Communication by speech is the most direct connection between human beings. Noise disturbs this connection because it masks some components of acoustical features and therefore reduces the information content of speech. Diminishing of intelligibility does not only prevent communication but can bring forth dangerous situations. The paper discusses the mechanism of speech production and the most important peculiarities of speech as information. The chief goal of the treatment is the redundancy of speech which is the most important factor to preserve information in the presence of noise interference. In connection to this the acoustical data of intelligibility measured chiefly by the author, will be given. A new computation method for the determination of intelligibility percentage in the presence of noise interference will be presented.

1. Communication by speech

The English word noise has two meanings. It means statistically fluctuating or simply non-periodical sound whose energy distributions depending on the frequency (so-called Fourier spectrum) consists of continuous, eventually densely located non-harmonic elements or is interspersed with them. According to its other meaning noise is any sound disturbing man in any of his activities. In certain languages there are two separate words for the two meanings.

Sounds with continuous spectrum may, of course, also carry information just as the so-called musical sounds with harmonic components. The former type is characteristic of several consonants, while characteristic examples for the latter are the vowels.

The disturbing noise may be the sound of both physical characters, but disturbance in understanding speech is caused in most cases and to the greatest extent by sounds with continuous spectrum. That is, the two meanings of noise are coinciding at such occasions.

Speech is the most important means of communication for human beings. Its functioning is linked with a bilateral human capability, with the ability of formation and of understanding of speech. Basic conditions of this are the following: intention of communication, the system of signals used according to a common agreement, the perfect condition of organs serving for emission and reception as well as the ability of
understanding. Therefore, the chain of speech communication is a complicated system where brain, nerves, speech organs and hearing all participate (Fig. 1). Feedback serving for the checking of transmission, namely, the fact that the speaker hears also his own voice, is not a basic condition but improves the speed and safety of communication.

Fig. 1. Diagram of the communication chain; \( I \) = information, \( C_{1,2} \) = cerebral function, \( N_{1,2} \) = nervous connections, \( M \) = motoric emission, \( R \) = reception, \( I' \), \( R' \) = feed-back information for the emitter, \( I_{1,2} \) = information store of both emitter and receiver

Communication by sounds is known also in the world of animals, but this is different from human speech, because with animals each information is given by a separate signal. Thus, of course, it is inapt for information on thoughts. Human speech is a system of signals built up on 35–40 elements, where meaning relies on various forms of connections between elements. Not only the possibility is given to form a new speech sound compound for any meaning, but also for the construction of a grammatical system in order to develop a literary language semantically perfectly tinged.

Speech is perfectly understandable — under appropriate acoustic circumstances — for healthy people mutually knowing the system of acoustical signals agreed upon (the language). By acoustical circumstances first of all the loudness of speech, the distance between speaker and listener and environmental background noise are meant. "Intelligibility" may decrease depending on them, what is more, it may even be lost. Therefore, the notion of intelligibility has a great importance in the evaluation of speech communication. With noise present both the speaker and the listener are faced with a difficult task: the former is disturbed by noise in thinking and the formation of speech, while the latter in hearing the series of signals and the cerebral evaluation of information content. It is first of all the phenomenon of "masking" that makes communication difficult [1].

Brain-work is, as a matter of fact, the decoding of the acoustical material heard, that will become more and more difficult according to what share and part of information is made unintelligible. Therefore, the harmful effect of speech—noise interference consists not only in the fact that the information is not understood, but also that the establishment of communication requires great efforts both on the side of emission (shouting) and on that of reception (combinative thinking).

That is why Robinson [2] ranks speech interference among primary human effects of noise. Namely, in speech disturbance stress is laid on the cerebral evaluating of

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