

ce sont les tons bas qui continuent à résonner trop longtemps. L'effet boomy est causé par le fait que des panneaux en bois entrent en vibration et continuent à vibrer lorsque dans la salle le son s'est déjà éteint. Les panneaux ont une durée du résonnement de 1 à 1,5 sec. C'est pourquoi l'effet-boomy ne se produit nettement que dans des pièces dont la durée du résonnement reste au-dessous de 1,5 sec.

Quelques-uns des effets cités se produisent surtout dans les studios de la T. S. F. et dans ceux employés à l'enregistrement de disques. Dans ces studios on réclame des durées du résonnement excessivement courtes (1) et par là on était à même de constater beaucoup plus nettement qu'autrefois les effets cités. Après coup cependant il nous est maintenant aussi possible de les discerner dans des salles plus grandes avec un amortissement plus normal, de sorte que l'acoustique générale des salles a tiré profit de la construction de studios, anormaux du point de vue acoustique, mais forts intéressants.

21. Ir. R. VERMEULEN (Eindhoven) : *Mechanical recording of sound on film.*

Ladies and Gentlemen,

Although not very familiar with the science of Phonetics, I still have the impression that part of your work consists in the recording of human speech, in the study of the wave of the sound and in making a FOURIER analysis. Now I hope that the new way of recording sound I am going to tell you about, will be of some use to you as by this sound record you can have almost at once not only the sound record itself, but also the wave form as ordinarily given by an oscillogram, and the FOURIER analysis.

The mechanism of this new way of sound recording, called the PHILIPS-MILLER system, is nearly the same as used for the recording on gramophone discs, i. e. a track is cut mechanically in a specially prepared tape, and so it has all the advantages of this method of recording. The result, however, is quite different and does not resemble the gramophone but is more like the sound-on-film record and the reproduction of the sound is accomplished in absolutely the same way : by throwing light on the record and collecting it in a photo-electric cell.

With an ordinary sound film the record is made photographically, either by modulating the intensity of a light beam or by shifting its position. As light is reputed to be free from inertia this photographic way seems to be the ideal one for recording the complete band of audible frequencies, including the highest ones.

(1) N. ASHBRIDGE, *Engineering*, Oct. 16 et 23, 1931.

It may look peculiar, that we should have ventured to improve upon it by using a clumsy knife rocking to and fro. But we succeeded in reducing the mass-effects of the knife 40 times and we gained by the combination of the mechanical recording and the optical reproduction several advantages. The principal one is that the sound record is immediately ready for reproduction without requiring any development or processing whatsoever. This allows the quality of the recording to be checked almost immediately, the delay being of the order of 1/5 of a second.

In my opinion this is also a big advantage for phonetic purposes, as it helps greatly in making rapid progress possible, and enables to make many more recordings in less time.

I think that in comparison with the gramophone record, it must be another advantage of the sound film, that the contours of the track form a replica of the wave form of the sound recorded. They can immediately be studied either in a small microscope or by making photographic enlargements, and there is no need to use an oscillograph. Further the sound film permits

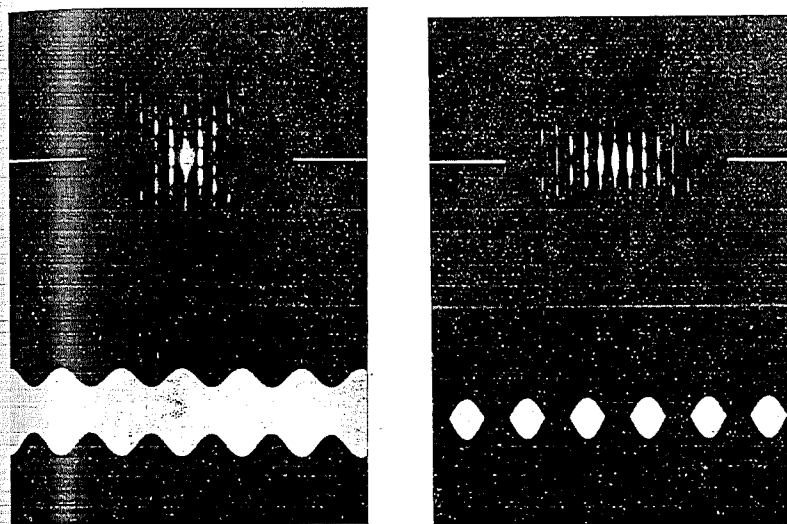


Fig. 1 and Fig. 2

a faithful reproduction of the sound as many times as you like, without wear of the record and parts of the record can be taken out and recombined with parts of other records in an arbitrary way.

