

A Study of Industrial Noise And Hearing Loss In a Controlled Population

—A Preliminary Report—

By C. D. YAFFE, M.S.

THE RELATIONSHIP of industrial noise to hearing loss is something which is probably of as great interest and concern as any problem currently faced in the field of occupational health. The numerous symposiums held, the training courses presented, and the committees established during the past few years to deal with the subject are evidence of the problem that exists. Exploration through these media of the available information shows that for various age levels there is a very considerable amount of knowledge about hearing, both normal and otherwise. There is also general acceptance of the belief that excessive noise of sufficient intensity and type (frequency) will produce permanent adverse effects upon hearing in individuals susceptible to noise provided there is exposure over a sufficient length of time. Lacking, however, is sufficient information regarding the relationship of type and intensity of the noise to time of exposure and hearing loss upon which to base standards, particularly where compensa-

Mr. Yaffe has, since 1948, been chief of the Engineering Section at the Public Health Service's Occupational Health Field Headquarters in Cincinnati. During the preceding 5 years, he was chief industrial hygienist for the State of Washington. This paper was presented, April 29, 1954, to the engineering session at the annual meeting of the American Industrial Hygiene Association in Chicago.

tion is under consideration. The dearth of suitable data of this sort is emphasized in the report recently released by the American Standards Association's Z24-X-2 exploratory subcommittee entitled "The Relations of Hearing Loss to Noise Exposure." This report was based on a thorough survey of all significant information available.

Realizing the immediate necessity for as much usable information as can be obtained, many individuals, organizations, and agencies have begun the collection and interpretation of audiometric data and analyses of industrial noise. Through their combined efforts some of the urgently needed answers should begin to appear within the next few years.

This paper describes one of the new studies which, it is hoped, will produce data helpful in the study of the relationship of noise to hearing loss.

Prison Industrial Operations

During the summer and fall of 1952, a survey, preliminary to a long-term study, was made of industrial operations conducted at several Federal penitentiaries. This preliminary investigation revealed the presence of a fairly large number of operations producing overall sound levels in the general range of 75 to 105 decibels, where some authorities feel reasonable standards might eventually be established. A wide variety of frequency characteristics was also presented by the industrial noises encountered.

Of equal importance, it was found that a fairly substantial number of workers are exposed to these noise conditions for periods of at least a year. Furthermore, a considerable number of the men have had little or no previous industrial experience involving exposure to noise. In addition, the study situation is unique in that it is known that none of the men has any significant exposure to noise except while on the job.

As a result of these findings, agreement was reached and a plan developed for a cooperative study by the United States Bureau of Prisons,

the Federal Prison Industries, Inc., and the Occupational Health Program, Division of Special Health Services of the Public Health Service. The Bureau of Prisons is responsible for the operation of the Federal penal institutions. Many people are not aware, however, that the industrial operations in the prison system are conducted by a Government-owned corporation established by the United States Congress in 1934. This corporation, called the Federal Prison Industries, Inc., produces a number of manufactured products. The law requires that there be sufficient diversity that free industry will not be adversely affected; and further, that there shall be no open market competition and that all products shall be sold to Government departments and agencies. In addition to the materials produced, the program of the Federal Prison Industries trains inmates to do useful work and to earn some money for the care of dependents and for reestablishing themselves upon completion of their sentences.

Under the plan of study developed, audiometric data and information on noise conditions are being collected at four penitentiaries—those located at Lewisburg, Pa.; Atlanta, Ga.; Leavenworth, Kans.; and Terre Haute, Ind. The industrial operations under study include those involved in the manufacture of steel shelving, wooden and steel furniture, brushes, shoes, clothing, cotton and woolen textiles, and printing. The equipment used and manufacturing methods employed are the same as those in private industry, and the men work the usual 40-hour week. Sound levels encountered are similar to those for comparable operations reported in the literature by other investigators.

A group of approximately 600 workers in these industries was selected for special study. Each man will have his hearing tested at 3-month intervals for a year. The frequency of audiometric tests after the first year will depend upon the findings. It should be possible to follow the hearing of the majority of this study group for several years. Nevertheless, some of them will be lost to the study through transfer, parole, or other causes, despite the fact that the group was picked from men expected to remain in custody more than 2 years. Men in the study group who leave the industry are replaced, however, by new workers having

similar job assignments. Through such turnover, it is likely that some useful audiometric data correlated with noise exposures will eventually be obtained on about 1,500 to 2,000 workers.

