper by ATHERLEY and ELSE "Effect of ear-muffs on the localization of sound under reverberant conditions" (Proc. roy. Soc. Med. 64, 203, 1971) presented experimental results which showed that the effect of wearing ear muffs was to increase the number of errors made in localizing the direction of a sound.

The second session of the meeting was devoted to medicolegal aspect and the texts of two papers were printed. The first by MURRAY, who was then Medical Adviser to the Trades Union Congress was headed "Advice to the employee" (Proc. roy. Soc. Med. 206, 1971). It was largely anecdotal in nature, but made the point of the difficulty of persuading employees to use ear protection. The second paper, by EVERETT who was a Queen's Counsel was, "Noise-induced hearing loss in industry: employers' liability" (Proc. roy. Soc. Med. 64, 207, 1971) and dealt with the theoretical possibility of a claim for occupational deafness and the points of law and precedents which might be invoked. The unsuccessful case of DOWN -v- DUDLEY COLES, LONG LTD. was not mentioned even though it had been heard over a year prior to the meeting. A third paper had been read to the meeting by Dr. J.W. James of the Ministry of Pensions on the subject of "Practical Problems in Legislating for Social Security in Compensation" but the text was not reproduced.

A paper "Noise and the environment" was given to the Library and Lay Section of the Society by HOLMES (Proc. roy. Soc. Med. 65, 360, 1972) who was a Public Health Inspector, just before the publication of the Code of Practice. This was largely concerned, as the title suggests, with environmental noise. A short section on industrial noise shows the author's lack of comprehension of this aspect of the subject as he writes of prognostic test for susceptibility to hearing loss, and quotes the noise level from a hydraulic press as being 140 dB(A).

The first article which appeared in the Journal for Industrial Nurses (7, 106, 1955) was a two page review of the subject of "Noise in Industry" by Dr. D. MALCOLM, who was an industrial medical officer. This was of necessity a very general article mostly concerned with the effects of noise, both psychological and physiological. The sole reference to hearing conservation was as follows: "Various types of ear pads and plugs are available to reduce the effects of noise. Cotton wool plugs are of no real value".

The next mention of noise did not occur in this Journal until 1960, when an article on "The problem of noise in industry" appeared (BARKER, J. Industr. Nurses 12, 164). This was again a very general paper mainly dealing with the effects of noise although not all the claimed effects have been scientifically proved. However, the author did briefly discuss some of the hygiene and other problems likely to be associated with the use of ear plugs in industry. Ear muffs were mentioned also.

The title of the journal was changed to Occupational Health in 1963, and two relevant papers were published in this year. "Care of the ear in industry" by CHADWICK (Occup. Health, 15, 135, 1963) was primarily concerned with the nurse's role in the physical care of the ear in industry. Acoustic trauma was mentioned and a hearing conservation programme outlined, but no really practical advice was given for the prevention of damage. "Industrial noise hazards and their prevention" by HICKISH (Occup. Health, 15, 196, 1963) again reviewed the effects of noise exposure and gave the outlines for a hearing conservation programme. Attenuation figures for dry cotton wool, good quality ear plugs and fluid-seal ear muffs were quoted and monitoring audiometry was advocated. The same volume

of the journal contained a review of the Ministry of Labour booklet "Noise and the Worker" which had been published earlier in the year (Occup. Health, 15, 334).

Another general article on the "Problems of Noise" appeared in 1964 (SPOOR Occup. Health, 16, 271). This dealt with the measurement of sound, occupational noise exposure, hearing loss and hearing conservation. Various types of ear plugs and ear muffs were described, but there was no mention of the practical problems associated with their use.

A rather theoretical article on "Occupational Noise" was written by SANDERSON in 1966 (Occup. Health, 18, 61). The subjects covered included the properties of sound, common sound levels, hearing damage, damage risk criterion values, interference with communications, speech interference levels, annoyance, noise rating, criteria for rooms, efficiency and fatigue and the legal aspects of noise. Much of this was clearly outside the responsibility of industrial nurses. No mention was made of hearing conservation or ear protection.

A paper on "Noise" given to a one day conference of the Industrial Society by MURPHY was reported in May/June 1966 (Occup. Health 18, 154). The speaker had evidently described some of the problems associated with ear protection based on his own experience, although the report was somewhat abbreviated.

Three papers were published in 1968, two of which were of some significance. Firstly BARKER (Occup. Health, 20, 67) described the electronically peak limited ear muff developed by the Explosives Research and Development Establishment for use in situations where sudden high intensity impulse noise exposures were likely to occur. Sister DREW (Occup. Health, 20, 179, 1968), who had been on a travel scholarship to North America, described compensation schemes and hearing conservation practices in American and Canadian industry, including the use of ear protection and audiometric testing. The role of the occupational health nurse and the practical difficulties associated with the use of ear protectors were both described in some detail.

The experience of a nurse involved in organising a hearing conservation programme from the outset some three years previously, including monitoring audiometry, in a small chemical plant were described by CRACKNELL (Occup. Health 20, 184, 1968). The results of 25 cases of occupational hearing loss, with the follow-up measures taken, were appended.

This was followed by a number of news items, firstly of a two day course "Audiology for Occupational Health Nurses" (Occup. Health 20, 260) and then of the publication of "Guidelines for Noise Exposure Control" by the American Industrial Medical Association (Occup. Health 20, 288). New acoustic laboratories at the University of Southampton were opened which incorporated facilities for audiology and industrial noise research (Occup. Health, 21, 55). Professor Burns' book "Noise and Man" was reviewed (Occup. Health 21, 181), and further courses on audiology were announced (Occup. Health 21, 129; 21, 233; and 21, 297).

The only paper published during 1969 was on the experiences of an industrial medical officer in "A heavy engineering medical service" by Dr. ROSS (Occup. Health 21, 280). Along with a number of other hazards, it mentioned the measurement of noise levels, and was illustrated with a photograph showing "Measurement of noise on the shop floor".

The reply to a parliamentary question on the prescription of occupational deafness was published early in 1970 (Occup. Health 22, 25). A commercially available film strip "Noise and Hearing" was announced shortly afterwards (Occup. Health, 22, 58). Another paper on the subject of "Environmental measurement" by STEEL in 1970 (Occup. Health 22, 99) contained a paragraph on noise and mentioned the

assessment of noise hazards using a simple sound level meter.

Later the same year, an editorial contribution headed "Breakthrough in noise measurement" (Occup. Health, 22, 183, 1970) gave a brief report of the judgement in the Down-v-Dudley, Coles, Long Ltd. case, tabulated maximum permissible noise exposures for various durations and mentioned the simple noise meter sold by the Noise Abatement Society. (This instrument proved to be quite unreliable and was condemned by the Noise Advisory Council some time later).

A report of the symposium on "Occupational Hearing Loss" held at the National Physical Laboratory in March 1970 was prepared by HOLGATE (Occup. Health 22, 190, 1970). Much of this was concentrated on the methodology, and particularly on the accuracy, of audiometry. Nevertheless, the reporter seemed convinced that monitoring audiometry was a good thing. The report of the joint Medical Research Council and National Physical Laboratory's investigation into "Hearing and Noise in Industry" (BURNS and ROBINSON, 1970) had been published just before the symposium, and this validated the equal energy concept for assessing noise exposures for periods shorter than a working day. Two other papers described the use of questionnaires and social surveys into the effects of occupational hearing loss on people's everyday lives.

A significant contribution was made by ACTON in October 1970 with a paper on "Personal ear protection" (Occupational Health, 22, 315). This reviewed the types of protection then available, and discussed many of the problems associated with the use of ear protection in practice. Typical average values and standard deviations were given for common types of commercially available protectors, and the author recommended subtracting one standard deviation from the quoted mean values in order to account for variations in fit and to give a realistic figure for the likely protection achieved in practice.

Apart from sundry news items, no relevant papers were published in 1971. The judgment in the first successful Common Law claim for damages in respect of occupational deafness (Berry-v-Stone Manganese Marine Ltd) was briefly reported as a news item in January 1972 (Occup. Health 25, 33, 1972), stressing the need for comfort and outlining the part the nurse had to play in examining ears and fitting the correct size of ear plugs. There was an editorial report of occupational hearing loss in the printing industry (Occup. Health 25, 136) and the publication of the Department of Employment Code of Practice was reported in the May 1972 issue (Occup. Health 25, 144).

2.8 Occupational Hygiene

The only periodical published in the United Kingdom devoted entirely to occupational hygiene is the Annals of Occupational Hygiene. This is the official journal of the British Occupational Hygiene Society.

The Annals of Occupational Hygiene was launched in December 1958 with an issue entirely devoted to industrial noise and hearing loss. It appears that the first four papers at least had been presented at a British Occupational Hygiene Society conference as formal discussion followed. The full list of contributions was as follows:-

CAWTHORNE: The clinical and physiological effects of noise (Ann. occup. Hyg., 1, 1, 1958)

LITTLER: Noise measurement, analysis and evaluation of harmful effects (Ann. occup. Hyg. 1, 11, 1958)

FLEMING and COPELAND: Principles of noise suppression (Ann. occup. Hyg. 1, 28, 1958)

CARPENTER: The effect of noise on work (Ann. Occup. Hyg. 1, 42, 1958)

HINCHCLIFFE: "Has your worker a noise problem?" (Ann. Occup. Hyg. 1, 55, 1958)

PARFITT: The analysis and control of vibration (Ann. Occup. Hyg. 1, 68, 1958)

MERCER: The application of correlation technique in noise analysis (Ann. occup. Hyg. 1, 81, 1958)

VAN LEEUWEN: A study of occupational deafness in the Netherlands (Ann. occup. Hyg. 1, 90, 1958)

COLES and KNIGHT: Auditory damage in young men after short exposure to industrial noise (Ann. occup. Hyg. 1, 98, 1958)

KNOX and LENIHAN: The Scottish Audiometer Calibration Service (Ann. occup. Hyg. 1, 104, 1958)

HINCHCLIFFE and LITTLER: Methodology of air-conduction audiometry for hearing surveys (Ann. occup. Hyg. 1, 114, 1958)

These papers generally fall into the categories of either cause and effect investigations or the theoretical treatment of noise measurement and control. The second author mentioned "methods of ear protection", illustrating V-51R ear plugs and R.A.F. Mark III ear muffs. This section of the paper amounted to less than one page, although average attenuation figures were given for the above types of hearing protection. Some problems of the design of hearing protection were discussed in relation to attenuation, but not to their practical use in industry. Hinchcliffe discussed the assessment of noise hazards and the measurement of hearing, and pointed out that noise damage was not the only cause of hearing losses which were maximal at 4 kHz. Van Leeuwen, and Coles and Knight were concerned with audiometric thresholds after exposure to various degrees of noise in their contributions. None of the papers mentioned the practical problems of hearing conservation including the use of hearing protection in industry.

The next issue in April 1959 contained a french paper "La lutte contre le bruit: protection des travailleurs contre les bruits et les vibrations" (the fight against noise: protection of workers against noise and vibration) by CHAVASSE et al (Ann. occup. Hyg. 1, 186). This was written in general terms and covered noise-induced hearing loss, noise control, hearing conservation and hearing protection.

The title of a paper by ROBINSON "Variability in the realization of the audiometric zero" (Ann. occup. Hyg. 2, 107, 1960) was self explanatory. This was followed by "A study of noise in a circular-saw shop and its effect on hearing" by HICKISH and CHALLEN (Ann occup. Hyg. 2, 133). The main parts of the study may be considered under three headings; firstly, noise measurment; secondly, measurement of hearing losses, and thirdly, consideration of preventative measures. The first two headingswere concerned with a cause and effect type of investigation and the latter heading was primarily concerned with noise reduction. Hearing protection was only mentioned in the final sentence: "Persons necessarily exposed to a hazardous level of noise should be provided with personal protection in the form of insert ear plugs or external ear muffs."

"Auditory hazards in a diesel engine test house" was the title of a paper in 1960 by COLES and KNIGHT (Ann. occup. Hyg. 2, 267). This was primarily concerned with the measurement of noise, discussion of the findings in relation to loss of

hearing and the presentation of audiometric data. The final section briefly dealt with the provision of hearing protection as follows:-

> "Modern types of ear-plug and ear-muff were available to the men, but, as is unfortunately a common experience, few were worn. Both forms of protection were said to be too uncomfortable for prolonged use, and there was also evident a certain degree of shyness at being seen wearing the external muffs".
>
> "The attenuation which can be expected from the V.51-R inserts or the Service Mark III muffs is shown by LITTLER (1958) in his Table I. When this is applied to the spectrum of Figure 2 above, it can be expected that neither Damage Risk Criterion would any longer be exceeded when either form of protection is worn and correctly fitted".

The service Mark III ear muffs referred to above were similar to a type available commercially from Messrs Denis Ferranti Meters Ltd as "Eargard" muffs from May 1958.

The annual report of the Slough Industrial Health Service by Dr. CHALLEN, the physician in charge, was reproduced in Annals of Occupational Hygiene (3, 283, 1961). This service then incorporated an occupational hygiene section. The report noted that "there appears to be a wave of interest in noise as a community and industrial problem at the present time". However, later it commented that:-

> "A major obstacle discouraging some firms from having their noisy processes investigated is a suspicion, which is well-founded, that reduction or suppression of noise at source is in many instances difficult and costly, if not impossible to achieve. Excluding personal protective measures, there are many engineering methods for reducing noise in a workshop even though they may not be applied at source, but the value of these in any set situation is not often assessed in terms of employee health and safety. There is certainly a great need for fundamental research on methods of suppression of noise at source and on machine design with this particular objective in view. In our experience punch press and automatic machine shops can be productive of dangerous levels of noise, and because they are ubiquitous in modern industry, an indeterminable but significant number of working men must be exposed to a hazard".

Evidence to the Committee on the Problem of Noise prepared on behalf of the British Occupational Hygiene Society by HICKISH et al was reproduced in the Annals of Occupational Hygiene (5, 183, 1962). In its evidence, the Society accepted that "the harmful human effects of exposure to excessive noise ..... are well known and well documented" but that "the recognition, measurement and control of noise in industry" was generally neglected. Concern was expressed that "Most literature on noise control originates in the U.S.A., ... we feel that it indicates a comparative neglect of the problem in this country". The report went on to review the extent of the problem in industry, noise measurement and assessment, audiometry and the requirements for the control of noise.

A paper by MURPHY in 1963 (Ann. occup. Hyg. 6, 15) was concerned primarily with "Noise Specifications" in the community situation, and gave figures for noise attenuation over various types of ground and the performance of barriers and enclosures for noise sources. Almost as an after-thought, the author added at the end of the paper "but there is another factor which must be considered. This is physical damage to hearing which can occur to any operators near machinery".

He then gave the hearing damage risk criterion graph used by the American parent of the Esso Petroleum Company. Although this was expressed in the old American Standard octave bands based on the musical scale, it was equivalent to a little over 90 dB(A) in modern terms. A scheme of corrections for shorter exposure durations was given which was close to the equal energy concept, but became more relaxed for shorter exposures.

A paper by ATHERLEY "Calibration of audiometers used in industry" (Ann. occup. Hyg. 7, 145, 1964) described a simple objective method for checking the stability of calibration of audiometers used for industrial screening purposes. This was followed in the December 1964 issue by three further papers on various aspects of audiometry. The first by BURNS et al (Ann. occup. Hyg. 7, 323) was "an exploratory study of hearing and noise exposure in textile workers". This was a classical cause and effect study giving some interesting findings on the aetiology of noise-induced hearing loss but reaching the conclusion that "Occupational hearing loss had been confirmed in textile workers". The study was described as "a small pilot study undertaken as a preliminary to a projected larger study of noise and hearing in industry". This could well have been a reference to the joint Medical Research Council and National Physical Laboratory study which commenced large scale industrial testing in about 1964. The title of the second paper "Problems of industrial audiometry" by ATHERLEY (Ann. occup. Hyg. 7, 335) was self explanatory. The third by TAYLOR et al (Ann. occup. Hyg. 7, 343) described "A mobile unit for the assessment of hearing" built by the Department of Social Medicine, Queen's College, Dundee (now the University of Dundee) for a study of noise-induced hearing loss in jute workers.

HICKISH and CHALLEN described the results of audiograms taken annually over a period of 3 years of 277 persons exposed to noise ("A serial study of noise exposure and hearing loss in a group of small and medium size factories", Ann. occup. Hyg. 9, 113, 1966). This paper falls into the cause and effect category. Some loss of hearing was found in persons exposed to noise levels not exceeding the damage risk criteria accepted at that time.

A paper by MURPHY in 1966 (Ann. occup. Hyg. 9, 149) featured some of the practical ways of dealing with "Noise problems in industry", and was based on his experience as an occupational hygienist with the Esso Petroleum Co. Ltd. He dealt with the measurement and assessment of plant noise in relation to hearing conservation, speech interference and community noise. Control of personal noise exposure was considered by means of noise control at the design stage, retrospective noise control at source, total or partial exposure and personal protection. Typical average attenuation values of cotton wool, two types of ear plugs and ear muffs were given, and the risk of dermatitis of the ear canal was mentioned. Employees should be warned of the hazards of excessive noise exposure, and a photograph was included of a warning notice in an Esso plant. Finally, monitoring audiometry was recommended. This paper was of particular significance because it reviewed contemporary practice based upon measures which had been tried and proved, rather than adopting an academic or theoretical approach to the subject.

The results of investigations into "Noise-induced hearing loss in (three) bench glass blowers" were presented by SANDERSON and STEEL (Ann. occup. Hyg. 10, 135, 1967). The problem was solved by the substitution of less noisy torches and the results are inconclusive. In the same issue, ACTON (Ann. occup. Hyg. 10, 143, 1967) reviewed 35 different published hearing damage risk criteria which gave widely differing "permissible" limits. State of the art recommendations were made for exposure to steady and intermittent noise, impulsive noise and noise which contained tonal components.

In July 1967 issue of Annals of Occupational Hygiene included papers presented to a conference on "Hazards in Foundries". ATHERLEY et al (Ann. Occup. Hyg. 10, 255) described a cause and effect type of study on "foundry noise

and hearing in foundrymen", although this did serve to highlight certain specific hazards within that environment. The next contribution by SUGDEN (Ann. occup. Hyg. 10, 263) of "Some notes on the provision of personal hearing protection for fettlers at an iron foundry" is much more significant. This describes the experiences of an industrial medical officer who persevered with trying to persuade personnel to use glass down ear protection. His success rate after six weeks was about 30%. Some of the reasons given by the men for not using the protection were analysed.

