

effectiveness of an appeal to facts against the verbalism which springs from uncritical acceptance of the abstract laws of thought."

Natural Sines to every Second of Arc, and Eight places of Decimals. Computed by E. Gifford. (Manchester: Abel Heywood and Son, 1914.) Pp. 543. Price 15s.

ANY practical means of assisting the computer is to be welcomed, and this volume of natural sines to every second of arc, and to eight places of decimals, will be sure to have a considerable practical value, even to those who use machines. The sines to $10''$ are those from the "Opus Palatinum of Rheticus" (published 1596); the sines to $1''$ were interpolated by the Thomas calculating machine being copied to ten places. The table is arranged like Chambers' log tables, the figures to the right of the seconds being prefixed to each of the sets in the same horizontal line, except when the sets are dotted, when the first four digits are taken from the line below. Considering the laborious nature of, and the accuracy required in the construction of these tables, the compiler is to be heartily congratulated on the successful completion of the task.

THE TYPE-READING OPTOPHONE.

ANY instrument designed for translating optical into acoustic effects, or light into sound, and thus to some extent substituting the ear for the eye, may be appropriately termed an "optophone." The intermediate link is either heat or electric current, and in view of the fact that a current of a few thousandths of a microampere is audible in the best modern telephones (if intermittent), one would naturally use an electrical rather than a thermal link. This is done in the various forms of "optophone" devised by the author since the Optical Convention of 1912.

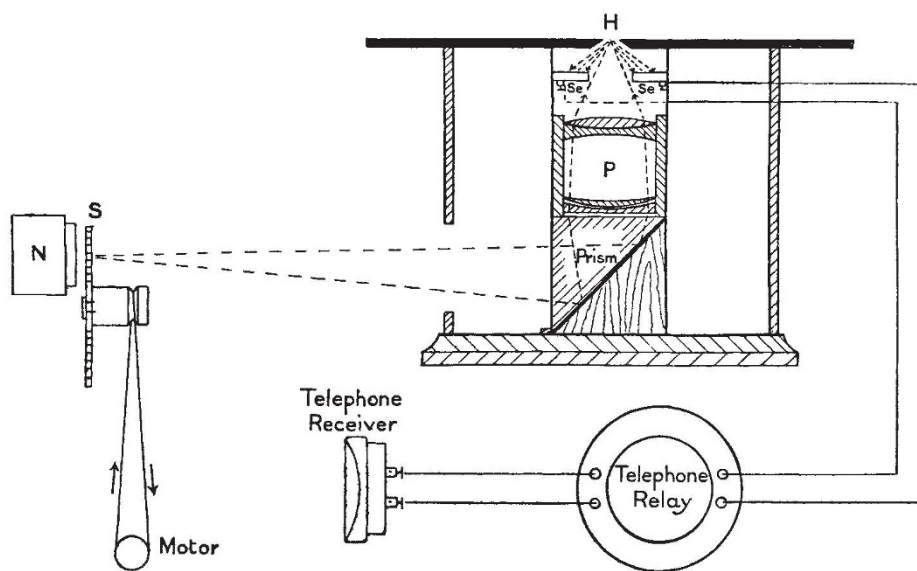
The latest of these, described before the Royal Society on May 28, and shown at the conversation of the society on June 16, is designed with the object of enabling blind persons to "read" ordinary letterpress by means of the ear. The accompanying illustration of the optical arrangement is reproduced from the Royal Society paper by permission of the council.

An optical system throws the image of a glowing Nernst filament upon the printed paper, laid face downwards on a suitably perforated desk.

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This image is broken up into a series of seven or eight luminous dots, flashing with different musical frequencies, by means of a rotating siren disc placed immediately in front of the Nernst filament. Some light-sensitive preparation, preferably of selenium, is placed close to the type so as to receive whatever light is diffusely reflected by it. The size of the image is made to fit the size of type to be read, and a sensitive telephone is put in series with the selenium and a battery, or with one of S. G. Brown's telephone relays.

It has been found possible to obtain a "readable" sound from type of the ordinary newspaper size. The straight black stem of a letter produces silence, and a curved letter, such as S, produces in its passage a set of gradually changing notes which are characteristic of the letter, and cannot be mistaken even after only a few minutes' practice. To learn the entire alphabet in this way should be a matter of a few weeks or months,



Type-reading optophone. N, Nernst lamp; S, rotating siren disc; P, printed matter, throwing image of line of intermittent dots on the printed matter placed face downwards at H; Se, selenium preparation receiving diffusely reflected light.

but the amount of practice required will vary very greatly from one person to another, as only a "musical" ear can readily detect the omission of certain notes from a given chord. Given an adequate alignment and line-changing mechanism, there is no reason why, with sufficient practice, ear-reading should not be almost as rapid as the ordinary reading at sight.

The choice of type is, of course, unlimited. There is no arbitrary element in the determination of the sounds required to represent the various letters, as each type will automatically produce its own characteristic sounds. With considerable practice, a blind person, thus trained to allocate certain notes to certain positions, should be able to construct "instinctively" a visual (or tactile) image of any new or unfamiliar letterpress type at the first hearing.

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