Also, and I think that you will appreciate this very much,

the FOURIER analysis of a sound film can be done in a very simple and direct way. In *Nature* Mr. D. BROWN (1) and my collaborator Dr. SCHOUTEN (2) have pointed out that by using a sound film as an optical grating, remarkable interference patterns may be produced.

If the recorded sound is a pure tone (fig. 1) the pattern consists on the axis of only two lines, each on one side of the direct ray. For a complex tone structure (fig. 2) it can be demonstrated, that on the axis a complete FOURIER analysis is produced, not only the distances of the lines being proportional to the frequencies but also the intensity of the lines being directly proportional to the intensity of the different components in the original sound.

I will now return to my original subject, the mechanical recording of sound on film. The essential difficulty lies in obtaining sufficient amplitudes at the high frequencies, and it is the invention of an American, Mr. J. A. MILLER, which made this possible. The Physical Laboratory of the PHILIPS Gloeilampenfabrieken at Eindhoven, Holland collaborated with Mr. MILLER to work out his proposals. The principle consists

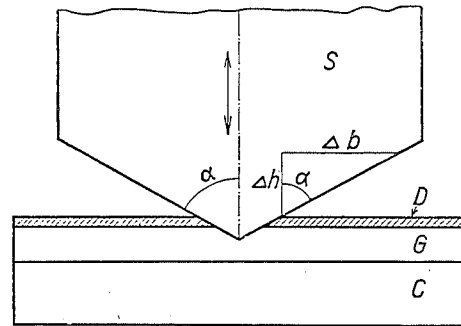


Fig. 3

in a mechanical magnification of the cutter movements which is achieved in an extremely simple manner, without adding inertia, or complicated levers.

The film is composed of a celluloid base C, (fig. 3), which instead of the usual photographic emulsion is coated with a layer of transparent gelatin of about 60 microns thick, upon which a very thin opaque coating, only 3 to 5 microns thick. A cutter,

(1) D. BROWN, *Nature*, 140, p. 1099, 1937.(2) J. F. SCHOUTEN, *Nature*, 141, p. 914, 1938.

in the shape of an obtuse angled wedge, is displaced perpendicularly to the plane of the film strip, in synchronism with the sound vibrations to be recorded. This cutter removes a shaving from the gelatin layer passing below it, the thin surface coating being removed as well, leaving a transparent trace against an opaque background. When the cutter moves perpendicularly to the film surface, the width of the transparent trace will vary

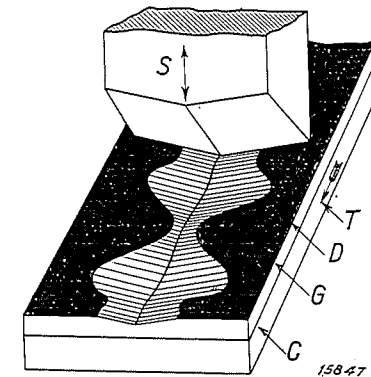


Fig. 4

within wide limits. These variations in width are in fact a linear (fig. 4) magnification of the cutter motion. The more obtuse the angle of the cutting wedge, the larger the magnification will be. We found that with an angle of 174 degrees good results can be obtained with a magnification of nearly 40.

To obtain the standard sound track of about 2 mm. as on ordinary sound films, the displacement of the cutter needs to have an amplitude of only 25 μ .

As you will not be interested in the technical details (1) (2) (3) (4), I will not discuss these and other difficulties here, I only wish to tell you that at this moment the system is in successful operation at different broadcasting stations.

I will conclude by enumerating the properties of the PHILIPS-MILLER system of sound-recording (5) (6).

