The Committee may think it desirable to make temporary changes in the room, or to make permanent changes at once with materials at present available. In view of this possibility it seems to me best to submit the report in its present form and to supplement it later if desirable.

The very brief description of the general problem of acoustics is embodied in the report to enable your Committee better to understand the difficulties sometimes encountered, the impossibility of effecting a complete correction in some cases, and the fact that a room acoustically corrected for one purpose is not suitable for other purposes.

The report contains a frank criticism of the design of the chamber. It must be remembered that the science of architectural acoustics is of very recent origin. For the best work, perhaps the only really scientific work, on the subject we are indebted to the late Wallace C. Sabine, who died recently without publishing his collected works. Although so little of real value in this line is found in architectural literature, there is to be found plenty of work of doubtful value done by men untrained in science.

In justice, then, I have to say that in my opinion it is unreasonable to expect an architect to be able in every case to design a room free from acoustic defects unless he has made a very special study of the subject, which, as explained above, is not easy. Furthermore, rooms are not designed solely for perfect acoustic purposes. Artistic excellence, and a form, traditional for certain purposes, must weigh heavily when the various properties come into conflict.

In conclusion I wish to thank the Committee for its kindness in accepting unfortunate delays in the work and for its good spirit in co-operation.

I am, &c.,
HARRY CLARK.

Mr. A. S. Malcolm, Chairman of the Furnishing Advisory Committee of the House of Representatives, Wellington.

REPORT TO THE FURNISHING ADVISORY COMMITTEE ON THE ACOUSTIC PROPERTIES OF THE CHAMBER OF THE HOUSE OF REPRESENTATIVES OF NEW ZEALAND.

The General Problem of Acoustics.

The simplest auditorium, the open air, has the one great defect that sound rapidly becomes faint as the distance from the speaker increases. The walls of a room reflect the sound-waves, thereby increasing the loudness, but reflection produces other effects which are undesirable.

The several distinct echoes produced by highly reflecting walls in a very large room are easily recognized. In a small room they occur in such rapid succession as to appear continuous, in which case the effect is called "reverberation."

Reflection also produces "interference" resulting in a peculiar distribution of sound such that while in a certain place the sound is intense, another place a few inches away (in some cases a fraction of an inch) will be in silence. Because of "interference" the sound from an organ-pipe, instead of dying away after the pipe has ceased to play, may become very much louder for a short time. "Interference" cannot be discussed briefly with profit: suffice it to say that my tests have shown that it can be reduced to a minimum in the chamber.

In a room of moderate size with highly reflecting walls and floor the audible reverberation may persist for six or seven seconds. Since in this time a speaker may pronounce perhaps thirty syllables, great confusion results. The reverberation-time depends only slightly upon the loudness, consequently in such a room little advantage is gained by speaking in a loud voice. A room of this kind may be said to be easy to speak in because a speaker can without effort fill the room with sound.

Reverberation-time depends upon the reflecting-power of the walls. Stone, cement, plaster, and wood are almost perfect reflectors. Soft material, such as curtains, carpets, cushions, and felt, together with certain tiles especially made for the purpose, being good absorbers of sound, reflect but sightly. The clothing of the people in the audience is a large factor in the absorption. It would be a comparatively simple matter to reduce the reverberation in a room of proper shape to any desired value by the use of such materials were it not for the fact that the relation of absorption to pitch is sometimes complex. Some materials used in certain ways absorb sounds of low pitch well, but reflect the high pitches. Others have the opposite effect. Still others absorb the middle register and reflect the high and low pitches.

The relations of the various pitches contained in the human voice constitute its peculiar quality, and the reverberation-times must bear a proper relation to one another.

Reverberation-time depends also upon the size of the room, the walls being of constant quality. It will be greater in a large room because of the greater distances which sounds must traverse between successive reflections.

The proper amount of reverberation in a room is to a certain extent a matter of taste. If it exceeds about 2·5 seconds the room is not suitable for any purpose. About 2 seconds is proper to piano and chamber music. Orchestral music demands a somewhat shorter time. Speaking is distinct only for times below 1 second. Further deadening increases distinctness, but always at a sacrifice of loudness. A much-deadened room impairs the musical quality of the voice or of the musical instrument, because a quickly damped note, considered scientifically, consists necessarily of an unpleasant combination of pitches. A highly damped room is said to be a difficult room to speak in; a great effort is required to fill the room with sound. Yet speech is quite distinct if an ordinary tone of voice is used.

In general, any acoustic correction consists in effecting a compromise among loudness, musical quality, and the confusion caused by reverberation.