pressure had that effect, it would presumably increase conductivity. Deposition of carbon in pores of brickwork would also in all probability increase conductivity unless a disintegrating effect accompanied it. Iron oxide if present in quantity would increase fusibility, shrinkage, and density on burning, and by lessening pore space would also be expected to increase conductivity.

Meeting held at The Queen's Hotel, Leeds, on Monday, April 19th, 1915.

MR. F. W. RICHARDSON IN THE CHAIR.

THE COMPOSITION OF SOME TYPES OF CHEMICAL GLASSWARE.

BY F. W. BRANSON, F.I.C.

The problems arising out of the present war as regards the supply of chemical glassware very soon became acute, owing to the fact that practically the whole of the glass apparatus used in this country was obtained from Continental sources, chiefly Germany and Austria. I therefore took early steps to ascertain by means of chemical analyses the composition of typical chemical glassware in general use (more particularly beakers and flasks) and miner's lamp glasses. The composition of these having been ascertained, it was possible to give manufacturers working formulae in October last. In order to secure economy and facility of output, one glass—a zinc borosilicate—was selected for the manufacture of beakers and flasks which were by that time urgently needed, by Ordnance Works more especially. This glass has been adopted by the British Laboratory Ware Association, Ltd., as exhaustive tests have proved it to be similar to what was the best obtainable previously, namely, Jena "zinc borosilicate" glass. Reports on "B.L.W." glass from various expert and other sources (particularly from Ordnance Works) prove it to be, if carefully annealed, a reliable and economical substitute for the various types of chemical glassware previously in use. A 750 c.c. flask made from an early batch was reported on as follows on December 14th, 1914:—"About 250 c.c. of water was put in the flask and well boiled, then quickly cooled by holding under the tap. The water was boiled again and quickly poured out and cold water run into the flask whilst as hot as possible. About 10 grms. of drillings was dissolved in hydrochloric acid, evaporated to dryness, baked hard, cooled, and dissolved in hydrochloric acid. This was repeated three times. In the last case baking was continued for 1½ hours on the hottest plate. 300 c.c. of 20% caustic soda solution was put in the flask and kept at a steady boil for 2 hours. The soda was quickly poured out and the flask plunged under cold water. There was no indication of 'frosting' on drying the flask."

The constituents of a large number of glasses will be found in:—Thorpe's Dictionary of Applied Chemistry, Vol. 2, page 719, also in "Formulas for Glass Manufacture" by the Institute of Chemistry, and in "Notes on Glass"† by the National Physical Laboratory.

The work I have carried out is partly covered by the "Notes on Glass" and "Formulas for Glass Manufacture" alluded to above, therefore I have not given any analytical data of glasses for which analyses have been recently published

except in the case of Kavalier's potash-soda glass, which show the close similarity between the two analyses, the figures in the second column being those given in "Notes on Glass."

	%	%
SiO ₂	75.96	76.02
Al ₂ O ₃	0.40	0.61
Fe ₂ O ₃	0.08	trace
CaO	8.48	7.38
MgO	0.14	0.30
K ₂ O	7.48	7.70
Na ₂ O	7.31	7.60
	99.88	99.64

This glassware was found to be next in order of merit to the Jena zinc boro-silicate glass, but owing to the war the supplies of potassium salts practically failed, therefore this type of glass was not recommended for manufacture. Experiments were also made (and are being continued) with a hard soda glass which works well in the blowpipe flame, the analysis being as follows:—SiO₂, 76.18%; Al₂O₃, 2.86; Fe₂O₃, 0.07; CaO, 4.52; MgO, 0.14; Na₂O, 16.43%.

No analyses were made of soft soda glasses, as these were already obtainable of British manufacture for the production of test tubes, etc.

Analyses were also made of two distinct types of glass combustion tubing. A Jena sample contained SiO₂, 66.90%; Al₂O₃, 6.38; Fe₂O₃, 0.22; BaO, 7.27; CaO, 7.91; MgO, 0.61; K₂O, 2.40; Na₂O, 1.25; B₂O₃, 7.22%.

