ASA Edition of Speech and Hearing in Communication

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Published in 1995; Originally Published in 1953

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Preface to ASA Edition

About 35 years ago the Research Laboratories of the Bell Telephone System started a comprehensive research program on speech and hearing, and its relation to the design of telephone systems. It was apparent that great advantages would come if one could describe accurately every part of the system, namely (1) the talker, (2) the microphone, (3) the electrical transmission line, (4) the telephone receiver (head phone or terminating loud-speaker), and (5) the listener.

The attack was first launched most vigorously on the constitution of speech issuing from the mouth of a typical talker to establish a reasonable description of speech; then one can find to what extent small imperfections and variations of the speech sounds affect the ability of the listener to recognize what the talker said. The work included study of both normal and abnormal organs of speech and hearing.

As the work progressed it became apparent that better and more precise instruments must be developed than were available, and a considerable part of the effort has been devoted to the matter of securing devices which would convert sound waves into electrical form and reconvert them again to sound with

the least possible distortion. Out of this have come unexpected rewards to the telephone and phonograph arts, for as these devices were perfected they found very immediate application to the great advantage of those industries.

One of the most difficult phases of the investigation has been that relating to the degree of precision with which the mind can differentiate and interpret sounds that are very nearly alike. This does not lend itself so readily to analysis and measurement as does the purely mechanical operation of the ear itself. The approach to this problem has been through the use of essentially perfect reproduction systems which could be deteriorated step by step until their faults became noticeable to the observer. This set a limit to the degree of perfection which could ever be demanded in the apparatus. When the deterioration was carried somewhat further, an estimate could be obtained of the degree of dissatisfaction presented by certain measured imperfections, and hence a practical basis of choice of a reasonably perfect system could be established.

Then after 15 years of such research work, a report was made to the public in the form of my book "Speech and Hearing" (published in 1929). Since its publication there has been a wealth of new information bearing upon this problem. Some of this information has come from the Bell Telephone Laboratories, but many other laboratories have made noteworthy contributions. This present book deals with all the information, and presents the subject, "Speech and Hearing in Communication", as an integrated whole. Chapters 15, 16, 17, and 18 summarize about thirty years of work with the Bell Telephone Laboratories by various groups on the perception of speech sound by listeners having normal hearing. They present it in the form of a method of calculating the articulation score expected by any talker-listener pair using any kind of system, which may be immersed in any kind of noise. In chapter 19 this is extended to the case of deafened listeners, and it is shown what the fundamental criteria must be for designing a hearing aid to be used by a deafened person having any kind and degree of deafness.

The last chapter deals with compensation cases due to injured hearing. The principles developed in the book are applied to this problem. A simple method is evolved for obtaining the effective hearing loss. It takes into account the hearing loss in both ears. This effective hearing loss is then related to the percent compensation that such a deafened person should receive compared to that which should be received by a totally deafened person.

Particular attention should be called to the material in chapter 14 which deals with dynamics of the middle and inner ear. This is much more mathematical than any of the other chapters. It develops equations from which one can determine the movements of the various parts of the hearing mechanism when a sound is impressed upon the ear drum. It shows that the results obtained from these equations agree with the splendid experimental work of Békésy so that one can say with considerable assurance that the dynamical behavior of the hearing mechanism is now well known.