annealing and liability to break with changes of temperature. Table glass is well annealed, so that the defect in question is not insuperable, and a want of care in the manufacture is suggested. The increased loss by breakage has become a serious consideration in the running of practical classes since British glass has been in use. As pointed out in previous correspondence, the danger of restricting import lies in the lack of inducement to further improvement.

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THE points raised by Mr. Jenkinson in his letter on the subject of laboratory and scientific glassware published in *NATURE* of October 28 should direct the attention of users of such glassware to the quality of the British-made product as compared with other well-known Continental brands.

No single type of glass can be superior to all others for all purposes. One glass may be superior as regards attack by water and acids, but inferior in respect to attack by alkaline solutions. As it would obviously be highly inconvenient in practice for chemists to use different types of glass for different reactions, a general average must be taken, and a study of the papers in the *Journal of the Society of Glass Technology* referred to by Mr. Jenkinson will convince any unbiassed person that the quality of British laboratory glass has been proved fully equal, if not superior, to that of any other laboratory glass from whatever source it may have been obtained.

In the earlier days of the war complaints were frequently heard as to the finish of British-made articles. Either they were too thin, too thick, uneven, or the colour and shape were unsatisfactory, etc. Whilst these complaints were frequently justified, they were chiefly due to lack of experience. The blowing of laboratory glassware of the desired thickness and even throughout requires considerable experience on the part of the glass-blower, and blowers trained in this branch of the industry were not available. The glass used in the manufacture of laboratory ware is much harder (less fusible and with a shorter viscosity range) than that to which the blowers were accustomed, and this militated against the rapid acquirement of the technical skill necessary to produce the best class of ware.

The hardness of the glass and the undesirability of using fining agents such as arsenic and antimony rendered it very difficult to obtain the molten glass homogeneous and free from small gas-bubbles, and necessitated increased furnace temperatures during melting, thus calling for alterations in the design of furnaces in use or the erection of new furnaces of special type.

The colour of British laboratory glass is admittedly inferior to that of the best foreign glass. This is due to the purity of the materials used, particularly the sand. British sands can be obtained with nearly the same degree of freedom from iron as the best Continental sands, but not in considerable quantity or of constant quality. For special purposes, where freedom from colour is essential—e.g. Nessler cylinders—specially selected qualities of British sands may be used, or even imported sands, but from the general point of view of the chemical and scientific glassware industry it is absolutely essential that we should be able to produce highly efficient laboratory ware without recourse to the importation of any material from outside the Empire, and so far as possible with only British materials.

Further experiment and experience both with materials and melting operations will undoubtedly lead to improvement in the appearance of the product,

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and we claim that as British manufacturers, with the aid of British men of science, we have mastered the difficulties attendant on the production of the necessary quality of glass so successfully. They will, given fair opportunity, master the less essential, but nevertheless desirable, property of pleasing appearance.

Scientific apparatus, particularly lamp-blown apparatus, has received a considerable amount of attention from manufacturers and men of science interested in the technology of the glass industry.

It is a fact, unfortunately, that in pre-war days the best work of this class was done by German and Austrian lamp-workers. This work is now carried on largely in this country (to a considerable extent by disabled soldiers and sailors), and great progress has been, and continues to be, made. Research work on the most suitable types of glass tubing for lamp-working purposes has been carried out with very successful results (*Journal of the Society of Glass Technology*, 1917, vol. i., p. 61; 1918, vol. ii., pp. 90, 154).

Manufacturers have followed up suggestions for possible improvement, sometimes with success and sometimes otherwise, but generally associated with considerable trouble and expense, and we may fairly claim that great improvement has been achieved in this direction, and that few grounds for legitimate complaint remain on the score of the annealing of British-made laboratory ware.

A further and most important section calls for mention, namely, the production of graduated apparatus. To some extent this is a factory operation, but the production of accurate and trustworthy graduated apparatus calls in addition for the most highly skilled, careful, and experienced work and supervision. The work entailed is much greater than appears on the surface. Experimental work has been carried out at the National Physical Laboratory and at Sheffield University, and the testing department of the National Physical Laboratory has drawn up stringent regulations for the certifying of first-class graduated apparatus, so that such apparatus with the National Physical Laboratory certificate of accuracy can be relied upon to be quite as trustworthy as the well-known German apparatus with the Reichsanstalt certificate.

Complaints and unfavourable comparisons have frequently been made in connection with British laboratory ware, and very few expressions of appreciation or gratitude to those manufacturers who stepped into the breach to supply an absolutely indispensable article, knowing that their productions were far from perfect, but striving, with the help of the best scientific aid in the country, to improve the quality of their ware. Very great progress has been made, but under the abnormal conditions ruling at present in this country it is essential that stability should be assured for some time to come until the industry has had time to settle down from what is practically an experimental stage to normal working conditions.

Is it conceivable that the research work done by Sir Herbert Jackson, Prof. Turner, the National Physical Laboratory, and others, and the patient and frequently thankless efforts of manufacturers to render this country independent in such an essentially key industry, should be wasted; and that the valuable experience already gained should be lost on account of the flooding of the English market with Continental productions—made so easy by the present rate of exchange between England and Germany—and the consequent transference of our energies to less essential, but certainly more lucrative, directions?

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November 2.