A number of papers presented at a British Occupational Hygiene Society Conference "Noise in industry - recent developments" were printed in the October 1967 issue of Annals of Occupational Hygiene. These may be listed as follows:-

TANNER, Recent noise measurement techniques, (Ann. occup. Hyg. 10, 375)

COLES and RICE, Hazards from impulse noise, (Ann. occup. Hyg. 10, 381)

ATHERLEY and NOBLE, Recent developments in audiometry, (Ann. occup. Hyg. 10, 389)

ROBINSON, Progress towards standards for noise and audiometry (Ann. occup. Hyg. 10, 401)

ERSKINE, Noise specification for industrial plant, (Ann. occup. Hyg. 10, 407)

FORD, Noise control,(Ann. occup. Hyg. 10, 415)

ACTON, Effects of ear protection on communication, (Ann. occup. Hyg. 10, 423).

Taken collectively, these papers represented the most up to date knowledge of the subjects at that time. The first paper discussed the difficulties of assessing personal exposure to intermittent or impulsive noise in the industrial environment. The publication of studies of hearing loss due to impulsive noise and the criterion for exposure to this type of noise virtually coincided with the appearance of the data in an acoustical journal. Likewise, the paper on ear protection reviewed information which had previously only been available in acoustical journals. The paper on "recent developments in audiometry" was concerned with research topics. This raised "The question of the role of audiometry in industry .... but it is not one that can be answered at this stage". The next paper dealt with progress towards reaching international agreement on standards for noise and audiometry. The implications of enforcing criteria for community and in-plant noise levels were discussed by Erskine. The paper on noise control concentrated on isolation and enclosure of machinery, and a number of practical points were mentioned. The final paper on ear protection reviewed information which had previously also only been available in acoustical journals. However, it must be said that, in general, these papers did not give practical advice on the institution or running of hearing conservation programmes at factory floor level.

Noise was included as one of the hazards associated with arc-air gouging by SANDERSON (Ann. occup. Hyg. 11, 123, 1968). The making of the two-part Royal Navy film "Dangerous Noise" was reported by KEMP (Ann. occup. Hyg. 11, 177, 1968). The first part was intended as an aid to training in the awareness of noise hazards and the need to use personal ear protection.

The proceedings of a conference on "Health Hazards in Agriculture" included a paper on "Machinery Hazards" (MOSS, Ann. occup. Hyg. 12, 69, 1969). This mentioned potential noise hazards from tractors, combine harvesters, grain driers,

feed mills, pig houses and chain saws, but made no allowances for the duration of exposure to these sources. Under the heading "A legal action for noise deafness", COLES (Ann. occup. Hyg. 12, 223, 1969) reported the unsuccessful action Down -v- Dudley Coles Long Ltd. This was the first time a claim had been made for other than traumatic deafness, although the noise exposure had occurred over a period of only two weeks in May 1966. A large part of the report was abstracted from the offical transcript of the judgment.

Four papers presented at a scientific meeting of the British Occupational Hygiene Society were published in the January 1970 issue as follows:-

COLES and RICE, Towards a criterion for impulse noise in industry, (Ann. occup. Hyg. 13, 43)

WALKER, Temporary threshold shift from impulse noise, (Ann. occup. Hyg. 13, 51)

MARTIN et al. Recurrent impact noise from pneumatic hammers. (Ann. occup. Hyg. 13, 59)

NOBLE, A new concept of damage risk criterion (Ann. occup. Hyg. 13, 69).

Taken together, the first three papers represented an up-to-date review of knowledge of the effects of impulse noise, particularly of the highly repetitive type commonly occurring in industry. They showed that conventional sound level meters are an inadequate method of measurement, and the only satisfactory ways of determining the parameters of impulse noise involved laboratory type techniques, such as using cathode-ray oscilloscopes, etc. In the final paper, Noble suggested the use of self-assessment questionnaires to allow men to determine their own level of hearing handicap. The tone of the discussion following this paper clearly showed it had been greeted with scepticism, as there were no safeguards against respondents exaggerating or telling lies in the industrial, as opposed to research, situation.

ATHERLEY and MARTIN ("Equivalent-continuous noise level as a measure of injury from impact and impulse noise", Ann. occup. Hyg. 14, 11, 1971) published a validation for the extension of the equal energy concept to certain industrial situations where impulse noise of moderate peak levels was superimposed on a fairly high level of continuous background noise, such as, for example, occurs in mass production drop forging. In spite of the rather limited range of noise samples used in the study, the authors expressed the view "that equivalent-continuous noise level for a typical working day may safely be used to calculate immission and hence risk of injury to hearing for noise of any type". Current opinion suggests that the "ad lib" extrapolation to cover "noise of any type" may not be justified and that a different hearing damage mechanism occurs in exposure to high intensity impulse noise, although the original study covering the types of noise specified was quite sound.

The British Occupational Hygiene Society "Hygiene Standard for wide-band noise" was published in the June 1971 issue. This recommended a limit of 90 dB(A) for 8 hours noise exposure, with an equal energy trading relationship of 3 dB(A) for every halving or doubling of exposure duration. These are exactly the same figures as were subsequently adopted in the Department of Employment Code of Practice. These values were a compromise between what was socially desirable on the one hand and technically feasible and economically acceptable on the other. The Committee expressed the view that "a reasonable objective would be to restrict occupational exposure to noise so that handicap should not occur in more than 1 per cent of persons exposed for a working lifetime".

The June 1971 issue also contained three papers on noise in petro-chemical plant, as follows:-

ERSKINE and BRUNT, Noise from chemical plant equipment (Ann. occup. Hyg. 14, 91).

TOWNEND, Noise from plant and equipment - an oil industry approach, (Ann. occup. Hyg. 14, 101)

SUTTON, Noise and the community, (Ann. occup. Hyg. 14, 109)

The emphasis in the first two papers was decidedly on noise specification and control at source without any reference to hearing, whilst the third was entirely concerned with community annoyance.

LEE and SMITH in 1971 (Ann. occup. Hyg. 14, 337) described "the control of noise produced by bar automatic lathes". The results were discussed in terms of hearing damage risk.

GUBERAN et al also in December 1971 (Ann. occup. Hyg. 14, 345) extended the study of "Hazardous exposure to industrial impact noise: persistent effect on hearing". This was essentially a cause and effect study. They concluded that "If this is confirmed by other surveys, it is foreseeable that the damage risk criteria for continuous noise could be extended to cover industrial impact noise". This paper was rather pre-empted by an earlier contribution from ATHERLEY and MARTIN (Ann. occup. Hyg. 14, 11, 1971).

HARRISON and STOKES described "A possible noise hazard inside air-fed hoods" and means by which the noise level had been reduced (Ann. occup. Hyg. 14, 351). The noise level had been sufficient originally to cause temporary hearing losses in two volunteer subjects.

There were no further publications relating to noise exposure or hearing loss in the Annals of occupational Hygiene before the publication of the Department of Employment Code of Practice.

2.9 Safety Journals prior to 1963.

A single section devoted to a review of safety journals would have proved unwieldy and difficult to use for reference purposes. As the titles or subject matter offered no further ready means of classification, the alternative seemed to be division by date. The year 1963 saw the publication of the Final Report of the Committee on the Problem of Noise and the Ministry of Labour booklet "Noise and the Worker", and these publications led to increased interest in the subject. Although this date does not produce a fifty-fifty split in the volume of material, it proved very convenient from many other aspects.

H.M. Factory Inspectorate published a quarterly journal "Industrial Accidents" commencing in 1933, and the title was changed in 1937 to "How Factory Accidents Happen". Publication was suspended following the outbreak of the Second World War and resumed under the title "Accidents" between 1949 and 1973. This has already been mentioned under the heading "Official Documents", but no relevant references were found in spite of a complete search.

The Royal Society for the Prevention of Accidents and its predecessors have published a monthly journal since 1925. Until 1935 this was devoted to all aspects of safety, and has been searched. A monthly bulletin on industrial accident prevention was published for members only from 1933, but this has not been located prior to 1961. "The British Journal of Industrial Safety" appeared in 1946, and this has been searched. The Society has also published the texts

of papers presented at its annual conference under the title "National Industrial Safety Study Conference Proceedings". These have been located and searched between 1930 and 1939, and then from 1948.

The British Safety Council commenced publication of a monthly tabloid newspaper-style periodical in November 1959 with the title "Safe Times", and this was changed to "Safety and Rescue" in October 1963. Copies are not usually retained by reference libraries, but the title is available in the Newspaper Library of the British Library Reference Division with the exception of four of the earlier issues.

A monthly commercial publication "Uniforms and Industrial Clothing" first appeared in 1955. The title was changed to "Safety Equipment and Industrial Clothing" in May 1957, and again in January 1960 to "Industrial Safety". These have been located and searched completely.

The Industrial Safety Officers' Section of the Royal Society for the Prevention of Accidents published "Safety Record" from 1946, and this was absorbed into the "Journal of the Institution of Industrial Safety Officers" when it commenced publication in 1953.

The first safety magazine ("Safety First") was published by the National Safety First Association (the forerunner of the Royal Society for the Prevention of Accidents) in 1925. Like all other pre-Second World War publications incorporating the word "safety", this was preoccupied with matters of life and limb and to a large extent with road safety. The insidious occupational hazards, including noise,were not given any consideration whatsoever in journals of this type prior to 1947.

The British Journal of Industrial Safety commenced publication in 1946, and in the following year carried the text of a paper by KING (Br. J. ind. Saf., 1, 59) with the title "Noise Abatement in Industry". This had been presented in the first instance to the National Safety Congress in October 1947. The author was concerned with the measurement and reduction of noise, and some practical examples were quoted. Questions arising in discussion and the replies given were published in the next issue (Br. J. ind. Saf., 1, 73). Three questions under the heading "The effects of noise" dealt with nuisance, jet engines and performance respectively.

An isolated advertisment for "Sonex" ear plugs appeared in the Summer 1951 issue. This referred to "danger to the hearing" and "permanent deafness". There were no further advertisements for ear protection in this journal for another twelve years.

A report by TOY (Br. J. ind. Saf., 5, 237) in 1962 described trials of "Glass down as an ear protector". These were essentially tests of its physical properties, and the author concluded that it would make a satisfactory ear protector. No recommendations were made for its application to industrial situations.

The Royal Society for the Prevention of Accidents also published a monthly news bulletin for its members, and the title has changed variously since its appearance as Industrial Accident Prevention Bulletin in 1933. This has been located and searched from the January 1961 issue. A product announcement for "Supersonex" ear plugs marketed by Amplivox Ltd. was carried in July 1962, and there have been occasional abstracts of publications on noise or hearing protection from that date also.

The Proceedings of the National Industrial Safety Study Conference were published separately by the Royal Society for the Prevention of Accidents. A

paper presented by HICKISH in 1960 was entitled "Noise in relation to industrial safety". The greater part of this paper was devoted to the theory of sound, the hearing mechanism, and the effects of noise. Reduction of noise at source was mentioned as "the most desirable method of noise control", but little practical advice was given. The final part of the paper dealt with hearing conservation. "When other means of noise reduction fail, resort should be made to the provision of personal protective devices". Some of the drawbacks and practical difficulties associated with the use of ear protection were discussed, but as is usual in papers of this vintage, the attenuation figures were optimistic. Routine monitoring audiometry was advocated.

The British Safety Council has produced a monthly tabloid newspaper-style publication since November 1959. This was known as "Safe Times" at first, and the title was changed to "Safety and Rescue " in October 1963. The style of reporting is often "journalistic", and the publication relies heavily upon news items. Copies are not usually retained by reference libraries, but it has been located and searched with the exception of four early issues.

An article which had first appeared in The Times newspaper on 1 April 1960 was reprinted in full in the July 1960 issue. The title was "The Problem of Noise in Industry - methods of dealing with it", and it dealt firstly with the measurement of noise and described some situations where a sound level meter had been used. Some examples of noise reduction, mainly relating to office situations, were given. The final paragraph opened:

> "There are, however, certain occupations in industry where a dangerous noise level just cannot be reduced. In such situations the solution requires that the men wear "ear defenders". For some reason, masculine vanity perhaps, these are not popular with most workers, and the safety officer has a hard, and often unrewarding, struggle to make his point."

This was the only reference to ear protection in the article, which was accompanied by an advertisement for "Lee Sonic Ear Valv" ear plugs.

A double page feature in January 1961 was headed "Quiet Please - for Safety's Sake". The main article suggested that excessive noise exposure was responsible for increased fatigue and headaches, had an adverse effect on health and efficiency, and was a contributory cause of accidents as well as causing deafness. It was "estimated that more than 40 per cent of all riveters have a degree of deafness in both ears as compared with 10 per cent in other trades." The final stage of noise control was given as "Reduction of noise at the ear by .... properly designed and fitted ear defenders." Monitoring audiometry was advocated. A section was devoted to office noise, but the final sentence read "In factories, workplaces, etc. where noise reduction to a reasonable level is impracticable, ear protectors are the only answer".

There were two subsidiary articles. JORDAN in an article "Couldn't stand the noise" under the heading "American newsletter" suggested that noise was a cause of absenteeism. It was claimed that "noise does not have to be deafening in intensity to be harmful and cause 'noise shock' to the worker". Where noise levels were in excess of a "comfort level" of 75 decibels, it was said that "workers will be found complaining of headaches, fatigue, nervous jitters, etc." The other article by CONNEL, Honorary Secretary of the Noise Abatement Society was headed "Noise drunk? You're accident bait", suggested that "millions" suffer from "noise sickness". Symptons were said to include colour blindness, loss of balance, congestion of the brain, and so on. Both the subsidiary articles made assertions which seemed to have little or no scientific foundation and the authors evidently set out to be alarmist. Unfortunately this approach detracted from the serious and substantially correct information conveyed by the main article.

The feature was accompanied by advertisements for "Lee Sonic Ear Valv" ear plugs and an acoustic screen for office machinery.

An "industrial noise conference" organised by the British Safety Council in co-operation with Ardente Industrial Services was announced in November 1961. This was to be, in effect, a press conference at which Billesholm's (now known as Bilsom) glass-down disposable ear plug material was launched in the United Kingdom. Papers presented by the two speakers, both from Sweden, were reported in another two page feature in January 1962.

HEIJBEL, who was Medical Director of Volvo, described the measures taken by his company to control noise and protect hearing. LIDEN who was from an audiological clinic described the mechanism of hearing and the manner in which noise damage occurs. Both speakers advocated the use of personal ear protection and the introduction of monitoring audiometry. Apparently occupational deafness was compensable in Sweden at that time. The report was accompanied by advertisements for "Anti-Noise" ear protectors (Billesholm's glass down as marketed by Ardente Industrial Services) and "Lee Sonic Ear Valv" ear plugs.

Ear muffs with fluid seals manufactured by Amplivox Ltd. were the subject of a news item in February 1962.

An article by COLQUHOUN in March 1962 "Psychological effects of working conditions" mentioned "the physiological effects of loud noise on hearing ability" as well as "the fact that working in noise (e.g. of 100 dB) is psychologically stressful". The effect was likely to be an increase in the number of mistakes made as the time of exposure to the noise increased.

"Supersonex" universally fitting ear plugs manufactured by Amplivox Ltd. were announced in April 1962. A report of the adoption of glass-down disposable ear plugs in a pin factory was made in December of the same year under the title "You can't hear a pin drop".

"Uniforms and Industrial Clothing" commenced publication in 1955, and in May 1956 showed a photograph of a worker in an American aircraft factory using "Stopples" ear plugs and ear muffs. The full trade name of the plugs was "Flents Anti-Noise Ear Stopples", and they consisted of wax-impregnated cotton wool. The type of ear muff was not identified. As far as is known, neither the "Stopples" nor the ear muffs were ever available commercially in the United Kingdom.

The title was changed to "Safety Equipment and Industrial Clothing" in 1957 and a twelve page (seven pages of text plus five of advertisements) supplement in January 1958 featured "Industrial noise - A survey of causes, effects and cures". The first article by TASKER dealt with the cause and effect of industrial deafness and excessive noise exposure, and quoted the Medical Research Council investigation carried out in the Midlands and reported by JOHNSTON in 1953. An attempt was made to describe the hearing mechanism and the nature of noise damage in everyday language. The following two paragraphs may be quoted on the subject of safe exposure limits:-

> "Although there are thus no precise limits, it is safe to say that if the overall noise level in a factory, as measured by a sound meter, is less than 85 decibels there is no danger to hearing. From 90-100 db. the possibility of permanent damage to the inner ear exists if highly susceptible individuals are subjected to long exposure. From 100 to 120 db. damage becomes probable rather than possible in this category of worker.
>
> When noise levels reach 120 to 130 db. the possibility of permanent damage to the hearing from long exposure become very

high for all individuals. Above 130 db. there is a very high possibility of damage from even short exposures"

It was suggested that "where noise levels cannot be reduced the wearing of 'ear defenders' should be mandatory".

The second article was on "Acoustic treatment as an answer to noise problems", and mostly dealt with the enclosure of machines and the correction of the acoustic conditions in offices and large public buildings. Mounting machines on floating floors and the erection of brick enclosures were suggested as "vastly more effective and a good deal less expensive than lining all the wall and ceiling surfaces of the shop" with acoustic absorbent material.

The final page headed "Some first lines of defence" suggested ear protection where "it is impossible to rid a process of noise without reducing either speed or efficiency". It was pointed out that cotton wool, though not "effective as a noise excluder, is still in use in many factories". It was said that "Many excellent ear pads which completely muffle outside noise are produced", but this statement must be queried as only "Nosonic" ear muffs were commercially available in this country at that time. These had hardly been advertised and were generally not available outside the aero-engine and aircraft industries. The suppliers publicity for the "Lee Sonic Ear Valv" ear plug was repeated. A device produced for the Royal Navy for use on the flight decks of aircraft carriers was described and illustrated. This consisted of "a close-fitting helmet in rainproof gaberdine fitted with removable ear capsules". The illustration showed a retaining tape tied under the chin. The suggestion that "the helmet could be adapted very simply for use in branches of industry" does not seem realistic as the device is unlikely to be acceptable under industrial conditions.

Apart from the helmet and the ear plugs mentioned above and Dawe sound level meters, the advertisements were entirely devoted to the supply and fitting of acoustic materials. The supplement was evidently reprinted as a booklet as it was publicised in subsequent issues of Industrial Safety.

A classified advertisement for "Lee Sonic Ear Valv" ear plugs appeared in the March 1958 and all subsequent issues with very few exceptions until September 1968. There were display advertisments for the same product in April and July 1958.