The other type of combustion tubing (Kavalier) gave the following figures:—SiO₂, 79.57%; Al₂O₃, 0.32; Fe₂O₃, 0.038; CaO, 7.80; MgO, 0.11; K₂O, 11.60; Na₂O, 0.66%. The infusibility of this glass is due to the high percentage of silica present.

A further problem investigated was the miner's lamp glass, the Continental supply having practically ceased. So far as my knowledge goes the Jena miner's lamp glass was the best then in use, and the analysis of one specimen gave the following:—SiO₂, 73.08%; Al₂O₃, 1.98; Fe₂O₃, 0.15; CaO and MgO, traces; Na₂O, 7.76; B₂O₃, 17.22%.

With instructions as to procedure these figures were given to a manufacturer, but the glass was found difficult to work, being rather pasty, even at a high temperature. The working formula was then altered with much better results, and the lamp glasses will bear the Board of Trade test of immersing in cold water and raising to boiling point, continuing at that temperature for 20 minutes, then suddenly plunging the glass into cold water (temperature 15° C.); no fracture resulted. It is a very tough glass and is broken with difficulty, say by a miner's pick.

The sand used in my experiments was of French origin and almost entirely free from iron. The calcium carbonate and aluminium hydroxide were of British origin and were commercially pure.

The high temperature coke furnace I used for the experiments was a very convenient one for the purpose, as the temperature could be readily regulated up to white heat and each experiment could be carried out in duplicate under the same conditions, similar to those obtaining in glass works. Each melt could be started cold and continued at the desired temperature for many hours.

In conclusion I beg to express my indebtedness for analytical and other assistance to Mr. F. H. Branson and Mr. W. McD. Mackey.

DISCUSSION.

MR. FRANK WOOD said that the great trouble in England was the shortage of labour: a long

* This Journal, April 30, 1915, pp. 424-5.

† This Journal, March 15, 1915, pp. 210-1.

training was necessary to produce an expert glassblower. He had been informed that if a glass contained arsenic, it became clouded with the repeated heating and cooling in working up in the blowpipe. He supposed arsenic was used because it cleared the molten glass of air bubbles and impurities, but this result could be obtained just as well by the use of ample time and heat. If sodium carbonate were used, the resulting glass was not so good as if the nitrate were used.

Mr. C. P. FINN asked whether there was any special process of annealing safety lamp glasses. He had seen glasses which fractured into pieces, only being held in place by the metal frame of the lamp. The nature of the fracture was similar to that of toughened glass or of a Rupert's drop.

The CHAIRMAN said that he supposed the glasses used in the electric lamps would have to be toughened.

Mr. WOOD said that in the modern lamps the globe carrying the filament was surrounded by a separate globe of very thick glass. If that outer globe were broken, it automatically extinguished the light.

Mr. T. FAIRLEY said that he had found that the moment the surface of toughened glass was fractured, the glass flew to pieces. The same thing happened if the outer surface were dissolved away in hydrofluoric acid. It appeared therefore that only the outer surface was toughened.

Mr. FRANK WOOD said that in the case of a doubtful looking apparatus it was very useful to re-anneal it by placing in a cold oil bath, and gradually heating to as high a temperature as was safe, afterwards allowing it to cool slowly.

Mr. F. W. BRANSON agreed with Mr. Wood that the presence of arsenic was objectionable and unnecessary. He considered that the use of a certain proportion of sodium nitrate in the manufacture of glass was an advantage. Pure alumina was very low in price and worked well. Several firms in this country manufactured miner's lamp glasses, and since the war certain tests had been somewhat relaxed by the Board of Trade. Some of the glasses were toughened by dipping in oil.

An extensive collection of British-made chemical glass and porcelain ware, nickel crucibles, filter-papers, etc., was exhibited by the British Laboratory Ware Association, Ltd.