Since audiometric tests were not performed prior to the study, baseline information on the original 600 men is lacking. This presents the same problem encountered anywhere when a program of hearing tests is first started on a group already employed. The data on the initial group, therefore, are not ideal. They are quite useful, however, if a large enough number of individuals are studied and compared with control groups not subjected to significant sound levels. Meanwhile, as a result of turnover in employment, there is a steady increase in the number of men in the study group on whom baseline data are available. Consequently, the quality as well as the volume of data should improve as the study progresses.

In addition to the study group from the Federal Prison Industries, there is a control group of approximately 150 inmates whose jobs do not include exposure to appreciable noise. These include men employed in prison hospitals, libraries, and comparable locations. This group will have hearing tests semiannually.

Under Medical Supervision

Medical care in Federal penitentiaries is provided by physicians from the Public Health Service who are assigned to these institutions. The program of audiometric testing in each prison is under the direct supervision of its chief medical officer. One byproduct of this study is that all new inmates at 2 of the penitentiaries now receive audiometric testing as a regular part of the physical examination given at the time of admission. The program may be extended to the other 2 Federal penitentiaries if it does not produce too much of an added burden on their medical departments.

All personnel performing audiometric tests have received personal instruction in techniques and procedures from a special consultant employed for this study by the Public Health Service. This consultant is a member of the subcommittee on noise in industry of the committee on conservation of hearing of the

American Academy of Ophthalmology and Otolaryngology, and, consequently, he is in a position to apprise that committee of developments in this study.

The rooms used for audiometry are located in the hospitals of the penitentiaries. While fairly quiet rooms for testing were found, they were improved for the desired purpose by acoustical treatment. Background noise levels in these rooms do not exceed 40 decibels.

The superintendents of industries in each of the penitentiaries have made valuable contributions to the study. It is through the Federal Prison Industries that the work and biographic data on all workers are obtained; and it is from these data that the study group is selected. While exact mechanisms of operation vary from one institution to another, the Prison Industries participates to a very considerable extent in the scheduling of men for testing and in arranging for them to leave their jobs for such purposes. This is not a simple matter since, in addition to the interruptions to production schedules, as encountered in private industry, special security problems are involved.

Measurements of noise are made by engineering personnel from the Division of Special Health Services of the Public Health Service. Included are not only determinations of overall sound levels but also octave band analyses. Several days are spent annually at each institution obtaining these data.

Provisions for Data Analysis

All data from the study are kept at the Occupational Health Field Headquarters in Cincinnati. Each penitentiary hospital at regular intervals sends all audiometric data to Cincinnati where they are transferred to punchcards specially designed for the study. The data sent include not only audiograms on the men in the study and control groups but also on all new inmates who are tested. This provides material for comparing the hearing of the prison inmates with the hearing of the general population as well as for other studies.

A separate card is maintained for each man tested. On it is recorded detailed information about him, his job, and the precise location where he works. It also contains space to record 12 sets of audiometric data on the individual and the dates of the tests.

Information obtained from sound analyses in the factories is likewise placed on specially designed punchcards. Detailed information about the type of sound at each location is recorded as well as the maximum, minimum, and average sound levels at each octave band and for the overall level. The latter data are also shown graphically on the reverse side of the card.

Through a special code used on both types of the cards to identify factories, departments, and work locations, cards on all men exposed to a certain type of noise condition may be easily separated for study.

The plan for hearing tests has been introduced to just one institution at a time and only extended to another when the operating routine had been given a thorough workout and found satisfactory. Consequently, the program at the fourth institution was just started in April 1954, although the first program began in February 1953. Thus, at the moment there are only 1 or 2 audiograms on most of the study group; and it would be inappropriate to attempt to draw any conclusions or even to indicate any possible trends. With the plan now operating on a full scale, however, a much greater volume of data should be accumulated during the coming year. The information obtained also will be more meaningful as it then may be possible to determine whether any changes having statistical validity are beginning to show up.

It is quite likely that no hearing losses attributable to workroom noise will be found in a large proportion of the group being studied. Many men were intentionally included who work in operations where sound levels are considerably below those considered harmful by the majority of authorities. Confirmation of such opinions is of value, however, for negative data are as necessary as positive data in the establishment of standards.