The report of an industrial health survey of factories in Halifax undertaken by the Ministry of Labour's Industrial Health Advisory Committee was covered in May 1958. This identified noise as a national problem and "liable to affect the health of the workers adversely". The report was published by H.M.S.O.

The granting of a patent for the ear muffs embodying fluid-filled ear cushions developed by SHAW and THIESSEN in Canada was reported in September 1958. These cushions were incorporated into ear muffs manufactured by Denis Ferranti Meters Ltd. and released commercially in May 1958 in the United Kingdom. These particular muffs were advertised in June and September 1959. These are the only advertisements which have been found for this product.

A brief and confusing news item under the heading "Noise and Alcohol" in the May 1959 issue reported that workers in a very noisy factory in Sweden who used "hearing aids .....suffered no ill effects over the years in strong comparison with those who had no aids". A survey of "some of the latest aids to personal protection" in the June 1959 issue described "new ear defenders" recently issued to British Overseas Airways Corporation ground staff. These were identified as Denis Ferranti "Eargard" muff from a photograph which showed them being worn incorrectly. A trade announcement in September 1959 publicised a transistorised sound level meter.

The title was changed to "Industrial Safety" in 1960, and an article by ALLEN in 1960 (Ind. Saf., 6, 152) on "Industrial health engineering" finished with a few paragraphs on the subject of noise control. Denis Ferranti muffs were illustrated again. A report of a paper "Noise in relation to industrial safety" given to the RoSPA National Industrial Safety Conference by HICKISH was published in July 1960. The report was confined to cause and effect matters, with no mention of remedies, although the original paper had included references to noise control and ear protection.

Various announcements concerning the marketing of ear muffs and ear plugs were made in the August 1961, March, May and July 1962, and May and June 1963 issues.

A brief report of a paper presented to another conference by HICKISH was the subject of a report in August 1963. This mentioned various forms of ear protection. The same issue contained an article "Hearing loss claims due to noise a potential basis for claims" (Ind. Saf., 9, 464) in a section headed "Legal notes". Although cause and effect were well known in certain industries, with boilermaking being given as an example, "no claims under the head of negligence are known to have been heard by the courts."

The Journal of the Institution of Industrial Safety officers was published between 1953 and 1964. There was no reference to noise or occupational deafness throughout this period.

2.10 Safety Journals from 1963 to 1972

"The British Journal of Industrial Safety" published by the Royal Society for the Prevention of Accidents was renamed "British Journal of Occupational Safety and Health" in 1971. The monthly news bulletin published for members of the Society as "Industrial Accident Prevention Bulletin" was renamed "Industrial Safety Bulletin" in 1966, "Occupational Safety Bulletin" in 1967 and "Occupational Safety and Health Supplement" in 1971. Publication of the papers presented at the Society's annual conference was continued as the "National Industrial Safety Study Conference Proceedings."

The British Safety Council publication "Safe Times" was known as "Safety and Rescue" from October 1963.

The commercially produced journal "Industrial Safety" continued without change of title.

The "Journal of the Institution of Industrial Safety Officers" ceased publication in 1964 when "Protection" became the official journal of the Institution.

"Safety" was published quarterly by the British Iron and Steel Federation in 1958, and publication was continued by the British Steel Corporation from 1968 after nationalisation of the industry. "Industrial Health and Safety" has been published monthly since 1968 by the Engineering Employers' Federation for its members.

All the periodicals mentioned above have been located and completely searched within the time period covered by this Section.

The British Journal of Occupational Safety carried a trade announcement for a muffler for a pneumatic drill in the Spring 1967 issue. This report concentrated on improvements in speech communication with no mention of hearing loss.

Noise was one of the hazards to "Health and safety in iron foundries" mentioned by BARNES (Br. J. occup. Saf., 7, 238) in the Summer 1967 issue. Some particularly noisy machines were listed, but it was stated that "research into

industrial noise problems has so far been very limited". In the absence of feasible noise reduction at source, "every effort should be made ..... to try to persuade noise-exposed workers to accept ear defenders".

A further trade announcement in the Winter 1970 issue showed an audiometric booth.

The title was changed again to Occupational Safety and Health in 1971, and publication became monthly instead of quarterly. The April/May 1971 issue carried product news of ear muffs and a simple sound level meter. Further product news of ear muffs was published in November 1971.

An article on health risks associated with farm machinery and equipment in December 1971 by MAY (Occup. Saf. and Health, 1 (9), 22) pointed out that the "ad hoc" fitting of cabs to tractors had increased driver noise exposure to levels in the range 95 to 110 dB(A). Ear defenders were stated to "represent current practical although only partially effective solutions". The Agriculture (Tractor Cabs) Regulations 1974 (Statutory Instrument No. 2034, 1974) subsequently limited the permitted noise level in the cabs of new tractors to 90 dB(A).

An agreement reached by G.K.N. Ltd. at their Cardiff nail factory in making the use of ear protection a condition of employment was reported in February 1972. There were various other news items and trade announcements, in each subsequent issue but no further articles as such until August 1972.

The August 1972 edition of Occupational Safety and Health was made a special "ear protection issue", and had obviously been prompted by the appearance of the Department of Employment Code of Practice earlier in the same year. The first article "Nice to hear you" (HOPKINSON, Occup. Saf. and Health 2 (8), 12, 1972) described the way the hearing mechanism is damaged by excessive noise, and outlined a hearing conservation programme. The attenuation figures quoted for various types of ear protection must be regarded as grossly optimistic. A barrister (ANON, Occup. Saf. and Health 2, 16, 1972) reviewed the first successful Common Law case for occupational deafness which had been decided in December 1971. A third article was on "Reducing noise in industry" (TAYLOR, Occup. Saf. and Health 2, 18, 1972). This was followed by a number of news items and trade announcements.

The monthly news bulletin published for members of the Royal Society for the Prevention of Accidents as Industrial Accident Prevention Bulletin carried product news of glass down material for making disposable ear plugs in May 1964. The title was changed to Industrial Safety Bulletin in January 1966 and to Occupational Safety Bulletin in 1967. There were abstracts of publications about noise or ear protection in the July and September 1967, January, February, June, August and November 1968, May, July, December 1969, February and May 1970 issues. Many of these publications were not of British origin and are not likely to have been readily available to readers. All British publications have been referenced in the relevant sections of this report.

The Royal Navy Film "Dangerous Noise" was mentioned in the May and September 1968 issues, and the filmstrip "Noise and Hearing" in the September 1970 issue.

The title was changed again in 1971 to Occupational Safety and Health Supplement. Further publications were referenced in the April/May and October 1971 issues. A one day RoSPA conference "Noise in Industry" was announced in the February 1972 issue. The publication of the Department of Employment Code of Practice was noted in the June 1972 issue.

The only paper in this period in the Proceedings of the National Industrial Safety Study Conference was by ATHERLEY in 1972 on the subject of "Noise". This had been inspired quite clearly by the publication of the Department of Employment

Code of Practice. The paper was very much concerned with the validation of the equal energy concept on which the Code was based, including its extension to impulse noise of the type produced by drop forging operations. Application of equal energy calculations to the utilization of ear protection showed that it must be worn virtually all the time in noise in order to be effective.

The publication of the Final Report of the Committee on the Problem of Noise (Command 2056, 1963), better known as the Wilson Committee Report, and of the (then) Ministry of Labour booklet "Noise and the Worker" were the subject of a two page feature in the July 1963 issue of Safe Times. The Wilson Committee Report was largely preoccupied with community noise, although the article in Safe Times gave some emphasis to the section on occupational noise exposure. Both articles mentioned the need to undertake surveys of noise levels and to provide ear protection. A table of "noise levels of typical sounds" listed some realistic values, but another table of "typical noise levels of contractor's plant" gave levels which could only have been experienced by on-lookers at an unspecified distance and not by the actual operators of the equipment. The feature was accompanied by an advertisement for "Anti-Noise" glass down material.

Messrs Artente received further publicity in July 1963 in a report headed "New Hearing Service", which offered noise surveys and "two minute hearing checks". The vehicle and equipment to be used in the joint Medical Research Council and National Physical Laboratory survey of hearing loss in industry were described in September 1963.

The publication of the Wilson Committee report evidently prompted another article "Are you going deaf?" in March 1964. In addition to mentioning the Report, this gave examples of noise levels of certain industrial machinery and the exposure criteria adopted in some European countries. The article was illustrated by a photograph of the poster issued by Messrs Billesholms to their customers, and another poster produced by the British Safety Council.

A trivial article in February 1965 headed "No noise" attributed various effects, some credible and some less so, to ultrasound.

A short article on "Hearing" in May 1965 was devoted to the problem of persuading workers to appreciate the hazards of noise and to use ear protection. It is worth quoting in part:

> "One does not have to look very far back to recall the resistance to such obvious safety aids as safety boots, goggles, hard hats and other items of protective clothing. It seems the same thing is happening to ear protectors .....
>
> In this country the individual seems to be relatively indifferent to possible harmful effects of excessive noise and industry in general is inclined to accept such conditions as an occupational hazard. This does not suggest little has been done, but indicates the readiness of the worker to accept unnecessarily hazardous conditons of work".

The article was accompanied by advertisments for "Lee Sonic Ear Valv" and "Anti-Noise" glass down ear plugs, and "Nosonic" ear muffs.

A short report in July 1965 "Deaf Dentists" related hearing loss to the noise of high speed dental drills. Ear muffs were featured in a trade announcement in August 1965. A photograph with the caption "Noise Hurts" in November 1965 showed ear muffs being used by ground staff servicing a jet aircraft. An article on "personal protection" in May/June 1966 showed a photograph of Denis Ferranti ear muffs, but these were not mentioned in the text.

A feature "Don't turn a deaf ear to noise hazards" covered one and a half pages of the Septemeber/October 1966 issue with its associated advertising. Parts of this could have been misleading. For example, the "danger level" was given as 102 dB, which is very considerably above the criterion recommended in the Ministry of Labour booklet "Noise and the Worker" published over three years earlier. The article also recommended "Lee Sonic Ear Valv" ear plugs, paraphrasing the advertising material produced by the distributors. These ear plugs offer virtually no protection to everyday industrial steady-state noise. Another poster produced by the British Safety Council was publicised.

The development of a pocket-sized noise dosimeter in Sweden was mentioned in February 1967, but this instrument does not seem to have been marketed commercially in the United Kingdom.

The possibility of successful claims for occupational deafness being made under Common Law was foreseen in an article "Lawyer predicts noise zones" in May 1967. The report quoted "There is plenty of law", and there seemed no reason why claims should not be made without any additional legislation.

The July 1967 issue carried a report accusing the Government of being "so ignorant about noise as a health hazard, no compensation is payable to workers deafened through occupational exposure". The remarks were attributed to Dr. Robert Murray, Medical Adviser to the T.U.C., when addressing a Royal Society of Health symposium.

In addition to loss of hearing, accidents, poor public relations and loss of efficiency were attributed to excessive noise in an article "Noise can make life more hazardous" in August 1967. Noise control at source was described as "the most fundamental approach", and ear protection as "the last line of defence". Some of the problems of convincing employees that they should wear ear protection were discussed.

"No action on noise" by the Minister of Housing and Local Government was reported in October 1967. This was concerned mainly with community noise, although the possible role of the Factory Inspectorate in assisting local authorities was mentioned. The same subject was repeated in a brief report "No noise law - yet" in November 1967.

There were trade announcements of ear muffs in November 1967, and January, March, 1968.

An article by GOYMOUR (Safety and Rescue page 14, July 1968) speculated that specific provisions regarding noise would be included in a new Factories Act. Such an Act never became law, and the Health and Safety at Work Act was based on the somewhat different concept of "enabling legislation". Various harmful effects of noise were mentioned, with the emphasis being placed on hearing loss. A level of 85-90 dB was taken "as a rough guide to the danger level". The Factory Inspectorate were reported to be "hoping shortly to issue more measuring instruments to the Inspectorate generally". Ear protection was only briefly mentioned and was "not thought to be entirely satisfactory", although some emphasis was given to noise reduction by enclosure. This included a description of the enclosures for multi-spindle wood moulding machines which had been developed by the Timber Research and Development Association.

An article in April 1969 featuring the medical and safety facilities of AC-Delco Ltd. showed a photograph of an audiometric facility used for pre-employment audiometry. Only a brief mention was made in the accompanying text. Further trade announcements of ear protection were made in the July 1969, and June, September and November 1970 issues.

The 1969 Annual Report of H.M. Chief Inspector of Factories (Command 4461, 1970)

was reviewed by JARDINE (Safety and Rescue, page 24, November 1970). This was the Report which had contained a chapter entirely devoted to noise, and which was critical of industry for not taking sufficient action over noise and occupational deafness.

Trade announcements for ear protection continued in December 1970, and February and April 1971. A feature on "Personal Protection" in April 1971 (Safety and Rescue page 22, April 1971) suggested that "prolonged exposure to noise in excess of 90 decibels is harmful", but gave misleading and grossly inflated figures for the attenuation afforded by ear plugs (20/30 decibels) and ear muffs(approximately 50 decibels). However, the feature did serve to draw attention to the availability of these devices, and to some of the drawbacks which may be encountered in their use.

There were still more trade announcements for ear protection in May, September and November 1971, and for a simple sound survey meter in January 1972. Britain was accused of being "several years behind countries like Sweden" in the field of noise control and ear protection (Safety and Rescue page 3, January 1972). The remarks were attributed to the regional manager of Bilsom International at a press conference held to promote their range of ear protection.

The first successful Common Law claim was reported in January 1972 (Safety and Rescue, page 21, January 1972). This report was based on the judgment delivered in the court.

A letter from a Trade Union official in the March 1972 issue drew attention to some practical points in the use of ear protection which had been omitted from a "recent" report dealing "with the serious effects of industrial deafness". A paragraph in the April 1972 issue was headed "Noise danger", but gave no real practical advice.

The publication of the Department of Employment Code of Practice was announced in May 1972 with the headline "Eight hours at 90 decibs - that's all!" (sic). The suggested hazard warning sign was reproduced with the report. It was pointed out that the base-line level of 90 dB(A) was in line with the American Walsh-Healy Act, but that the Americans "are less strict at higher noise levels".

Industrial Safety printed a review of the Ministry of Labour Booklet "Noise and the Worker" in September 1963. The review mentioned the provision of ear protection and monitoring audiometry. A one page report with photographs of the start of the joint Medical Research Council and National Physical Laboratory research project on hearing and noise in industry appeared in the next issue (Ind. Saf. 9, 570, October 1963). This was followed in November by a Letter to the Editor on the same subject from the Honorary Secretary of the Noise Abatement Society. A trade announcement in December 1963 showed a sound level indicator.

In April 1964, SHERWOOD (Ind. Saf. 10, 199) wrote about "How to tackle a noise reduction programme". It is unfortunate that an American criterion of 95 decibels was quoted for the provision of ear protection, although some very sound advice was given on the need to fit and use protection properly. The article was concluded with a brief summary of means of controlling sound transmission.

The next reference to noise was in February 1965, when the work of three Government research stations (the National Physical Laboratory, National Engineering Laboratory and Building Research Station) was reviewed under the heading "A new attack on noise" (Ind. Saf. 11, 81). The article concluded with mention of the publication of the Department of Scientific and Industrial Research booklet "Noise in Industry". The only mention of occupational noise exposure was in the last sentence "Finally, ear protectors may have to be considered and different types are described."

ROGERS (Ind. Saf. 11, 444 August 1965) described "Garments to beat noise". These

had been developed as protection against the extremely high noise levels encountered in jet engine testing and certain other aviation environments, and were hardly applicable to ordinary industrial situations. A "Frankenstein noise-protection suit" was illustrated which provided complete bodily as well as ear protection. The use of such devices would hardly be contemplated by industrial safety officers for everyday use. There was a further trade announcement for ear protection in May 1966.

The June 1966 issue of Industrial Safety carried a feature "Spotlight on ear protection and noise control". This started with a report of American experience in dealing with occupational deafness claims, and predicted a similar situation in this country. HENERY (Ind. Saf. 12, 331) described various types of ear protection drawing on his own company's products as examples. Amplitude sensitive properties were claimed for Mallock-Armstrong ear plugs: a claim which has not been substantiated by scientific tests as far as is known for ordinary industrial noise levels. He was more realistic about the average level of protection afforded by various devices than many contemporary and even later articles, and said that at "high intensity noise levels, of about 100 decibels or above, ear plugs cannot give the degree of protection necessary for safety and one has to turn to the muff type". Other articles dealt with noise control and machine design.

Simple sound level meters were featured in trade announcements in May and December 1967. A short item in January 1968 reported the hearing conservation programme initiated at a Rotherham steelworks.

In an article "Protection from head to toe" in February 1968 (Ind. Saf. 14, 83), a check list of situations requiring ear protection was given. A noise level of "about 80/90 decibels" was "considered to affect hearing after long exposure". Ear plugs were quoted as reducing "the noise level reaching the ear by about 20-40 decibels", which must be regarded as a grossly excessive figure for the performance of this type of ear protector.

Noise conditions in eleven European countries were examined in a report prepared by the International Wrought Copper Council and reviewed in Industrial Safety in March 1968. The review started with "In the past there has been a too passive acceptance of noise at work...." There were trade announcements for ear protection in April and May 1968.

A lecture given to the Derby Industrial Safety Group by EUINTON, a medical inspector of factories, was reported at length in June 1968 (Ind. Saf. 14, 303). The lecture had evidently been medically biased as some emphasis was placed on the mechanism of hearing damage. A hearing conservation programme was divided into five stages, the last being "fitting men with ear plugs or muffs". The lecturer was realistic about this:-

> "Plugs were generally unsatisfactory, and were probably incapable of reducing the noise level in the auditory canal by more than 10 or 15 decibels. A muff could be extremely comfortable to wear, being very light in construction and having a fluid-filled ear piece; it was probably capable of reducing the noise level by 30 or more decibels."

Medical supervision was considered essential, and monitoring audiometry was advocated. (A fuller text of the lecture was published in Trans. Soc. Occup. Med. 18, 142).

An article contributed by an anonymous "working safety officer" in the August 1968 issue (Ind. Saf. 14, 410) was headed "What Priority do you give to ear protection". This discussed many of the pros and cons of using protection in a practical sort of way, and the contributors attitude can be summed up by the

quotation:-

> "It is necessary that safety officers get the picture right because of the current pressures now being (quite rightly) applied to reduce noise levels. The question of priorities must enter into the whole consideration. There is a limit to the personal protection which an individual will, and in some circumstances is able to wear and in my view protection of the ears comes fairly well down the list."