Generally, I may say, that the system combines most of the advantages of the mechanical recording with those of the optical

(1) R. VERMEULEN, *Philips Techn. Rev.*, 1, p. 107, 1936.(2) A. TH. VAN URK, *Philips Techn. Rev.*, 1, p. 135, 1936.(3) A. CRAMWINCKEL, *Philips Techn. Rev.*, 1, p. 211, 1936.(4) C. J. DIPPEL, *Philips Techn. Rev.*, 1, p. 230, 1936.(5) R. VERMEULEN, *Akustische Z. S.*, 3, p. 65, 1938.(6) R. VERMEULEN, *Journ. Soc. Motion Pict. Eng.*, 30, p. 680, 1938.

reproduction, the chief one being that the sound track can be reproduced immediately after recording, without requiring any previous developping.

The majority of the inconveniences encountered in photographic recording are avoided, for the film strip can be handled throughout in ordinary daylight. The sound track has very sharp definition, since there is no diffusion of light in the emulsion. Background noise is small, as the coating of the film is free of grain; and the recording of high frequencies is improved since the finite width of the light-slit required in photographic recording is absent. The transparency of the trace is greater since no photographic fogging is produced and the density of the coating has an optimal value from the outset.

On the other hand, many of the advantages of the sound film are retained since these are not associated with the method of recording but with the method of optical reproduction adopted. A few of these are: long playing time, very slight wear of the record and avoidance of the needle-changing required with the gramophone, absence of mechanical reaction upon the motor-drive, a feature facilitating the maintenance of constant speed.

I hope to have succeeded in giving you an impression of the PHILIPS-MILLER system of sound recording and that it may contribute to the further development of the phonetic science.

TUESDAY, 19 JULY. AFTERNOON

SESSION „PHONETICS AND BROADCASTING“

Chairman : Prof. MARCEL COHEN.

22. Prof. A. LLOYD JAMES (London) : *Phonetics and Broadcasting in Britain.*

Broadcasting in Britain continues to present interesting problems in many fields of linguistic study, some of which fall outside the scope of a purely phonetic investigation if one restricts the term „phonetics“ to the study of speech sounds. I claim, however, the right to interpret the term in my own way and to present to you what appear to me to be some of the most interesting problems in that branch of linguistic study which deals with the relation between written and spoken language. It has become abundantly clear in my mind that ordinary written English, which may satisfy all the accepted canons in grammar, syntax, vocabulary, sentence structure and style generally, is very often unsuitable for the purpose of reading

aloud at sight, or indeed for broadcasting at all. It looks as though our literary language is suffering from the effects of silent reading and is designed more with that end in view than with a view to being read aloud.

A news bulletin, written according to the traditions of news-writing, is given to an Announcer to read, perhaps without any time for rehearsal on his part. It may contain such a sentence as this :

„Another suggestion from the Magistrates' Association was that every road junction should have a sign to show which of the roads was the major one, and thus make clear to motorists who had to give way to the other.“

The handling of a sentence of this kind is a difficult matter, and the editing of written material for reading offers a scope for typographical development. Consideration must be given to the particular need for a theory of punctuation based on sense groups.

Another point of interest, not strictly phonetic, lies in the differing nature of „context“ in the two forms of language, written and spoken. Visual language is rich in its ability to provide context. The eye has before it a constant mass of print; it can range around, can anticipate, can recapitulate; it enables the brain to gather a whole background for the matter in hand. Now, it has been pointed out that in language, knowledge of context is a great factor in intelligibility. To know what a man is talking about, or going to talk about, is to go half way to understanding him. In ordinary conversation with people we can see, the eye again does much to establish context, and contributes to intelligibility. We see gestures, expressions and environment. But when the speaker is invisible, all context has to be established by audible means; and herein lies the danger. A man reading a script knows his context; he has written his script possibly; the very possession of a script gives him an immeasurable advantage over his listeners, and inevitably he reads as though his listeners have his script before their eyes. There are many differences between what is known as the good broadcaster and the bad one; having studied the matter from every angle over a period of fourteen years, I believe that the main difference is fundamentally linguistic. The good broadcaster writes — if he writes at all — a language that will stand reading aloud; and he carries his listeners with him, establishing his contexts — and there are all sorts of contexts, emotional as well as verbal — as he goes.

It is in this respect that I feel our linguistic education to be lacking; we have become a race of caterpillars devouring newsprint, wherever we see it, and we have left our language