THE ANALYSIS OF TANNING MATERIALS.

BY ALEXANDER T. HOUGH.

It is a recognised fact that the official method of analysis of the International Association of Leather Trades Chemists, even in its present improved form, leaves much to be desired from the point of view of accuracy.

Mr. Bennett's recent suggestions (this J., 1914, 33, 1182, *seq.*), if finally adopted, will greatly enhance the value of the method, and it is to be regretted that the research work was not pushed to this point before the last change of method was made in 1907, as it was even then realised in which direction the present official method could be improved and made to give higher non-tannins.

The change which was then made reacted upon the trade inconveniently for some considerable time, owing to the apparent loss of tannin indicated by the new method; and at that time, if this loss had been still greater to the extent of the sugges-

tions now made by Mr. Bennett, the resistance of the trade would probably not have been stronger.

The friction caused by the previous change of method passed, in England, in about a year. But on the Continent of Europe it was so great that the trade actually proved stronger than the chemists, and to this day, although the "shake" method is the official method of the I.A.L.T.C., it is only used on the Continent rarely, and by special request of the client; ordinarily the old filter-bell method obtains, using dry chromed hide-powder.

It will certainly be difficult to impose a second and still more sweeping change than the last on the English trade, and it seems rather futile to force more changes upon our own people when the continental and American trades will not fall into line as they ought to do, for the improvements suggested are equally applicable to all present methods of tannin analysis, and if adopted in England only will put English traders to a serious disadvantage.

In Mr. Bennett's first paper there is, however, one statement which appears to be misleading: he says that by increasing the dilution of the extract solution the non-tannins are increased, and he quotes figures showing that by adding 100 c.c. of water to each 100 c.c. of tannin solution shaken with 20.5 grms. of wet chromed hide-powder, an increase of non-tannins is obtained.

Now although the experimental work is correct and higher non-tannins are actually obtained under these conditions, the higher non-tannins are not due to dilution of the solution, but to the fact that 20.5 grms. of hide-powder is now being used to detannise 200 c.c., whereas before, the same quantity was used to detannise 100 c.c. The concentration of the hide-powder has been decreased, and it cannot therefore do as much work in a specified time. If the quantity of tannin per litre of solution is decreased by 50%, and 100 c.c. be shaken with 20.5 grms. of wet chromed hide-powder, the non-tannin will actually be lower than with a stronger solution, for obviously, there being less tannin in the solution, it is more quickly absorbed, and the hide-powder subsequently commences to absorb the non-tannins. That this is a fact may be proved by experiment. The difference is not great, but that only proves the efficacy of chroming the hide-powder, one object of which is to reduce the absorption of non-tanning matters. Thus, by dilution of the tannin solution, lower non-tannins are obtained unless larger quantities of solution be used, or smaller quantities of hide-powder, and the same result may be obtained by increasing the strength of the solution of tannin. Actually it would seem best to use tannin solutions of the present official strength and reduce the quantity of hide-powder employed to such a point that detannisation is just effected.

Then again Mr. Bennett suggests that the reduction of the quantity of hide-powder employed may "involve some extension in the time of shaking." This seems as undesirable as it is unnecessary, for if changes are to be made, they should be as few as are necessary to obtain the desired degree of accuracy. Now the concentration of the tannin solution being constant, smaller quantities of hide-powder take longer to detannise, and *vice versa*, since the present method uses a large excess of hide-powder, there is no need to alter both factors—hide-powder and time. The quantity of hide-powder should, as suggested, be reduced to such a point that it will do its work in the official $\frac{1}{2}$ hour. If the detannisation is not complete too little powder has been employed.

It thus appears that, so far as infusions of fresh tanning materials and solutions of tanning extracts are concerned, it is only desirable to change three factors, viz.:—(1) The acidity of the hide-powder before chroming, which should be reduced to *nil*