The issue of 25 noise-measuring instruments to divisional offices of the Factory Inspectorate was reported in October 1968. The same issue carried an item alleging that "Discotheques are deafening". The second edition of the Ministry of Labour booklet was reviewed in December 1968, and there was a trade announcement of ear muffs.

The page devoted to comment by the Industrial Safety (Personal Equipment) Manufacturers Association described noise as "the latest industrial problem" in March 1969, although it was pointed out that it was "not a new hazard". The current interest appeared to stem from the publication of the Wilson Committee Report in 1963. The problems of selecting suitable criteria were discussed in a continuation of the article in June 1969, but actual values were not suggested. The article was concluded in September 1969.

NORRIS, in the July 1969 issue, wrote about "Getting noise into perspective", and he clearly gave noise low priority as had certain earlier contributors. He quoted:-

> "A German doctor, in the course of a discussion on the subject in Liege in 1968, summarised the situation admirably when he pointed out that, in certain unlikely but still existent work situations, a workman might be called on to wear a helmet, eye protection, ear protection, respirator, body protection, gloves and protective footwear. 'Take away the helmet', he said, 'and he may sustain a fractured skull. Remove his eye protection and he may be blinded. Take off the respirator and asphyxiation can follow. Strip him of the various items of body protection and he can sustain fatal burns, or be permanently crippled. But if you remove his ear protection, the worst result will be that he can hear the television less well when he retires.'
>
> An over-simplification, maybe. Yet it has an element of truth in it."

He then went on to give practical advice about measuring noise and providing ear protection. Although he quoted a damage risk criterion of 90 decibels, he considered "the cross-over point" between ear plugs and muffs to be about 120 decibels. This is clearly placing too much reliance on the performance of ear plugs as an ear protector.

Wax ear plugs were publicised in March 1970. Under the heading "Testing for noise pollution" in the April 1970 issue, LORANT (Ind. Saf. 16, 158) described the Westinghouse reverberant room facility. This probably referred to the Westinghouse Corporation of America, and not to any British company by that name. Further product announcements were made in the April and May 1970 issues. The publication of the report of the joint Medical Research Council and National Physical Laboratory investigation "Hearing and Noise in Industry" was noted in May 1970. New sound level meters were announced in June and September 1970.

The United States noise regulations, incorporated in the Walsh-Healey Act were outlined in October 1970. The basic exposure limit is 90 dB(A) for eight hours,

but the trading allowance is 5 dB(A) for each halving of exposure duration. This contrasts with the 3 dB(A) "equal energy" relationship subsequently adopted by most European countries.

The 1969 Annual Report of H.M. Chief Inspector of Factories was featured in November 1970, and a section was devoted to the chapter on noise. It was noted that many companies with noise problems were apparently not providing ear protection for their employees. More products, publications or services were announced in November and December 1970 and February 1971. The publication of the British Occupational Hygiene Society standard for wide-band noise was mentioned in June 1971.

The first course to be organised by the newly formed Safety and Hygiene Group of the University of Aston in Birmingham had been on the subject of "Noise in Factories", and this was given coverage in August 1971. A one day meeting on the subject of ear protection, also to be held at the University of Aston, was announced in September 1971. An audiology course at the University of Salford was publicised in October 1971. Trade announcements continued every month from October 1971 to the end of the period of the search.

An editorial in February 1972 reported the first successful common law claim for occupational deafness, and speculated that "the Government is likely to come under increasing pressure to allow deafness as an industrial disease for compensation purposes". An article "First noise compensation case" (Ind. Saf. 18, 83) in the same issue was based on the judgment delivered in the court. It was said to "break new and important ground".

The publication of the Department of Employment Code of Practice was commented upon in June 1972 "only as a hesitant step where bold legislative action would have been more appropriate". The contents of the Code were reviewed at some length later in the same issue (Ind. Saf. 18, 276). This was illustrated with the warning symbol recommended in the Code.

Protection, the official journal of the Institution of Industrial Safety Officers, briefly noted the publication of the Department of Scientific and Industrial Research booklet No. 6 "Noise in Industry" in the December 1964 issue under the heading "Dangerous Decibels". There was no further reference to noise until January 1969 when an electronic peak limiting ear muff device was illustrated and described in an article on the role of the Ministry of Technology in developing safety equipment. This had been produced at the Explosive Research and Development Establishment and was intended to protect against unexpected impulsive noises whilst allowing normal communications to be maintained in between times.

There was a trade announcement of a simple sound meter in January 1970. The same issue reported a written reply to a parliamentary question in which the Secretary of State for Social Services announced that he had referred the question of prescription of occupational deafness to the Industrial Injuries Advisory Council for their consideration. The March 1970 issue warned of a craze for "personalising" ear muffs prevalent in America which involved drilling holes in the cups. A brief report of the National Physical Laboratory Symposium "Occupational Hearing Loss" was given in the May 1980 issue.

An article in January 1971 "Against Noise" (Protection 8 (1), 13) described the Ford Motor Company noise control and hearing conservation programme. This included noise specifications for new plant and noise control at source where feasible, as well as the provision of ear protection and monitoring audiometry. This issue also contained a trade announcement of an audiometric booth.

"Health in Construction" in the July/August 1971 issue (Protection 8 (6), 10)

contained a paragraph on noise and a small photograph of ear muffs. "Hazard Vetting" in September 1971 (Protection 8 (7), 5) also briefly mentioned noise and included a photograph captioned "taking a noise level reading". There was a trade announcement of ear muffs in October 1971.

The January 1972 issue devoted a full page feature to the Berry -v- Stone Manganese Marine Ltd. judgment (Protection 9 (1), 3). Besides reporting the decision, this warned safety officers "The moral seems to be that ear muffs are more efficient than ear plugs .... and, more important, to be on the safe side steps should be taken to ensure that the employees are made aware of the availability of these protective devices". There was a further trade announcement for ear muffs in April 1972, and the publication of the Department of Employment Code of Practice was reported in May 1972 by FREEMAN (Protection 9 (5), 4 and 9 (5), 12). Difficulties were foreseen in enforcing the wearing of ear protection, and government legislation was predicted.

"Safety" which was published first by the British Iron and Steel Federation from 1958, and latterly by the British Steel Corporation has carried little information on noise. A review of "The Handbook of Noise Control" (by C.M. Harris) published in America in April 1962 stated "hearing loss is thought to result from exposure to steady noise". Glass down disposable ear plugs were described in the Summer 1962 issue without giving the source of this material. In August 1963 under "Your health is their business", hearing tests carried out in the laboratory of the Slough Occupational Health Service were mentioned. The publication of the Ministry of Labour booklet "Noise and the Worker" was announced in November 1963. Peak limiting ear muffs were featured in an article "Small bangs for big" in November 1969. It was stated that "the equipment is useful when there may be sudden loud noise, like gunfire or explosions, rather than when noises are continuous". The first article to spell out the hazards of excessive noise exposure and the need for hearing protection was in June 1972, (DUNCAN, "How shock-proof are your ear drums"). This was based on the Department of Employment Code of Practice published in the April of that year.

The Engineering Employers' Federation have produced "Industrial Health and Safety" monthly for its members since 1968. This reported the publication of the Department of Employment Advisory Leaflet No. 72 "Noise control on building sites" (August 1968 issue), the reprint of the Ministry of Labour booklet "Noise and the Worker" (November 1968), the report of the joint Medical Research Council and National Physical Laboratory investigation by BURNS and ROBINSON "Hearing and Noise in Industry" (April 1970), H.M. Factory Inspectory Technical data note 12 "Notes for the guidance of designers on the reduction of machinery noise" (June 1970), the second edition of "Noise and the Worker" (January 1972) and the Department of Employment Code of Practice (May 1972).

2.11 International Publications, etc.

The following items were published by international organizations during the period under consideration. Apart from reviews in certain specialised journals they were not generally well publicised, and in all cases could only be obtained by post.

Recommendation No. 97 of the 36th Session of the International Labour Conference in 1953 concerned the protection of the health of workers in places of employment, and paragraph 2 called upon employers to take measures to eliminate or reduce as far as possible noise or vibration which constitutes a danger to the health of workers. The United Kingdom Government accepted this in principle in a white paper in 1955 (Command 9422) but did not consider it practicable to legislate on the subject at that time.

The International Labour Office published CIS Information Sheet No. 4 in 1961 on

the subject "Maximum acceptable levels for industrial noise". This was a four page pamphlet which reviewed certain hearing damage risk criteria in use in America, France, Germany and USSR. On the basis of these publications it recommended the adoption of a "middle of the road" frequency spectrum, which summates to approximately 88 dB(A) in present day terms.

The World Health Organisation published a booklet by BELL in 1966 "Noise, An Occupational Hazard and Public Nuisance" as No. 30 in the Public Health Papers series. The greater part of this was devoted to a "state of the art" review of occupational noise exposure and hearing conservation practice, although the source of much of the information had been American papers. Nevertheless, sufficent information was given to enable an employer to initiate and run a hearing conservation programme.

The International Labour office CIS Information Sheet No. 17 "Noise in Industry" published in 1968 was largely based on BELL'S W.H.O. publication, and much of the text and many of the figures are identical. Photographs of ear protectors, sound level meters and an audiometer were all obtained from American sources, although one of the sound level meters was manufactured by Bruel and Kjaer in Denmark in the first instance.

The International Wrought Copper Council represents the interests of the copper industry throughout Europe, and in 1968 produced a handbook "Introduction to the Study of Noise in Industry". This reviewed "Effects of noise on the human body", including hearing loss, and gave "suggested upper limits for exposure to continuous noise" and "for variable noise levels". However, the greater part of the document was concerned with a review of the legal situation in member countries, and with examples of engineering noise control in the copper industry. There was one short paragraph each on ear plugs and ear muffs, but no practical information on their usage or on hearing conservation generally. This handbook has been fairly widely quoted.

2.12 Other Publications

There have been many publications concerning noise and occupational hearing loss in professional and trade journals, particularly within the wood-working and petro-chemical industries. The following have been selected for review as they appear to have been widely quoted outside the immediate area of circulation of the publication.

In October 1953 an article appeared in a publication called "Scope" with the title "Noise in Industry". This was wide ranging, and covered topics such as occupational hearing loss, noise measurement and noise control, with a brief mention of ear protection at the end. It was written in a journalistic style and illustrated with a number of trade photographs. "Scope" was described as "a magazine for industry", but was, in fact, the forerunner of "Business systems and Equipment", and this is consistent with the nature of the advertising matter interspersed with the text. Circulation is understood to have been by direct mailing and it was sent gratis to selected recipients. The first officially audited circulation was for 1960 when an average of 19,475 copies of each issue were distributed. The unsubstantiated figure for the circulation in 1953 was 7,000 copies.

The Industrial Welfare Society conducted a survey among its member companies, probably during the winter of 1960-61. The results are summarised by DAVIES in I.W.S. Summary No. 83 "Industrial Noise" dated June 1961. This confirms the low level of interest in noise and occupational deafness shown by industry at that time. Only 8% of the questionnaires were returned compared with a normal response of over 50% in other surveys, and over half the responding companies employed more than 500 people. Out of 55 firms responding, only 6 had carried out a

comprehensive noise survey and a further 4 a partial survey. A paper based on this survey was presented by DAVIES to the National Physical Laboratory Symposium "The Control of Noise" in 1961, and an abbreviated text is published in the proceedings of the symposium.

Reprints of a paper by HEIJBEL "Practical Experience of Hearing Conservation in Industry" are widely distributed by Messrs Bilsom International to advertise their products. This describes hearing tests in industry, and the steps which can be taken to conserve hearing through the use of glass down ear protectors. The title page of the reprint describes it as a "Lecture held at the Industrial Noise Conference in London, December 1961". However, this was apparently a press conference organised by Ardente Ltd. in conjunction with the British Safety Council to launch Billesholm's glass down disposable ear plug material which Messrs. Ardente were to market on an agency basis as "Anti Noise". (Messrs Billesholm's became known as Bilsom International in March 1968).

A chapter by ATHERLEY and PURNELL in the Industrial Safety Handbook published in 1969 was entitled "Noise control", although it was in actual fact biased towards the effects of noise and hearing conservation. Examples of noise levels measured in a number of industrial situations were given, and a hearing damage risk criterion of 90 dB(A) was inferred although not categorically stated. Available types of ear protection were tabulated together with some of the practical difficulties and slightly optimistic upper noise levels in which each type would provide "reasonable protection". The need for the routine supervision of users of ear protection was stressed. Other parts of the chapter covered whole-body effects, safety, annoyance and speech interference. Appendices to the chapter described simple acoustical theory and the methodology of audiometry, although no recommendations were made for or against the adoption of routine monitoring audiometry in industry.

2.13 Summary

The easiest way to summarise the state of knowledge is to select the publications which represented a turning point in the knowledge and practical application of hearing conservation in each discipline. These are probably as follows:-

Official Literature

Ministry of Labour (1963) Safety Health and Welfare Booklet No. 25 "Noise and the Worker", H.M.S.O.

Committee on the Problem of Noise (1963) "Noise - Final Report", Command 2056, H.M.S.O.

Industrial Medicine

BURNS (1965) "Noise as an environmental factor in industry", (Trans. Ass. industr. Med. Offrs. 15, 2) when an authoritative hearing damage risk criterion was published, and the values of the attenuation provided by various types of ear protection were applied to this criterion.

RICE and COLES (1966) "Design factors and use of ear protection" (Brit. J. industr. Med. 23, 194) when the types of ear protection available and the difficulties associated with its usage were fully reviewed for the first time.

HINCHCLIFFE (1967) "Occupational noise-induced hearing loss" (Proc. roy. Soc. Med. 60, 1111), TAYLOR et al (1967) "A pilot study of hearing loss and social handicap in female jute weavers" (Proc. roy.

Soc. Med. 60, 1117) and KERR (1967) "Noise problems connected with the manufacture of nylon and terylene yarn" (Proc. roy.Soc. Med. 60, 1121). These were three papers presented to a meeting of the Section of Occupational Medicine of the Royal Society of Medicine held on 3 March 1967.

Industrial Nursing

DREW (1968) "Conservation of hearing programmes in North America" (Occup. Health, 20, 179) described the practices she observed during a study tour of North America.

CRACKNELL (1968) "Investigations into noise and its effect on employees carried out in a manufacturing plant" (Occup. Health, 20, 184) described her experience of hearing conservation measures in a small chemical plant.

ACTON (1970) "Personal ear protection" (Occup. Health, 22, 315) reviewed the types of ear protection available and the difficulties and problems associated with its application in industry.

Industrial Hygiene

MURPHY (1966) "Noise problems in industry" (Ann. Occup. Hyg. 9, 149) showed the measures which had been taken successfully in one plant.

"Noise in industry - recent developments" a series of papers presented at a British Occupational Hygiene Society Conference and reproduced in Annals of Occupational Hygiene for October 1967.

Safety

The publication of the Final Report of the Committee on the Problem of Noise (Command 2056, 1963) and the Ministry of Labour booklet "Noise and the Worker" (H.M.S.O.) were the subject of a feature in Safety and Rescue in July 1963.

"Ear protection and noise control". A feature comprising several articles in Industrial Safety in June 1966.

The attitude of Safety Officers that they had bigger problems to worry about than noise was summed up in articles in Industrial Safety for August and July 1969, and noise was referred to as "the latest industrial problem" in June 1969. Nevertheless there were a number of constructive references to ear protection and hearing conservation in Industrial Safety from this period onwards.

An anonymous article "Noise can make life more hazardous",(Safety and Rescue page 13 August 1967), and GOYMOUR "Shakespeare should have been around to-day!", (Safety and Rescue page 14 July 1968.). Parts of an earlier article in Safety and Rescue for September/October 1966 could have been misleading and have lulled otherwise uninformed employers into a false sense of security.

Protection, the official journal of the Institution of Industrial Safety Officers, did not carry an article on hearing conservation until January 1971.

None of the journals published by the Royal Society for the Prevention of Accidents considered the subject in any depth until August 1972, i.e. after the publication of the Department of Employment Code of Practice.

3.0 EAR PROTECTION

This section is restricted to a consideration of the situation which existed in the United Kingdom. Reference to a chapter on ear protectors by ZWISLOCKI in the "Handbook of Noise Control" published in America in 1957 shows that types of ear plug and ear muff were commercially available there which have never penetrated the British market. Subsequent knowledge gained from such literature should not be allowed to influence impressions of the contemporary situation which prevailed in this country.

3.1 Development

The first reference to an ear plug intended as protection against noise (i.e. as opposed to use as a surgical dressing or when bathing) was found in the proceedings of the section of Otology at the British Medical Association annual conference published in the British Medical Journal on 13 October 1883. This was the invention of Dr. Ward COUSINS, and the relevant section of the report reads as follows:

> "The instrument was intended for a sound-deadener. It would, when introduced firmly into the meatus, take off the shock of sound, and reduce it to the extent of two thirds. It consisted of a conical vulcanite plug, shaped like a rifle-bullet, closed by a thick disc of the same material. It formed an elastic and very confortable protection, which could be very conveniently put in and taken out in a moment. It was recommended by Dr. Cousins for persons working in loud noise, such as artizans in factories, soldiers and sailors during the discharge of cannon, and all who were painfully affected by noise. Many were, under those circumstances, permanently affected, and this little apparatus was proposed as a sound-deadener, and, therefore, a preserver of the ear against those chronic changes which a life of labour amidst noise was liable to produce. The plug must not be merely introduced into the ear, but firmly pressed and screwed round the meatus. It was made also fixed in spring-supports, which passed behind the head, the cushion being supported on a little stem, and the pressure regulated by a screw."

The reference to comfort is apparently contradicted by the need to firmly press and screw the device round the meatus. The comfort of the version with "spring-supports" where the pressure was regulated by a screw must be very questionable.

Another type of ear plug known as the "Mallock Armstrong" was developed in this country in about 1913 as a protection against the noise and blast from naval guns. These were originally turned from wood, although "Vulcanite" or another thermo-setting type of plastic material was substituted later. These plugs have spherical ends with a hole through the middle, which is closed by some sort of translucent film (originally "gold beaters skin") restrained by fine brass-coloured gauze. This was claimed to impart non-linear attenuation properties to the device, but as far as is known this assertion has never been scientifically proven in respect of the steady-state type of industrial noise. These plugs were available in five, and possibly seven, sizes.

In a discussion on "Occupational diseases of the ear, nose and throat, and their prevention" held in 1925, Major T.J. FAULDER of the Royal Army Medical Corps. (British Medical Journal 14 November 1925) mentioned "The Ward Cousins hollow rubber plug; plasticine wool; and the Macnaughton-Jones celluloid or rubber cone" as well as the Mallock-Armstrong plugs. Celluloid was said to be dangerous, but it was not stated whether this was because of its flammability or the possibility of injury from sharp edges. The plasticine/wool mixture had to be prepared by the user. The author expressed a preference for "plugs of ordinary wool with vaseline."

