LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

New Types of Optical Glass

In view of the interest shown in new optical glasses recently produced in Great Britain and in the United States, we wish to summarize the present position and to indicate probable lines of development.

Advances in lens design have led to a demand for new glasses with optical properties different from those available hitherto as outlined in a recent paper by B. K. Johnson¹, who mentions glasses with high refractive index and low dispersion. Non-silicate glasses of this type containing rare earth oxides in high proportions and with optical properties ranging from 1.71 to 1.97 in refractive index and from 54 to 19 in V value have been described in the patent literature², but so far as we are aware, only one of them has been made available in Great Britain, namely, one with refractive index $n_D = 1.745$ and with $V = 45.8$.

Examination of the well-known n_D - V diagram for optical glasses shows that there is a large field for exploration, and it is desirable that the glass-maker should have some guidance as to the requirements for lenses of various types. On the other hand, without definite information that new glasses are available, the computer does not wish to spend time on designs which utilize optical properties for which there may be no corresponding glasses. It is our hope that this short account of new glasses developed by this Company will be of interest to designers and serve to stimulate experiments in lens design.

The new glasses contain appreciable quantities of silica and boric acid as the network formers, and their exceptional properties depend on the addition of the oxides of barium, lead, zinc and certain other metals. Their optical properties are plotted in the accompanying graph, and they lie between the limits of V value of 60 and 40 and have refractive indexes greater than $(1.860 - 0.004 V)$. The American and some new German glasses³ are included for comparison. The partial dispersions of the new glasses have not yet been determined for all the types, but it is interesting to note that the glass *SBF* 717480 has relative partial dispersions almost identical with those of the standard Telescope Flint 525512⁴. In the diagram, two bold circles indicate the main types on which production is concentrated. Other types not shown may be obtained by interpolation, but it is obviously advantageous to limit the number as there may be developments in another region in the n_D - V diagram. The glasses are divided into two general types, those with V values greater than 55 being called Special Barium Crowns (*SBC*) and those with V values less than 55, Special Barium Flints (*SBF*).

The vitreous stability of the glasses, that is, their resistance to devitrification during melting, moulding and annealing, is as good as, or better than, that of the normal types of optical glass, and the compositions and melting technique are such that a high degree of homogeneity can be obtained.

Having regard to their extreme optical properties, the glasses can be considered as substantially free from colour, particularly those with high V value. The transmissions in the near ultra-violet (3650 Å.) are generally higher than those for ordinary flints of the same index. Preliminary results indicate that

The curve encloses the area covered by Chance standard glasses. $\circ$, Chance silicate glasses. $\times$, Kodak glasses, U.S.P. 2150694 and 2206081; and B.P. 462304 and 534680. $+$, Schott glasses, U.S.P. 2297453.

their resistance to weathering is not less than that of normal flint glasses.

The method of melting is by electric heating in platinum pots; Faraday seems to have been the first to use platinum crucibles in his classical experiments to produce homogeneous optical glass⁵, followed later by Vernon Harcourt, but electricity was not then available to provide accurate control and application of temperature.

Owing to the chemical nature and high cost of the raw materials used, it is not possible to make the glasses on the scale of normal optical glass manufacture, and the process has been limited to small-scale meltings. The manufacture of optical glass on this scale to give freedom from striae and bubbles has required the development of a new technique such as was not previously possible. The degree of control which can be exercised results in more closely repeatable properties than is possible with large-scale manufacture. While glass of useful size can be obtained on the present scale, the plant is undergoing development to enable larger meltings to be made.

The methods for the development of new glasses are now well established as a result of this work, and we would welcome the views of computers on requirements in optical design.

We have been encouraged to pursue this work by the active interest shown by the Admiralty and the other Service Departments, working through an Interdepartmental Committee under the chairmanship of the Director of Scientific Research, Admiralty.

W. M. HAMPTON.
R. E. BASTICK.
W. N. WHEAT.

Chance Brothers, Limited,
Glass Works, Smethwick. Jan. 31.

¹ Johnson, B. K., *Proc. Phys. Soc.*, **55**, 291 (1943).

² Brit. Pats. 462304 and 534680. U.S.P. 2150694 and 2206081. *J. Sci. Instr.*, **19**, 94 (1942).

³ U.S.Pat. 2297453.

⁴ See Chance-Parsons Optical Glass Catalogue.

⁵ Bakerian Lecture, *Phil. Trans. Roy. Soc.*, **120**, 1 (1830).