No further references to the Ward Cousins or Macnaughton-Jones devices have been found, and it is not known whether they were ever made available commercially.

WESTON and ADAMS in an Industrial Health Research Board Report in 1932 refer to "various makes of vulcanite plug used by bathers".

A reference in The Times of 29 September 1934 indicated that waxed cotton wool plugs were available from chemist's shops.

Some sort of ear plugs and ear muffs were available during the Second World War supposedly as a protection against bomb blast and the noise of gun fire. JOHNSTON (1953) reported that neither were suitable for use in industrial environments. Trials of the ear muffs by "several subjects with normal hearing under the noise conditions of a boiler shop showed that considerable aural fatigue from noise occurred when the defender was worn". In other words, it was not effective in preventing temporary hearing losses.

A type of ear plug known by the code number V-51R was developed in America during the Second World War, and is still one of the best durable (i.e. as opposed to disposable) ear plugs available at the present time. It consists of a capsule of soft plastic or silicone rubber, with a bell shaped cup at its tip which seals against the inside of the ear canal. The capsule has a shape roughly equivalent to the average ear canal. A flange and tab at the outer end prevent too deep insertion and provide a grip. Five sizes are available. The original report by SHAW et al was published by the U.S. Office of Scientific Research and Development on 1 July 1945, and was declassified on 10 May 1946.

Plugs of a very similar design but with two sealing flanges were developed by the Commonwealth Acoustic Laboratories, Sydney somewhat later. The first reference traced was a report giving the results of attenuation measurements published by the Flying Personnel Research Committee of the Air Ministry in this country in 1954 (DICKSON et al 1954).

The Lee Sonic "Ear Valv" was developed in America sometime after the 1939-45 war, but the first reference traced was a report by NEELEY dated 1952 (quoted by DICKSON et al 1954). This consisted of a small metal cylinder sealed into the ear with two rubber flanges of increasing size perpendicular to the axis of the device. Later derivatives have three rubber flanges. The cylinder is perforated, and contains a diaphragm which is held in a central position by coiled hair springs on either side. The advertising literature claims that the diaphragm moves under the influence of incident sound thereby closing the hole. It has been calculated that the valve would require a sound pressure level of at least 175 dB to close (THIESSEN, 1961). Ear plugs with a small aperture (of the order of 0.5 mm) operate linearly up to about 110 dB (SHAW, 1979). At higher sound pressure levels the impedance of the orifice increases due to non-linearity, thereby reducing the rate of pressure rise in the ear canal. Thus the peak pressure level reaching the ear drum from intense impulse sounds of short duration is reduced. There is evidence that the Lee Sonic "Ear Valv" provides some protection against impulse noise of the gunfire type, probably due to the non-linear process mentioned above, but the device offers very poor attenuation to ordinary everyday industrial noise levels.

Another type of soft elastic ear plug known as the Selectone was developed by ZWISLOCKI in 1952 (J. acoust. Soc. Am., 24, 762). The comfort and attenuation provided are very similar to the V-51R, but for some reason it never seems to have caught on. A version of this plug known as the Selectone K incorporates an acoustic low-pass filter.

A type of ear plug of unknown pedigree was first sold by Messrs Amplivox as "Supersonex" and later by other companies. This consists of three disc-like

flanges of increasing size on a stem. The whole is moulded in soft rubber or plastic. The plug is inserted into the ear until one of the flanges meets resistance from the inside of the ear canal. One size is intended to provide a universal fitting for all persons.

Mallock Armstrong "Nosonic" Mark I ear muffs were produced at about the end of the Second World War in response to requests from the aero-engine industry for adequate protection against the noise of engine testing. The Mark II appeared in about 1948 and the Mark V in about 1955. As far as can be determined, the development had proceeded very much on an 'ad hoc' basis. The company has become Anticoustic Ltd. since, but the name "Nosonic" has been retained.

Scientific development of ear muffs proceeded mainly in Canada. The initial stages of work towards an improved seal or cushion was reported to a meeting of the Acoustical Society of America (SHAW and THIESSEN, 1954). The conclusion of this work and the design of a very much improved type of ear muff was described in the January 1958 edition of the Journal of the Acoustical Society of America (SHAW and THIESSEN, 1958). The muffs illustrated were the same as those marketed commercially by Messrs Denis Ferranti Meters Ltd. in May 1958. The fluid-filled seals invented by Shaw and Thiessen were an essential feature of a British Patent (number 791660, filed 18 May 1955 and published 5 March 1958) granted to the National Research Council of Canada for an "ear defender".

Glass-fibre material for disposable ear plugs was developed by Messrs Billesholms (now known as Bilsoms) in Sweden in the mid 1950's, and was available in Sweden by March 1958. The same material pre-formed into plugs (known as "Propp") was introduced in Sweden on 21 April 1971.

3.2 Commercial Availability

The development of a product does not necessarily ensure its commercial availability. The following information has been elicited from suppliers and other sources regarding the dates of the introduction of various products.

Mallock-Armstrong ear plugs were available from about 1914.

"Various makes of vulcanite plug" were apparently available in 1932 and intended for use by bathers (WESTON and ADAMS,1932).

Waxed cotton wool ear plugs were available from chemists' shops at least as early as 1934 as "Quies". These are still sold.

Ear plugs of the V-51R pattern were marketed in this country by Messrs Amplivox Ltd. from November 1950 under the trade name "Sonex", and by British American Optical Company Ltd. in late 1968 or early 1969 as "Hear-Guard" ear plugs.

"Selectone" ear plugs were first introduced by Messrs Ardente in about October 1960. "Supersonex" universally fitting ear plugs were marketed by Messrs Amplivox Ltd. from June 1961. The Commonwealth Acoustic Laboratory type ear plugs were manufactured by Protector Safety Products Ltd., who entered the United Kingdom market in 1965.

It has not been possible to ascertain when the Lee Sonic "Ear Valv" was first sold in this country, but advertisements dating from January 1957 have been found.

The Mallock-Armstrong "Nosonic" ear muffs were available within the aero-engine industry from sometime after the Second World War. This became the Anticoustic Company and Mr. Henery, the managing director said in his evidence in the High Court hearing of McGuiness -v- Kirstall Forge and Engineering Ltd. that sales to industry in general had begun in about the mid-1950's.

Comfortable and effective ear muffs based on the fluid-seal principle (described by SHAW and THIESSEN 1958) were manufactured for the armed services by Messrs Denis Ferranti Meters Ltd and marketed commercially as "Eargard" in May 1958. Fluid-seal ear muffs of a more robust pattern were marketed as "Sonogard" by Messrs Amplivox Ltd from August 1961. Fluid-seal ear muffs have the disadvantage of being highly susceptible to damage in industrial environments, particularly where there are sparks or hot particles such as flying scale. Puncturing of the seals in use, causing glycerine or a similar fluid to run down the face, used to be a common reason given by industrial personnel for not using ear muffs. The problem was overcome by the introduction of foam-filled seals by Messrs Amplivox Ltd in January 1962, although they were not produced in large numbers until the mid-1960's.

Protector Safety Products Ltd introduced their muffs to the British Market in 1965 and the British American Optical Company in late 1968 or early 1969.

Ardente Ltd in conjunction with the British Safety Council held a press conference in London on 6 December 1961 to launch "Billesholms" glass down material for fashioning disposable ear plugs. This was marketed on an agency basis by Messrs Ardente as "Anti-Noise". The manufacturer's name was changed to Bilsom on 8 March 1968. Messrs Bilsoms set up a direct marketing company, selling the product under their own name, in March 1971. Pre-formed plugs of the same material (known as "Propp") were displayed at an International Safety Exhibition at Olympia on 25 - 28 October 1971, and were made generally available in 1972.

The E.A.R. semi-disposable foam plastic ear plugs were introduced into the United Kingdom by Messrs Racal-Amplivox in December 1974.

3.3 Advertising and Publicity

Advertisements are carried mainly by the professional and trade periodicals. Some difficulty was experienced in tracing advertising matter, as libraries usually remove advertisement pages, etc, when binding journals. However, unbound sets of all relevant publications were eventually located and have been searched.

A photocopy of an advertisement from the Mallock Armstrong Company clearly shows a "Nosonic" Mark I or Mark II ear muff. This is believed to be from an aircraft engineering journal from shortly after the Second World War, possibly of the title "Aircraft Engineering".

Another early isolated advertisement was found in the Summer 1951 edition of the British Journal of Industrial Safety. This followed the launch of the V-51R ear plugs under the brand name "Sonex" by Amplivox Ltd. The advertisement was headed "Too much noise is dangerous" and referred to danger to hearing, auditory fatigue, damage to the auditory nerve and permanent deafness. The next advertisement mentioning ear protection to appear in this journal was in Summer 1963, and the next advertisement from Amplivox Ltd to be found was in the September 1961 issue of Industrial Safety, following the launch of their ear muffs.

The first product to be advertised regularly was the "Lee Sonic Ear Valv". The efficacy of this device is doubtful, and the early advertising did not mention hearing hazard. The full text of an advertisement placed in the January 1957 issue of Accidents, and at intervals thereafter, was as follows:-

> "Is NOISE your enemy
>
> Guard against the many harmful effects of excessive noise with the Lee Sonic EAR-VALV, a new protective device with proved performance
>
> Prevents all harmful noise from reaching the ear drum

Enables normal conversation to be heard

Comfortable to wear

Eliminates sense of isolation found with ear plugs

Write for literature:-

R.W. Sutton (Consultants) Ltd.,
7 Lansdown Place, Cheltenham".

Between March 1958 and September 1968 there was a small classified advertisement each month in the series of journals eventually known as "Industrial Safety" for the "Lee Sonic Ear-Valv" ear plug with the text:

"Lee Sonic EAR-VALV

Actuated by sound pressure; automatically controls sound entering ear; removes harm from noise without interfering with conversation

Write for literature:

R.W. Sutton (Consultants) Ltd.,
7 Lansdown Place, Cheltenham".

This was supplemented by display advertisements in January, April and July 1958, September 1959 and April 1960. The text of these larger advertisements was similar to that in Accidents.

Denis Ferranti "Eargard" ear muffs were advertised in Safety Equipment and Industrial Clothing for June and Septemebr 1959. These are the only known advertisements for this product.

A full page advertisement for Amplivox ear muffs first appeared in Industrial Safety in September 1961. This referred to the "damaging effects of high noise" without being more explicit. The advertisement was repeated in May 1962, and March and April 1963.

A half page advertisement for a Swedish ear muff and helmet appeared twice during 1962. The ear muffs were decidedly light in weight (165g.) and were advertised to "stop dangerous high frequency sounds, yet permitting ordinary conversation". Technical details of these muffs have never been found, but the performance can only have been poor.

Three half-page advertisements from the Mine Safety Appliances Co. Ltd in April, May and July 1963 listed ear defenders among their range of safety products.

A one-off full page advertisement from Ardente Industrial Services appeared in July 1963. This was quite explicit about the hazards of excessive noise exposure and was headed "Noise will make this man deaf at 50 .... unless you act now! " Messrs Ardente were agents for Billesholm's (later known as Bilsoms) disposable glass-down ear plug material at that time.

There was no relevant advertising in Industrial Safety between July 1963 and March 1965 apart from the "Lee Sonic Ear Valv" classified entries. Full page advertisements for Amplivox ear muffs (March) and British American Optical ear plugs and muffs (May) appeared during 1965. Ear muffs were advertised in January, February and June 1966. Only one advertisement appeared during 1967 in the May issue apart from the "Lee Sonic Ear Valv" classified entries. Ear muffs were advertised again in February 1968.

Regular advertising in Industrial Safety dates from late 1968 to early 1969 with the first of a series of advertisements for "Lee Sonic Ear Valv" ear plugs (from November 1968) and "Anti-Noise" glass down disposable ear plug material (January 1969). Several other companies also advertised during 1969 and 1970.

Safe Times carried a display advertisement for the "Lee Sonic Ear Valv" (with the same text and format as the original advertisement in the January 1957 issue of Accidents) in July 1960, January 1961 and January 1962. Messrs Ardente advertised their "Anti-Noise" glass down ear plugs in January 1962 and July 1963.

The title was changed to Safety and Rescue in October 1963, and there was a small advertisement for the "Lee Sonic Ear Valv" (with the same text as in Industrial Safety) in April 1964, and then monthly from September 1964 to February 1965 inclusive. Display advertising for "Lee Sonic" ear plugs, "Anti-Noise" glass down and "Nosonic" ear muffs accompanied an article on "Hearing" in May 1965. An advertisement placed by a Swiss manufacturer of ear muffs seeking agents appeared in July, August and September 1965. Amplivox Ltd were listed as suppliers of "Noise protection" in a "Directory of Trades and Services" between August 1965 and the July/August 1966 issue inclusive. "Lee Sonic Ear Valv" plugs were advertised again in December 1965 and the April/May 1966 issue inclusive.

An article on noise hazards in September 1966 was accompanied by display advertisements for Amplivox and Nosonic ear muffs and "Lee Sonic Ear Valv" ear plugs.

Between January and June 1967, the address of Ardente Industrial Services Ltd was given as a supplier of ear protection in the "Safety Service Directory". A display advertisement for "Lee Sonic Ear Valv" plugs appeared again in March 1967, and thereafter at intervals of two or three months through to the end of the period of the search. Amplivox noise-excluding communication headsets were advertised in the March and August 1967 issues of Safety and Rescue.

Ardente Industrial Services placed an advertisement for disposable glass down ear plug material ("Anti-Noise") in Safety and Rescue on a monthly basis, with occasional omissions, between January 1968 and June 1971. Amplivox ear muffs were advertised at intervals of two or three months between March 1968 and June 1970. "Silenta" ear muffs were advertised in February and March 1969.

Protector Safety Products joined the advertisers in May 1970, and British American Optical Company in June 1970, both with ear muffs. From about mid-1970, advertisements for some form of ear protection appeared in every issue of Safety and Rescue.

In contrast to Industrial Safety and Safety and Rescue, other periodicals were slow to publish advertisements for ear protectors.

The September 1963 issue of the Journal of the Institution of Industrial Safety Officers carried an advertisement for Ardente Industrial Services similar to the one which had appeared in Industrial Safety at about the same time. It's successor, Protection, carried quarter-page advertisements for "Lee Sonic Ear Valv" ear plugs in December 1965 and March 1966. The next advertisement was in March 1969 for "Anti-Noise" glass down. After this date, advertisements appeared on a regular basis from several companies.

Advertising in the RoSPA series of journals was even more sporadic. The isolated advertisement for Amplivox "Sonex" ear plugs in the Summer 1951 issue of British Journal of Industrial Safety has already been noted. The next advertising was not until Summer 1963, when three successive issues contained a half page advertisement showing ear defenders among the safety products of the Mine Safety Appliances Co Ltd. There were similar advertisements from the British American Optical Company in Summer 1964, Siebe Gorman in Spring and Summer 1966 and Spring 1967. There was then a complete void until the April/May 1971 issue of

Occupational Safety and Health, after which advertising appeared on a regular basis.

The second edition of the booklet "Noise and the Worker" published in June 1968 carried advertisements from the following suppliers of ear protection:

Amplivox Ltd (Sonex and Supersonex ear plugs and Sonogard muffs)

Anticoustic Company (Nosonic ear defenders)

Boots pure Drug Co Ltd (Muffles wax ear plugs)

R.W. Sutton (Consultants) Ltd (Lee Sonic Ear Valv)

Note: The first edition of Noise and the Worker published in 1963 did not carry any commercial advertising.

In summary, the immediate post-war advertisements in an aircraft engineering journal and in the Summer 1951 issue of the British Journal of Industrial Safety were undoubtedly isolated examples. Most interest has been shown by the publications Industrial Safety and Safety and Rescue or their predecessors, which carried sporadic advertising from 1958 and 1960 respectively, although there were some quite long periods when no advertisements appeared. Regular advertising in both these journals dated from about 1968. In contrast, the Journal of the Institution of Industrial Safety Officers and its successor Protection only carried three advertisements prior to March 1969 when regular advertising commenced. The series of journals published by the Royal Society for the Prevention of Accidents carried seven advertisements between 1963 and 1967. There was then a complete void until regular advertising appeared in the April/May 1971 issue.

A complete schedule of all advertisements is given in Appendix 3.

3.4 Measure of Protection

The protection afforded by early forms of ear plug and ear muff was undoubtedly poor. Unfortunately, samples of many of the early types of protection do not remain, and it is not possible to test their acoustic performance by modern techniques. However, a wide range of devices were tested by the Central Medical Establishment of the Royal Air Force and published in Flying Personnel Research Committee Report 884 of June 1954. Results for Selectone ear plugs were published initially by ZWISLOCKI (1952) with the original description of the device. The methods used in both cases stand up to modern scrutiny fairly well, and were similar to the former American Standard test method, which was in widespread use until the publication of a British Standard in 1974. Comparative tests have shown that measurements made according to the old American method were similar to those obtained by the British Standard test method except where the protector had directional properties (MARTIN, Ann. occup. Hyg. 20, 229, 1977).

The results obtained were as follows, with attenuation being given in decibels. The figures in brackets represent one standard deviation (ZWISLOCKI, did not publish standard deviations for the Selectone plugs):-

	Frequency Hz					
	500	1k	2k	3k	4k	8k
cotton wool	3 (3)	3 (5)	7 (5)	10 (5)	8 (5)	13 (6)
Lee Sonic Ear Valv	0 (4)	4 (6)	12 (7)	16 (8)	13 (5)	11 (12)
Mallock-Armstrong plugs	9 (9)	13 (11)	20 (11)	23 (12)	22 (12)	18 (9)
Commonwealth Acoustic Laboratories (Mk 1) plugs	14 (12)	16 (10)	24 (10)	25 (10)	25 (9)	22 (9)
Nosonic Mk 1 muffs	6 (4)	11 (4)	19 (7)	28 (5)	37 (8)	36 (7)
Nosonic Mk II muffs	11 (4)	18 (4)	25 (6)	33 (5)	37 (5)	36 (5)
V-51R plugs	14 (7)	18 (9)	25 (9)	31 (12)	30 (11)	27 (11)
Selectone A plugs	23	23	35	36	37	33
Selectone K plugs	9	14	28	39	42	40

It should be noted here that the Zwislocki results for the Selectone ear plugs seem generous for any type of ear plug, and a result more in keeping with the figures for the V-51R would be expected. Although these plugs are still available, results of more recent tests have not been found.

In assessing the practical attenuation to be expected from an ear protector, it is usual to subtract one standard deviation form the mean result in order to allow for some variation in fit between individuals and also for the use of the device in far from ideal conditions as opposed to the laboratory conditions under which the test was conducted. In fact this only gives the protection to be expected by 84% of a population; the other 16% will be afforded less protection. This is the procedure recommended by the Department of Employment Code of Practice and the resulting figure is known as the "assumed protection". Values for the assumed protection may be derived from the above figures as follows, negative results being expressed as zero on the basis that an ear protector cannot amplify sound:-

	Frequency Hz					
	500	1k	2k	3k	4k	8k
cotton wool	0	0	2	5	3	7
Lee Sonic Ear Valv	0	0	5	8	8	0
Mallock Armstrong plugs	0	2	9	11	10	9
Commonwealth Acoustic Laboratories (Mk I) plugs	2	6	14	15	16	13
Nosonic Mk I Muffs	2	7	12	23	29	29
Nosonic Mk II Muffs	7	14	19	28	32	31
V-51R plugs	7	9	16	19	19	16

In assessing the implication of the above table, it should be appreciated that the requirements for hearing protection are usually dictated by the noise levels in the 500 Hz and/or 1 kHz octave bands.

3.5 Comfort

There is no doubt that early forms of ear protection were uncomfortable and it would not have been reasonable to expect a person to wear it for the duration of a working shift. JOHNSTON commented upon this in 1953 (Br. J. industr. Med. 10, 41).

Contemporary comments regarding the comfort and effectiveness of various devices made by the Flying Personnel Research Committee (DICKSON et al, 1954) are reproduced as follows:-

> Mallock-Armstrong ear plugs:
> "This is very uncomfortable and fits badly. Moreover, in many subjects it is not retained well in the meatus".
>
> Commonwealth Acoustic Laboratories (Mk I) plugs:
> "This is not so comfortable as other defenders and some subjects find that it does not fit at all well. This is undoubtedly due to the fact that only one size is available."
>
> Nosonic Mk I muffs:
> "Relatively comfortable but does not fit behind the ears satisfactorily".
>
> Nosonic Mk II muffs:
> "The headband spring is so strong that one's head feels as if gripped in a vice. It does, however, fit well."
>
> V-51R plugs:
> "This is comfortable and easy to use. It retains its position in the ear reasonably well."

BLAKEY in 1956 (Trans. Ass. industr. Med. Offrs., 6, 56) noted "that ear defenders at best are clumsy and uncomfortable instruments". His article carried an illustration of what appeared to be the Nosonic Mk II ear muffs.

In 1958, BURNS (Trans. Ass. industr. Med. Offrs. 8, 127) noted that "ear plugs which had been available in this country had been uncomfortable", whilst in the same year KEATINGE and LANER (Br. J. industr. Med. 15, 273) wrote that "workers found many of the existing protectors both uncomfortable and otherwise inconvenient".

In 1960, COLES and KNIGHT (Ann. occup. Hyg. 2, 267) wrote about a situation where V-51R ear plugs and the Armed Services version of Denis Ferranti "Eargard" ear muffs had been available; "Both forms of protection were said to be too uncomfortable for prolonged use".

Even as late as 1970, COLES (Proc. roy. Soc. Med. 63, 1016, 1970) wrote: "the trend of development has been towards obtaining increased usage of ear protectors by means of attention to such factors as wearability, durability, versatility and 'communicability'" of earmuffs. He continued: "not all manufacturers have succeeded in finding the right combination" (in the design of foam seals), and of Glorig "Sound Sentry" semi-insert earplugs: "both the head-band itself and the concentrated focus of pressure by the plug on the ear canal opening can cause discomfort." Ear plugs were mentioned last: "most types of plug tend to be uncomfortable in different people....."

4.0 OTHER HEARING CONSERVATION MEASURES

4.1 Measuring Instruments

A British Standard "Memorandum on the use of sound level meters" (B.S.1479) was published in 1948. Although this referred to the American Standard for sound level meters published in 1944, it did not specify or quote any figures or criteria for the performance of measuring instruments. This memorandum was solely concerned with the use of "secondary noise meters" of the "objective type" for field measurements, and stressed the need for calibration against a primary standard and the importance of defining the units of measurement (methods for expressing the equivalent loudness of sounds in "phons" and other comparative scales were in vogue at that time). This British Standard was withdrawn when it was superseded by B.S. 3489 in 1963.

The performance of measuring instruments was covered by separate British and International Standards for industrial grade and precision grade sound level meters. The British Standards were as follows:

B.S. 3489:1962 Sound level meters (industrial grade)
B.S. 4197:1967 A precision sound level meter.

Corresponding international recommendations published by the International Electrotechnical Commission were:

I.E.C. 123(1961) Recommendations for sound level meters
I.E.C. 179(1965) Precision sound level meters.

The British and International documents were essentially similar, and specified an accuracy within ± 1 dB for precision grade and within ± 3 dB (except at a frequency of 1 kHz where the limits are ± 2 dB) for industrial grade instruments over the middle part of the audible frequency range. This is the part of the frequency range which is relevant to most industrial noise measurements. Work has been started since 1972 on the consolidation and revision of the above standards to include impulse noise measurement, and laboratory and survey grade instruments.

Although a British Standard for measuring community noise from industrial premises (B.S. 4142) had specified the use of at least an industrial grade meter in 1967, the first official document to recommend any grade of instrument for noise measurements inside the working environment appears to have been the third edition of "Noise and the Worker" (H.M.S.O., 1971). This stated quite simply "It is advisable to purchase a meter complying with British Standards, and to obtain with the meter a portable calibrator for making routine checks of accuracy"

The use of a precision grade instrument is preferred, but is not obligatory, for measurements made according to the Department of Employment Code of Practice: "It is preferable to use a sound level meter complying with B.S. 4197 (Precision sound level meters).... Meters complying with B.S. 3489 (Sound level meters (industrial grade))may also be used provided that allowance is made for the reduced accuracy of these instruments when measuring noise which is marginally above, or below, the limit in Section 4". This seems to imply the acceptance of a basic criterion of 87 dB(A) instead of 90 dB(A) when an industrial grade instrument is used.

Early noise meters were of the subjective type and relied upon the observer making some sort of loudness judgment. In the masking method, the loudness of a "standard" noise was adjusted by a calibrated volume control until it was just masked by the noise to be measured. In the loudness balance method, a tone of 800 Hz or 1 kHz was reproduced through an ear-phone in one ear, and balanced with

the noise heard in the other ear. The possibility of asymmetry of the hearing was overcome by repeating the judgment with the ear-phone on the other ear. The results were, of course, relative, but a standard error of less than 1 dB was claimed with a panel of ten observers in a laboratory (KING, 1965). This corresponds to a standard deviation of about 3 dB, obtained with a relatively large group of observers under nearly ideal conditions. It must be concluded that the reliability of this method for site measurements of noise levels with only a single observer was poor.

These early instruments were often called audio-meters. This name should not be confused with the present day meaning of audiometer, which is a device for measuring hearing acuity. There is a reference in The Times of 16 May 1928 to an "audio-meter" being used by a Dr. Low of the National Physical Laboratory "for the scientific measurement of sound". Further references in The Times of 3 July 1930 and 24 June 1931 described the method of use of this instrument. It is known that these instruments were also produced and used by the Research Laboratory of the Metropolitan-Vickers Company (now part of G.E.C. Ltd) in the 1930's.

Objective instruments consisting, in principle, of a microphone, amplifier and indicating meter were produced at about the same time, and there are several references to such meters in the index of the Journal of the Acoustical Society of America during the 1930's. An American Tentative Standard for Sound Level Meters was published in 1936 (American Standards Association Z 24.3), and BARSTOW (1940) reported that "During the four years that the standards have been in force, practically all commercially available sound level meters have been modified to conform to them". It is not known if any of these early American instruments were imported into the United Kingdom, but The Times of 4 September 1937 refers to the National Physical Laboratory building "a new simplified sound level meter" which was presumably of the objective type.

The first commercial instruments produced in this Country were offered for sale by Dawe Instruments Ltd in 1946. These were built to meet the American Standard. This Company introduced "industrial grade" instruments in about 1959/60 in anticapation of the publication of the British Standard for this type of instrument (B.S. 3489) in 1962. The first "precision grade" instrument was produced by Bruel and Kjaer (as type 2203) in Denmark in 1959 in anticipation of the International Electrotechnical Commission recommendation for precision sound level meters (I.E.C. 179) first published in 1965. This instrument was first offered for sale in this country in 1959.

The general reduction in the size and weight of electronic components enabled various body worn meters to be produced, but it is not thought that any of the early instruments operated on an energy or integrating principle. For example, the "Exposimeter" described by MURPHY in 1966 (Ann. occup. Hyg., 9, 149) summated the time for which the noise exceeded a pre-set level. However, data at several different noise levels would have enabled a crude estimation to be made of the noise energy sustained by the wearer.

The first averaging meter appears to have been marketed in America early in 1971 by the General Radio Company. It was not listed in the 1970 catalogue of their British subsidiary company. This instrument operated according to the requirements of the Walsh-Healey Public Contracts Act, i.e. each 5 dB increment in noise level was considered to be equivalent to a halving or doubling of exposure time with an upper limit of 115 dB(A). True energy meters were not produced commercially until after the validation of the concept of equivalent continuous sound level as a predictor of hearing damage by BURNS and ROBINSON (1970). The first noise average meter to be produced in the United Kingdom was delivered by Computer Engineering Ltd on 27th September 1972, although this had been preceded

several months earlier by a formal announcement and considerable publicity.

4.2 Signs, Notices and Posters

The first official design for a warning sign was the yellow "Chinaman" pattern with the caption "Use ear protectors" illustrated in Appendix 6 of the Department of Employment Code of Practice published in April 1972. An alternative wording for use when the sign was attached to noisy machines read "Use ear protectors when operating this machine". Copies of these signs were available commercially soon after the publication of the Code of Practice.

A blue circular warning sign in accord with guidelines set down by the European Commission was published in British Standard 5378:1976. This had the meaning "Hearing protection must be worn". The sign shows ear muffs on an outline head, and the shape and colour make the sign obligatory. These signs are also available commercially.

The first posters for display in industry appear to have been published by Messrs Billesholms sometime in the 1960's for supply to customers purchasing their glass down disposable ear plug material. These showed the now familar image of a "shaking man" with fingers in his ears with the caption:- "Your EARS are Precious, Noise Can Damage, Protect Your Ears". A small facsimile of the poster accompanied an article in the March 1964 issue of Safety and Rescue, so presumably the original had been available for at least a month or two prior to that date. The change of name from Billesholms to Bilsom International AB was registered on 8 March 1968 and the "shaking man" image was registered as a trade mark on 19 December 1969. There is a note on the registration document to the effect that the symbol had been used for several years prior to this date. The first publication found showing this symbol was Safe Times for January 1962.

A poster produced by the British Safety Council with the caption:

"Noise Hurts, Protect your ears"

was publicised in the March 1964 issue of Safety and Rescue. Another poster with the caption "Noise Hurts, wear your ear protection" was shown in the September/October 1966 issue. Both posters were publicised again in the July 1968 issue of Safety and Rescue.

Publication of posters by the Royal Society for the Prevention of Accidents was announced in the September 1972 issue of Occupational Safety and Health Supplement.

4.3 Audio-visual Material

The 1963 edition of "Noise and the Worker" listed two films for hire from the Central Film Library. "Dangerous Noise" was a black and white Dutch film with English sound track, and "Ear Protection in Noise" was a colour film made in America. Neither of these films seem to have been widely shown, and neither have been seen by the present author.

The need for an up to date educational film was recognised by the Royal Navy, and another film with the title "Dangerous Noise" was released in 1967. This was in two parts: the first sub-titled "Listen while you can" was intended for factory-floor audiences, whilst the second part "Medical aspects and hearing conservation" was intended for management, medical and technical staff. The first documented public showing was to a British Occupational Hygiene Society conference in September 1967.

Advertising films with the titles "It's just that simple" and "Contraphon" were released by Bilsom International Ltd, by 1971, and "Sound of Sound" by the British American Optical Company Ltd by August 1973.

A filmstrip "Noise and Hearing" with either a printed or taped commentary was marketed by Camera Talks Ltd in 1969. This was publicised in various journals and magazines during 1970.

5.0 ATTITUDES AND PREJUDICES

5.1 Official

Until relatively recently, official attitudes to noise and occupational deafness were definitely negative.

The Departmental Committee on Compensation for Industrial Diseases (The Samuel Committee) reported in 1907 (Command 3495) "Boilermakers' deafness..... does not however prevent a man from continuing his trade and it cannot therefore give rise to claims for compensation on the ground of incapacitation."

In 1928, The Minister of Health refused a request to "consider the desirability of setting up a Committee to investigate the effects of noise upon the health and efficiency of the people", saying "As at present advised, my right hon. Friend does not think that there will be advantage in the setting up of a Committee of this kind" (Parliamentary Debates 217, 859, 1928). A similar request in 1937 to "appoint a committee to inquire into the detrimental effect of unnecessary noise on the health of people" was likewise refused (Parliamentary Debates (written answers) 325, 41, 1936-37).

The Annual Report of the Chief Inspector of Factories and Workshops for 1934 (Command 4931, 1935) may be quoted as follows: "Most industrial noises are inevitable and cannot be eliminated at the source .... the isolation of noise by constructional methods may well be regarded as so expensive as to preclude adoption". More recently in 1952, Mr. Harmar Nicholls, M.P., pointed out in the House of Commons that if the Factory Inspectorate had powers to deal with industrial noise, it "is so much below establishment that it would be doubtful if they could give attention to the matter" (Parliamentary Debates 500, 168, 1951-52).

A Government white paper in March 1955 (Command 9422) outlined proposed Government action on certain recommendations adopted at the International Labour Conference in 1953. This accepted in principle paragraph 2 of Recommendation No. 97 which called for measures by employers to eliminate or reduce harmful noise or vibrations, "but the Government do not consider it practicable to legislate in the present state of knowledge on the subject and are therefore unable to accept an obligation to ensure the application by employers of this particular provision".

Mr. L. A. Marquand speaking in a general debate on noise in The House of Commons in December 1955 inferred that no government departments or establishments, including the National Physical Laboratory, were concerned with the matter, and neither were the Trades Union Congress or the British Employers' Federation (the forerunner of the Confederation of British Industry) (Parliamentary Debates 546, 2665, 1955-56). In an answer to a member's question in March 1956 it was stated that the Committee on Individual Efficiency in Industry "considered the subject of noise at its meeting last month and concluded that the evidence available did not justify it treating research on this subject as a matter of primary urgency in relation to other commitments of greater importance from the point of view of industrial productivity" (Parliamentary Debates 550, 17, 1955-56).

The Government finally conceded to requests "to set up a committee to examine the nature, sources and effects of the problem of noise and to advise what further measures can be taken to mitigate it" on 14 December 1959 (Parliamentary Debates 615, 1018, 1959-60). This committee was to be the well known Wilson Committee on the Problem of Noise, which reported in July 1963 (Command 2056).

The question of prescription of occupational deafness under the Industrial Injuries Act was first raised by Mr. Prentice in a question in the House of Commons on 1 February 1960. The Minister of Pensions and National Insurance replied that he had "no such proposals" (Parliamentary Debates 616, 610, 1959-60). There were

numerous other parliamentary questions on the same subject before the need for further research into the subject was conceded on 29 January 1962 (Parliamentary Debates (written answers) 652, 55, 1961-62) and occupational deafness was made a prescribed industrial disease with effect from 3 February 1975.

5.2 Of Management

It was difficult to find references to the attitudes of management, and perhaps this is a reflection of the apathy shown by that quarter.

A quote from a district inspector in the Annual Report of H.M. Chief Inspector of Factories for 1929 (Command 3633, 1930) reads "As far as I have enquired, I have not found in this district any factories where efforts have been made to minimise the volume of noise. The managers, and others receiving no complaints rarely consider the question."

JOHNSTON wrote in 1953 (Br. J. industr. Med. 10, 41) "It was well recognised among the foremen that if a workman objected to the noise of the work, he would soon change to a quieter job".

In a paper to the Occupational Health Section of the Royal Society of Health Congress in 1955, Air Vice-Marshal Dickson said that he did "not think managements have sufficiently appreciated the possibility of increased efficiency and production through curtailment of noise". He continued "the general attitude has been and still is that the problem of damage to hearing is better left alone, since to investigate the hazards of noise would only emphasise and invite attention to a condition which has not been properly defined". In discussion of the paper, Mr. P. Cutbush of the British Standards Institution, said "that so little attention had been given to the subject of noise by British industry generally, that up to now noise tended to be something which had to be accepted and about which little could be done". The paper was reported in The Times on 29 April 1955, and the official text printed in the Royal Society of Health Journal 75, 529, 1955.

In 1958, Sir Terence Cawthorne, an eminent ear, nose and throat consultant wrote "General opinion still regards noise as an annoying distraction rather than a danger to hearing" (Ann. occup. Hyg. 1, 1). The Annual Report of the Slough Industrial Health Service for 1959-60 (Ann. occup. Hyg. 3, 283) noted that: "A major obstacle discouraging some firms from having their noisy processes investigated is a suspicion, which is well founded, that reduction or suppression of noise at source is in many instances difficult and costly, if not impossible to achieve".

The report of a survey carried out among its members by the Industrial Welfare Society in 1961 by DAVIES, gives a broad insight into the attitudes of industrial management at that time, the second paragraph of the introduction reads:

> "Industry, however, has shown little collective interest and concern for the noise it produces daily, although it is at work, for eight hours a day, that some persons are exposed to the most hideous noises. It seems we have become so familiar with noise as to be contemptuous of it".

The report was based on replies from 55 out of 700 member firms, compared with a stated normal response rate of over 50% to Industrial Welfare Society questionnaires. Specific quotations from four respondents were given in the Report, which are quoted as reported below:-

> (a) "Spinning mill. Being steady continuous noise on one note we don't hear it. Newcomers are acclimatised in a few hours"

(b) "Noise is inherent in the operation"

(c) ".... generally speaking, however, the noise is unavoidable and acceptable."

(d) "Attention of higher management has been drawn recently to the psychological effects of the high noise level in the main production departments caused by increased mechanisation".

Some 32 firms indicated "no", "not known" or "no proof" to the question "Have you any jobs that MAY produce occupational deafness". The interests of these firms included engineering and metal-work (at least 7 companies), textiles (3 companies) and drop forging, all of which could be classed as traditionally noise hazardous occupations.

The Introduction to the booklet "Noise and the Worker" published in 1963 by the Ministry of Labour said:

> "Noise is not a new problem in industry but for a long time it has tended to be accepted, both by management and workers, simply as part of the job. This is still the attitude in many factories, either because the harmful effects of noise are not appreciated, or because it is thought that nothing can be done about them."

A similar wording was retained in the second and third editions of the booklet published in 1968 and 1971 respectively. The International Wrought Copper Council "Introduction to the Study of Noise in Industry" published in 1968 expressed a similar sentiment "In the past, noise in the work-place has been taken for granted. Factors which have helped this attitude to persist have been, until recent years, the difficulty of making accurate measurements of noise and of hearing-loss."

The 1969 Annual Report of H.M. Chief Inspector of Factories (Command 4461, 1970), which has already been reviewed, was extremely critical of industry for not doing enough to help itself. The attitude of safety officers at this time, that they had bigger problems to worry about than noise, was summed up in articles in "Industrial Safety" for August 1968 and July 1969.

Even as late as 1972, the Factory Inspectorate published Technical Data Note 31 "Noise in weaving sheds: a short survey" which said: "it is not usual for workers in weaving sheds to be provided with protectors, and it is commonly asserted that even if available they would not be worn."

5.3 Towards Accepting Noise and Hearing Loss

There is no doubt that in the past, men accepted noise and hearing loss as part of their jobs.

The Annual Report of H.M. Chief Inspector of Factories for 1908 said "Men are apt to regard the deafness as inevitable". The Annual Report for 1929 (Command 3633, 1930) quotes a district inspector:"In general there are no complaints from the workers. They tell me they never notice the noise after the first week in the factory."

WESTON and ADAMS (1932) in the course of their studies into the effect of noise on the performance of weavers asked

> "whether the shed noise affected them in any way. The almost invariable reply was 'we've got used to it' .... there appeared to be a general reluctance on the part of experienced weavers to admit

that noise might affect them or their work, the attitude being "noise is part of our work and we have to make the best of it".

The 1934 Annual Report of H.M. Chief Inspector of Factories (Command 4931, 1935) went on at length in similar vein:-

> "With regard to the effect of noise, the first thing that strikes an observer is the amazing tolerance which the workers have acquired. In weaving sheds, for example, the operators are able to converse apparently without effort, whereas a casual visitor finds it almost impossible to give audible speech. The workers on being questioned express no concern because, presumably, they have become inured to it.....
>
> ....One would expect that noise must eventually have some injurious effect; yet, while it is true that many boilermakers and shipyard workers are subject to deafness, it is remarkable that complaints from operatives are almost never received".

The Annual Report for 1953 (Command 9330, 1954) also accepted the situation:

> "Reduction or elimination of noise has made as little progress in factories as it has elsewhere .... the indifference of some people to noise is illustrated by the case of an elderly woman who was transferred from a tin box department because the works nurse thought the noise was tiring her. She very soon begged to be moved back again as she missed the noise! So far noise is a problem untouched by legislation and left to the discretion of factory managements."

JOHNSON reporting in 1953 the results of a survey into occupational deafness carried out on behalf of the Medical Research Council (Br. J. industr. Med. 10, 41) wrote:

> "with few exceptions, workers in the boilermaking and stamping trades were aware of the high incidence of occupational deafness, but were not apparently perturbed by the prospect. The insidious onset of deafness which resulted in a man being unaware of the degree of his hearing loss and the relatively high proportion of old hands with serviceable hearing engenders a spirit of laissez faire".

Another reason for the apparent lack of complaints was suggested by DICKSON in 1955 (Roy. Soc. Health J. 75, 529) "Many employees are reluctant to complain of any symptoms suggesting deafness for fear it will bring about loss or limitation of employment." The Times of 4 October 1957 (page 11f) reported "In contrast with that of the U.S., the public of this country is slow in coming to realize the enormous amount of damage to hearing and other bad effects due to noise in industry."

In a debate in the House of Commons on 2 December 1955, Mr. J.E.B. Hill, M.P. (Parliamentry Debates 546, 2702, 1955-56) said "that there is a general injury to health is probably borne out by the fact, as I understand it, that the sound in cinemas in areas of heavy industry tends to be run at a higher level than elsewhere in the country." Later in the same debate Mr. H.A. Marquand, M.P. (Parliamentry Debates 546, 2708, 1955-56) said "people have too easily accepted that it is impossible to have industrial production without noise. They put up with it. They have assumed somehow or other that we can do nothing about it."

A possible socio-medical explanation was suggested by CAWTHORNE in 1958 (Ann. occup. Hyg., 1, 1):

> "An interesting feature about deafness from .... noise is that the sufferer often does not realize the cause of his defect. This is quite understandable because in most instances the onset is very gradual and so long as the loss of hearing is limited to high tones only it does not cause any great inconvenience to the everyday life of the worker. Furthermore, others in the same line of work experience a similar gradual dulling of hearing and it is only too often accepted as a natural event that is to be expected in the later years of working life".
>
> "Also many workers follow the same trade as their fathers and even their fathers' fathers, so that it may be thought to be a family failing. Consequently it has been difficult in the past to encourage workers in noisy industries to take any steps to protect their hearing".

No published evidence was found of the Trades Union Congress taking an interest in the subject of occupational deafness prior to December 1959, when "a circular was sent to all affiliated organisations asking for information about their general experience of this problem in order to enable the General Council to build up a broad picture of industries and occupations where complaints of injury to hearing were arising." (Report of Proceedings, 92nd Annual Trades Union Congress 1960). The Times published a report of the outcome of the survey on 19 December 1960 (page 15c) "About a year ago the T.U.C. circulated unions asking for information about deafness resulting from noise at work. They found that in a number of industries the fact that workers frequently became partially and sometimes wholly deaf was taken for granted, but there was little precise evidence."

STEWART, who had been Medical Officer in the factories where the earlier Medical Research Council survey had been carried out, took the matter further (J. Laryngol. Otol. 75, 479, 1961):

> "With few exceptions boilermakers and drop-forge stampers were aware that deafness occurred in their industry. But this caused no worry nor was it considered in any way serious, it was just accepted as part of the job. The insidious course of their deafness had made them unaware of the degree of hearing loss. Many of the older men still had serviceable hearing, and some had learned to lip-read. Social experiences were interesting. Complaints of trouble or worry at home because of deafness were rare. Men were perfectly willing for their sons to enter their trade. Deafness was perhaps an excuse to avoid union meetings or going to church. Television had not yet "arrived", but the cinema was well patronized, more often for vision than the spoken word and a number confessed to lip-reading."

The booklet "Noise and the Worker", published in 1963 by the Ministry of Labour, observed in the introduction that "Noise is not a new problem in industry but for a long time it has tended to be accepted, both by management and workers, simply as part of the job." The same words were used in the introduction to the second and third editions published in 1968 and 1971 respectively.

An article on"Hearing" in the May 1965 issue of Safety and Rescue opened with the sentence "Although much has been written and said on the problems of harmful noise we continue to tolerate this growing menace to our health and comfort and most of us accept it as part of the growing complex of life". The article continued in the fourth paragraph "In this country the individual seems to be relatively indifferent to possible harmful effects of excessive noise and industry in general is inclined to accept such conditions as an occupational hazard". The 1969 Annual Report of H.M. Chief Inspector of Factories (Command 4461, 1970) seemed resigned

to the situation "in some of the noisier trades.... there is unfortunately..... a tradition of partial deafness."

The attitude of acceptance of noise was further illustrated by a report in The Observer of 7 February 1971:"Any campaign against industrial noise is hampered by several obstacles. Many workers are inclined to accept it 'It's all part of the job, isn't it?' a foundry worker told me. Many believe they get used to the noise." HOPKINSON in 1972 (Occup. Saf. and Health 2, 12, August 1972) wrote "Very few people complain about noise in their work because they take it to be part and parcel of their employment."

5.4 Against Putting Things in Ears

There seems to be an almost instinctive aversion among the general population to putting things in their ears. This was fostered by early medical practitioners, as is shown by a small book "Hearing and how to keep it" published in "Ward and Lock's long life series" in about 1892/93. The cause of this aversion may have been the high incidence of ear disease in the general population before the advent of modern drugs. The same book mentioned that "the growth of the fungus Aspergillus on the drum-head and the wall of the auditory canal is by no means uncommon," and of eczema "the latter disease invades the canal, as it does not uncommonly". Suppurative diseases were mentioned with "when the ear runs, as it often does in children", and "boils and abscesses are common" in the auditory canal.

Specific quantitative data is rarely given in early literature, but figures published in the 1927 Report of H.M. Chief Inspector of Factories (Command 3144, 1928) showed that 7.4% of a population of cotton weavers were deaf due to "chronic or residual chronic suppurative otitis media." As the population has been screened on the basis of deafness and not otitis media, any cases of otitis media not causing deafness must have been passed over. By inference the true incidence of otitis media must have been higher.

The annual report of the Medical Research Council for the year 1937-1938 (Command 5939, 1939) estimated that there were "said to be 2,500,000 people in this country with disabling degrees of deafness, and that disease of the middle ear is admittedly responsible for a large proportion of these cases. Thus it has been estimated that this condition is responsible for 90 per cent. of all cases of acquired incomplete deafness in children."

JOHNSTON screened subjects from heavy industry in 1948 and 1949 (Br. J. industr. Med. 10, 41, 1953). Out of 219 persons, he found 17 with active suppurative otitis media, and 39 with scarring or a dry perforation of the tympanic membrane (ear drum); that is 25% of the total with present or past evidence of middle ear disorders.

A Supplement to Safety Equipment and Industrial Clothing on Industrial Noise in January 1958 carried the warning:

> "Another point which puts solid ear-plugs in an unfavourable light is the medical assurance that the ear canal should be left open for the healthy circulation of air. It is also accepted that complete blocking of the ear canal can upset a person's normal sense of balance".

The latter assertion is questionable, but it serves to under-line the beliefs held by the general population at that time.

HINCHCLIFFE, in Scientific Foundations of Otolaryngology (Heinemann 1976) noted that middle ear disorders were more prevalent in the lower social classes, and

quoted a Medical Research Council survey of otitis media taken in Great Britain in 1955. The incidence of otitis media varied with the time of year between about 30 and 150 cases per month per 1000 of population. Surveys of two rural populations carried out in 1957 and 1958 by the same author (Brit. J. prev. Soc. Med. 15, 128, 1961) showed that about 20% of the population suffered from scarred or perforated typanic membranes, or otitis media. In addition there were other conditions such as otitis externa which are contra-indicators for putting things in the ears, and which can exist independently of but maybe at the same time as the above.

Even as late as 1975, HOWELL showed that 20% of men in the 55 to 64 year old age group employed in a steel works had a history of ear pathology, although the proportions were significantly lower in the age group below age 34 years.

With such an incidence of middle ear disorders, a reluctance towards putting materials such as vaseline soaked cotton wool or plasticine in the ears is hardly surprising.

5.5 Against Using Ear Protection

The resistance of working populations against using ear protection is relatively well documented. For example, Dr. A. Scott, in answer to a question about protection from boilermakers' deafness put to him by the Departmental Committee on Compensation for Industrial Diseases in 1907 (Command 3495) said: "Yes, putting something in their ears: but they will not do that although it would ease it very much .... It would preserve their hearing."

WESTON and ADAMS (1932) used ear plugs to reduce the level of noise affecting weavers in their experiments on the effects of noise on working efficiency. Only six out of ten subjects passed comments which were any way favourable towards the use of the plugs. Only one subject was reported to have continued to use the plugs after the end of the experiment.

The 1934 Annual Report of H.M. Chief Inspector of Factories (Command 4931, 1935) also expressed resignation towards accepting the situation:-

> "Only in comparatively few cases do the workers appear conscious of any inconvenience sufficient to justify the wearing of ear protectors. Any attempt at compulsion must be viewed in the light of the known tremendous difficulty in getting workers to wear goggles to protect their eyes from dust or flying fragments."

JOHNSTON in 1953 (Br. J. industr. Med., 10, 41) wrote: "the average workman is notoriously careless in the use of safety devices, particularly where these are provided to prevent uncommon accidents or disease of delayed onset". He quoted a case of a group of workmen in America provided with ear defenders, of whom only one third used them regularly, one third used them occasionally and one third discarded them soon after issue. However, it must be pointed out that the ear defenders available at that time were particularly uncomfortable.

An article in The Times of 24 October 1955 headed "The Curse of Noise" reported that ear plugs "are most unpopular". CHALLEN and HICKISH contributing to The Times Review of Industry in August 1958 added cynically "Protective devices do not conserve hearing when they are stored in a clothes locker".

BLAKELY in 1956 (Trans. Ass. industr. Med.Offrs. 6, 56) observed that "only 30% of personnel will wear ear defenders", and he based his observations on experience within the United Kingdom Atomic Energy Authority where medical and health physics services were well organised.

KEATINGE and LANER in 1958 (Br. J. industr. Med. 15, 273) reported an audiometric survey conducted between 1951 and 1956, and observed "During the period mentioned no protective devices were in use, largely because the workers found many of the existing protectors both uncomfortable and otherwise inconvenient."

BURNS (Trans. Ass. industr. Med. Offrs. 8, 127, 1958) observed that ear muffs which had been available in this country had been uncomfortable but that a new pattern developed by the National Research Council of Canada were more acceptable. These only became available commercially in this country in May 1958.

A correspondent in The Times on 1 April 1960 writing about ear defenders suggested that "For some reason, masculine vanity perhaps, these are not popular with most workers, and the safety officer has a hard, and often unrewarding, struggle to make his point."

ALDERSLEY-WILLIAMS in "Noise in Factories" (H.M.S.O., 1960) noted that "Ear protection is not likely to be popular with employees." COLES and KNIGHT also in 1960 (Ann. occup. Hyg. 2,267) noted that "Modern types of ear plug and ear muff were available to the men, but, as is unfortunately a common experience, few were worn. Both forms of protection were said to be too uncomfortable for prolonged use, and there was also evident a certain degree of shyness at being seen wearing the external muffs."

An article in Safety and Rescue in May 1965 drew a parallel with the situation regarding other forms of safety equipment. "One does not have to look very far back to recall the resistance to such obvious safety aids as safety boots, goggles, hard hats and other items of protective clothing. It seems the same thing is happening to ear protectors."

The second report of the Joint Standing Committee on Health, Safety and Welfare in the Drop Forging Industry (1966) observed that "there is great operator resistance" to the use of ear defenders. In the same year, RICE and COLES (Br. J. industr. Med. 23, 194, 1966) wrote "Resistance of personnel towards using ear protectors is universal though varying in degree .... The universal use of ear protectors in any given noise-hazardous situation is very unusual and is seldom found except where the protectors embody communication or the noise level is extremely high."

SUGDEN noted his experience at trying to get men to use ear protection in 1967 (Ann. occup. Hyg. 10, 263). At first acceptability by the men was good, but after six weeks "resistance became apparent and only about 30% of the men were wearing protection regularly". Some men gave more or less valid excuses for not wearing protection such as feeling unsafe, but twelve out of twenty defaulters "had no specific objections, but were not prepared to make the effort necessary on their part to use the protection provided". Similar figures were quoted by KERR (Proc. roy. Soc. Med. 60, 1121, 1967): "about 30% of those working in the noisy area were wearing ear protection (glass down).... Ear muffs are not popular; they are either too hot or too heavy, and probably too conspicuous". In discussion of Dr. Kerr's paper SMITH (Proc. roy Soc. Med. 60, 1125, 1967) said "there was always great difficulty in persuading workers in industry to wear ear protectors."

The Annual Report of H.M. Chief Inspector of Factories for 1969 (Command 4461, 1970) noted "resistance to the wearing of ear protection in some of the noisier trades where there is unfortunately both a tradition of partial deafness and a feeling that the use of protective devices is vaguely unmanly."

A report in The Observer on 7 February 1971 said "Ear defenders or ear muffs are another line of defence. They are much maligned. Many workers will not wear them." In the same year, MURRAY who was then Medical Adviser to the Trades Union Congress, said (Proc. roy. Soc. Med. 64, 206):

> "Any form of personal protection is difficult to put across, especially when the result of failing to use it is not immediately apparent. A variety of objections are usually raised - the possibility of ear infection from ear-plugs, isolation from their fellow workers, fears that they will not hear danger signals or changes in the running of the machine and aesthetic objections ('Makes me feel a proper Charlie'). These are not easy to overcome but discussion gradually breaks down the barriers and in some cases the payment of 'inconvenience money' overcomes the last objections."

Even as late as 1972, H.M. Factory Inspectorate (Technical Data Note 31 "Noise in weaving sheds: a short survey") observed an attitude which they summed up as "there can be little doubt that a radical change in outlook on the part of weavers will be needed before hearing protection is universally accepted".

6.0 APPENDICES

6.1 Literature searched

Unless otherwise stated, the search of the following publications has been complete.

ACCIDENTS
1949-1973 Quarterly.
H.M. Factory Inspectorate, H.M.S.O.,London
(continuation after break of How Factory Accidents Happen)

ANNALS OF OCCUPATIONAL HYGIENE
From December 1958 Quarterly
Pergamon, Oxford.

BRITISH JOURNAL OF COMMERCE SAFETY
1966 (only) Quarterly
Royal Society for the Prevention of Accidents, London
(incorporated into British Journal of Occupational Safety from 1967)

BRITISH JOURNAL OF INDUSTRIAL MEDICINE
From 1944 Quarterly
British Medical Association, London.

BRITISH JOURNAL OF INDUSTRIAL SAFETY
1946-1966 Quarterly
Royal Society for the Prevention of Accidents,London.
(replaced by British Journal of Occupational Safety with consecutive volume and issue numbering)

BRITISH JOURNAL OF OCCUPATIONAL SAFETY
1967-1970 Quarterly
Royal Society for the Prevention of Accidents, London
(continuation of British Journal of Industrial Safety with consecutive volume and issue numbering, replaced by Occupational Safety and Health)

H.M. CHIEF INSPECTOR OF FACTORIES ANNUAL REPORT
Annually during year following
H.M.S.O., London
(NOTE: The Annual Report of H.M. Chief Inspector of Factories on Industrial Health was published as a separate volume between 1957 and 1966 inclusive)
Searched from 1920.

HOW FACTORY ACCIDENTS HAPPEN
1937-1939 Quarterly
H.M.S.O., London
(continuation of Industrial Accidents with consecutive numbering. Replaced after break in 1949 by Accidents).

INDUSTRIAL ACCIDENT PREVENTION BULLETIN
1933-1965 Monthly
Royal Society for the Prevention of Accidents, London
(replaced by Industrial Safety Bulletin with consecutive volume and issue numbering)
Searched from 1961.

INDUSTRIAL ACCIDENTS
1933-1937 Quarterly
H.M.S.O., London
(replaced by How Factory Accidents Happen with consecutive numbering)

INDUSTRIAL HEALTH AND SAFETY
From 1968 Monthly
Engineering Employers Federation, London

INDUSTRIAL SAFETY
From 1960 Monthly
United Trade Press, London
(continuation of Safety Equipment and Industrial Clothing with consecutive volume numbering).

INDUSTRIAL SAFETY BULLETIN
1966 (only) monthly
Royal Society for the Prevention of Accidents, London
(continuation of Industrial Accident Prevention Bulletin with consecutive volume and issue numbering, replaced by Occupational Safety Bulletin with consecutive volume and issue numbering)

JOURNAL FOR INDUSTRIAL NURSES
1949-1962 Monthly
McMillan, London
(replaced by Occupational Health with consecutive volume numbering)

JOURNAL OF THE INSTITUTION OF INDUSTRIAL SAFETY OFFICERS
1953-June 1964 Quarterly
Institution of Industrial Safety Officers, London
(continuation of Safety Record, replaced by Protection)

NATIONAL INDUSTRIAL SAFETY STUDY CONFERENCE PROCEEDINGS
From about 1930, Annually
Royal Society for the Prevention of Accidents, London.

OCCUPATIONAL HEALTH
From 1963 Monthly
McMillan, London
(continuation of Journal for Industrial Nurses with consecutive volume numbering)

OCCUPATIONAL SAFETY AND HEALTH
From 1971 Monthly
Royal Society for the Prevention of Accidents,London
(continuation of British Journal of Occupational Safety)

OCCUPATIONAL SAFETY AND HEALTH SUPPLEMENT
From 1971 Monthly
Royal Society for the Prevention of Accidents, London
(continuation of Occupational Safety Bulletin)

OCCUPATIONAL SAFETY BULLETIN
1967-1971 Monthly
Royal Society for the Prevention of Accidents, London
(continuation of Industrial Safety Bulletin with consecutive volume and issue numbering, replaced by Occupational Safety and Health Supplement)

OFFICIAL REPORTS OF PARLIAMENTARY DEBATES (HANSARD)
Daily during session
H.M.S.O., London
Searched from 1920

PROCEEDINGS OF THE ROYAL SOCIETY OF MEDICINE
From 1907 Monthly
H.K. Lewis & Co. Ltd., London
(The Section of Occupational Medicine held its inaugural meeting on 12 October 1964, and reports of the meetings of this section were included in the Proceedings from Volume 58 (1965))
Searched from 1965

PROTECTION
From September 1964 Monthly
Alan Osborne and Associates, London.
(continuation of Journal of the Institution of Industrial Safety Officers)

SAFE TIMES
1959-1963 Monthly
British Safety Council, London
(replaced by Safety and Rescue with consecutive volume and issue numbering)
(November 1959, January, May and October 1960 missing)

SAFETY
From 1958 Quarterly
British Iron and Steel Federation until 1967 and British Steel Corporation from 1968, London

SAFETY AND RESCUE
From 1963 Monthly
British Safety Council, London
(continuation of Safe Times with consecutive volume and issue numbering)

SAFETY EQUIPMENT AND INDUSTRIAL CLOTHING
1957-1959 Monthly
United Trade Press,London
(continuation of Uniforms and Industrial Clothing with consecutive volume and issue numbering, replaced by Industrial Safety with consecutive volume numbering)

SAFETY FIRST
1925-1935 Monthly
National Safety First Association, London

SAFETY RECORD
1946-1953 Quarterly
Royal Society for the Prevention of Accidents, London (Industrial Safety Officers Section)
(incorporated into Journal of the Institution of Industrial Safety Officers)
Searched from November 1947

THE TIMES
1785 Daily
Times Newspapers Ltd., London
Searched from 1920 using The Official Index to the Times, Film Edition.

TRADES UNION CONGRESS ANNUAL REPORT
Annually
Trades Union Congress, London.
Searched from 1925

TRANSACTIONS OF THE ASSOCIATION OF INDUSTRIAL MEDICAL OFFICERS
1951-1966 Quarterly
Livingstone, Edinburgh
(replaced by Transactions of the Society of Occupational Medicine with consecutive volume numbering)

TRANSACTIONS OF THE SOCIETY OF OCCUPATIONAL MEDICINE
From 1967 Quarterly
Livingstone, Edinburgh
(continuation of Transactions of the Association of Industrial Medical Officers with consecutive volume numbering)

UNIFORMS AND INDUSTRIAL CLOTHING
1955-1957 Monthly
United Trade Press, London
(replaced by Safety Equipment and Industrial Clothing with consecutive volume and issue numbering)

6.2 References

Only papers, reports, etc. which have advanced or reviewed the state of knowledge have been referenced, even though these may have been published anonymously on occasions. Advertisements, announcements, editorial matter and the like have not necessarily been included in the list of references.

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6.3 Schedule of Advertisements

A complete list of advertisements is given below. The absence of the title of a journal or magazine listed in Appendix 6.1 may be taken as confirmation that it carried no advertising relevant to this review within the approiate period.

Accidents

1957 January: "Lee Sonic Ear Valv" ear plugs.

July: as above.

1958 July to 1959 July inclusive: "Lee Sonic Ear Valv" ear plugs.

1960 January to 1969 April inclusive:"Lee Sonic Ear Valv" ear plugs.

1970 October: Ardente "Anti-Noise" glass down.

1971 April: Ardente "Anti-Noise" glass down.

July: British American Optical ear muffs.

October: Bilsom glass down and ear muffs; "Com-fit" ear plugs.

1972 January: as above.

April: as above.

July: Bilsom glass down and ear muffs; "Com-fit" ear plugs; "Safe-T" ear muffs.

October: as above.

British Journal of Industrial Safety (see Occupational Safety and Health).

British Journal of Occupational Safety (see Occupational Safety and Health)

Department of Employment and Productivity

"Noise and the Worker", Safety Health and Welfare Booklet No. 25.

1968 (second edition): Amplivox audiometers, ear plugs and ear muffs; Boots "Muffles" ear plugs; "Lee Sonic Ear Valv" ear plugs; "Nosonic" ear muffs.

1971 (third edition): "Antisonic" ear muffs; Ardente sound level indicator; Bruel and Kjaer sound level meters; Castle Associates sound level meters; Chapman and Smith ear muffs; Dawe sound level meters; "Safe - T" ear muffs.

Industrial Safety (including Safety Equipment and Industrial Clothing 1957-59)

1958 January: Dawe sound level meters; "Lee Sonic Ear Valv" ear plugs.

March to December inclusive: "Lee Sonic Ear Valv" ear plugs (classified)

April: "Lee Sonic Ear Valv" ear plugs

July: as above.

1959 February to December inclusive: "Lee Sonic Ear Valv" ear plugs (classified).

June: Denis Ferranti "Eargard" ear muffs.

September: "Lee Sonic Ear Valv" ear plugs; Denis Ferranti "Eargard" ear muffs.

1960 January to December inclusive: "Lee Sonic Ear Valv" ear plugs (classified).

April: "Lee Sonic Ear Valv" ear plugs.

1961 January to December inclusive: "Lee Sonic Ear Valv" ear plugs (classified)

March: "Industrial Noise" booklet.

April: as above

June: as above

July: as above

August: as above

September: Amplivox ear muffs.

October: "Industrial Noise" booklet.

1962 January to December inclusive: "Lee Sonic Ear Valv" ear plugs (classified)

January: "Industrial Noise" booklet.

March: as above

April: as above

May: Amplivox ear muffs.

June: Trelleborg (Sweden) ear muffs.

September: as above

1963 January to December inclusive: "Lee Sonic Ear Valv" ear plugs (classified)

March: Amplivox ear muffs

April: Amplivox ear muffs; Mine Safety Appliances ear defenders.

May: Mine Safety Appliances ear defenders.

July: Mine Safety Appliances ear defenders; Ardente "Anti-Noise"glass down and hearing conservation service.

1964 January to June inclusive and August: "Lee Sonic Ear Valv" ear plugs (classified).

1965 March: Amplivox ear muffs.

April: "Lee Sonic Ear Valv" ear plugs (classified)

May: British American Optical ear plugs and ear muffs.

1966 January: Protector ear muffs.

February: Amplivox ear muffs.

June: "Safe-T" ear muffs; "Nosonic" ear muffs.

1967 May: Protector ear Muffs.

1968 February: Protector ear muffs; "Lee Sonic Ear Valv" ear plugs (classified).

September: R.S. Allsop and Associates consultants.

November: "Lee Sonic Ear Valv" ear plugs.

1969 January to December inclusive: Ardente "Anti-Noise" glass down.

January: "Lee Sonic Ear Valv" ear plugs.

March: "Lee Sonic Ear Valv" ear plugs; "Silenta" ear muffs.

May: "Lee Sonic Ear Valv" ear plugs; Protector ear muffs.

June: Cosmocord "Acos" sound level meter.

July: "Lee Sonic Ear Valv" ear plugs; "Silenta" ear muffs.

September: "Lee Sonic Ear Valv" ear plugs.

1970 April: Protector ear muffs; British American Optical ear muffs; Amplivox ear plugs and ear muffs.

June: Amplivox ear plugs and ear muffs.

September: Protector ear muffs; Amplivox ear plugs and ear muffs.

November: Amplivox ear plugs and ear muffs.

1971 March: Ardente "Anti-Noise" glass down.

September: British American Optical ear muffs.

November: Chapman and Smith glass down and ear muffs.

1972 February: Chapman and Smith glass down and ear muffs.

March: Chapman and Smith glass down and ear muffs; Mine Safety Appliances ear plugs and ear muffs.

April: Chapman and Smith glass down and ear muffs.

May: Mine Safety Appliances ear plugs and ear muffs.

June: Bausch and Lomb (U.S.A.) sound level meter, ear muffs and audiometer.

Journal of the Institution of Industrial Safety Officers (see Protection)

Occupational Safety and Health (including British Journal of Industrial Safety 1946-66 and British Journal of Occupational Safety 1967-70)

1951 Summer: Amplivox "Sonex" ear plugs.

1958 Winter: Slough Industrial Health Service noise measurement and analysis and audiometry.

1959 Spring: as above

1963 Summer: Mine Safety Appliances ear defenders.

Autumn: as above

Winter: as above

1964 Summer: British American Optical ear muffs.

1966 Spring: Protector ear muffs.

Summer: as above.

1967 Spring: Siebe Gorman ear muffs.

1971 April/May: Parmelee ear muffs; Cosmocord "Acos" sound level meter; Mine Safety Appliances ear protection.

June: Parmelee ear muffs; Bilsom glass down and ear muffs.

July: Parmelee ear muffs; Bilsom glass down and ear muffs; British American Optical ear muffs.

August: Bilsom glass down and ear muffs; British American Optical ear muffs.

September: Parmelee ear muffs.

October: Bilsom glass down and ear muffs; Chapman and Smith glass down and ear muffs.

November: Bilsom glass down and ear muffs; Protector ear muffs.

December: as above.

1972 January: Bilsom glass down and ear muffs.

February: Bilsom glass down and ear muffs; Chapman and Smith glass down and ear muffs.

March: Bilsom glass down and ear muffs; Chapman and Smith glass down and ear muffs; Mine Safety Appliances ear plugs and ear muffs; Protector ear muffs.

April: Bilsom glass down and ear muffs; Chapman and Smith glass down and ear muffs; Protector ear muffs.

May: Bilsom glass down and ear muffs; Chapman and Smith glass down and ear muffs; Mine Safety Appliances ear plugs and ear muffs; "Com-fit" ear plugs.

June: Bilsom glass down and ear plugs.

July: Bilsom glass down and ear plugs; "Silenta" ear muffs.

August: Bilsom glass down and ear muffs; "Com-fit" ear plugs; Cosmocord "Acos" sound level meter; Parmelee ear muffs; British American Optical ear protection; "Silenta" ear muffs; Amplivox ear muffs; Focal Displays warning signs; "Itex" ear muffs.

Protection (including Journal of the Institution of Industrial Safety Officers, 1953-64).

1963 September: Ardente "Anti-Noise" glass down and hearing conservation service.

1965 December: "Lee Sonic Ear Valv" ear plugs.

1966 March: as above

1969 January: "Lee Sonic Ear Valve" ear plugs; Ardente "Anti-Noise" glass down.

March: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Amplivox ear muffs.

May: as above.

July: "Lee Sonic Ear Valv" ear plugs; Amplivox ear muffs.

September: as above

November: as above.

1970 January: as above.

March: "Lee Sonic Ear Valv" ear plugs.

May: as above.

July: as above.

November: "Silenta" ear muffs; Camera Talks audio-visual aids.

1971 January: "Lee Sonic Ear Valv" ear plugs; Amplivox hearing conservation.

February/March: Camera Talks audio-visual aids.

May: "Lee Sonic Ear Valv" ear plugs; Amplivox hearing conservation.

July/August: British American Optical ear muffs.

September: Bilsom glass down and ear muffs; Amplivox ear muffs.

November: Camera Talks audio-visual aids; Bilsom glass down and ear muffs; Amplivox ear muffs.

December: "Lee Sonic Ear Valv" ear plugs.

1972 January: Amplivox ear muffs; Mine Safety Appliances ear plugs and ear muffs.

February: "Lee Sonic Ear Valv" ear plugs; Mine Safety Appliances ear plugs and ear muffs.

March: Amplivox ear muffs: Mine Safety Appliances ear plugs and ear muffs.

April: "Lee Sonic Ear Valv" ear plugs; Mine Safety Appliances ear plugs and ear muffs; Parmelee ear muffs.

May: Amplivox ear muffs; Castle Associates sound level meters; "Silenta" ear muffs; British American Optical ear protection.

Safe Times (see Safety and Rescue)

Safety and Rescue (including Safe Times 1958-63)

1960 July: "Lee Sonic Ear Valv" ear plugs

1961 January: as above

1962 January: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down and hearing conservation service.

1963 July: Ardente "Anti-Noise" glass down and hearing conservation service.

1964 April: "Lee Sonic Ear Valv" ear plugs.

September: as above

October: as above

November: as above

December: as above

1965 January: as above

February: as above

May: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; "Nosonic" ear muffs.

June: Bar (Switzerland) ear muffs.

August: Bar (Switzerland) ear muffs; Amplivox ear protection (classified).

September: as above.

October: Amplivox ear protection (classified)

November: as above.

December: "Lee Sonic Ear Valv" ear plugs; Amplivox ear protection (classified).

1966 January: Amplivox ear protection (classified).

February: as above

March: as above

April/May: "Lee Sonic Ear Valv" ear plugs; Amplivox ear protection (classified)

May/June: Amplivox ear protection (classified)

July/August: as above

September/October: "Lee Sonic Ear Valv" ear plugs; "Nosonic" ear muffs; British Safety Council poster; Amplivox ear muffs.

1967 January: Ardente ear protection (classified)

February: as above

March: "Lee Sonic Ear Valv" ear plugs; Ardente ear protection (classified); Amplivox noise excluding communication headsets.

April: Ardente ear protection (classified).

May: "Lee Sonic Ear Valv" ear plugs; Ardente ear protection (classified).

June: Ardente ear protection (classified)

August: "Lee Sonic Ear Valv" ear plugs; Amplivox noise excluding communication headsets.

October: "Lee Sonic Ear Valv" ear plugs.

December: as above

1968 January: Ardente "Anti-Noise" glass down.

February: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down.

March: Ardente "Anti-Noise" glass down; Amplivox ear muffs.

April: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Amplivox ear muffs.

May: Ardente "Anti-Noise" glass down.

June: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Amplivox ear muffs.

August: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down.

September: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Amplivox ear muffs.

October: Ardente "Anti-Noise" glass down.

November: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Amplivox ear muffs.

December: Ardente "Anti-Noise" glass down.

1969 January: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down.

February: Ardente "Anti-Noise" glass down; "Silenta" ear muffs.

March: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; "Silenta" ear muffs; Amplivox ear muffs.

April: Ardente "Anti-Noise" glass down; Amplivox ear muffs.

May: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Amplivox ear muffs.

June: Ardente "Anti-Noise" glass down.

July: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Amplivox ear muffs.

August: Ardente "Anti-Noise" glass down.

September: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Amplivox ear muffs.

October: Ardente "Anti-Noise" glass down.

November: "Lee Sonic Ear Valv" ear plugs; Ardente"Anti-Noise" glass down; Amplivox ear muffs.

December: Ardente "Anti-Noise" glass down.

1970 January: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down.

March: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Amplivox ear plugs and ear muffs.

May: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Amplivox ear plugs and ear muffs; Protector ear muffs.

June: British American Optical ear muffs.

July: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down.

September: Ardente "Anti-Noise" glass down; "Com-fit" ear plugs.

October: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down.

November: Ardente "Anti-Noise" glass down.

December: Ardente "Anti-Noise" glass down; Ardente ear muffs (separate advertisement); "Com-fit" ear plugs; Camera Talks audio-visual aids.

1971 January: Ardente "Anti-Noise" glass down.

February: "Lee Sonic ear Valv" ear plugs; Ardente"Anti-Noise" glass down.

March: Ardente "Anti-Noise"glass down.

April: "Lee Sonic Ear Valv" ear plugs.

May: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Parmelee ear muffs.

June: Ardente "Anti-Noise" glass down.

July: "Lee Sonic Ear Valv" ear plugs.

August: as above

September: British American Optical ear muffs.

October: Parmelee ear muffs; Bilsom glass down and ear muffs; "Com-fit" ear plugs.

November: "Lee Sonic Ear Valv" ear plugs; Bilsom glass down and ear muffs.

December: Bilsom glass down and ear muffs: "Com-fit" ear plugs.

1972 January: Bilsom glass down and ear muffs; Mine Safety Appliances ear plugs and ear muffs; Parmelee ear muffs.

February: "Com-fit" ear plugs; Chapman and Smith glass down and ear muffs.

March: Bilsom glass down and ear muffs; Mine Safety Appliances ear plugs and ear muffs.

April: Bilsom glass down and ear muffs; "Com-fit" ear plugs.

May: "Lee Sonic Ear Valv" ear plugs; Ardente "Anti-Noise" glass down; Mine Safety Appliances ear plugs and ear muffs; Parmelee ear muffs; Chapman and Smith glass down and ear muffs.

Safety Equipment and Industrial Clothing (see Industrial Safety).