

*DISCUSSION.*

**Mr. Chas. R. Darling** (*communicated*) : I am quite in agreement with the authors regarding the results obtained for absolute conductivity between  $20^{\circ}$  C. and  $100^{\circ}$  C. as insufficient to guide the selection of a furnace insulator ;

not only for the reasons stated by them, but because of the alteration in conductivity displayed by materials at different temperatures. Careful experiments might show that one material which is inferior to another at low temperatures, may be a superior insulator at high temperatures.

The apparatus devised by the authors is not completely adapted to measuring the relative insulating powers under the conditions actually existing in a furnace. The presence of the water-jacket causes the external temperature to be practically the same in each case, which would not obtain if the water-jacket were absent, as in an actual furnace. When exposed to air, under working conditions, the external temperatures would probably differ with each material. The most reliable test would be one carried out under the conditions obtaining in practice.

In some heat insulation tests recently carried out at the City and Guilds' Technical College, Finsbury, by Dr. S. P. Thompson and Prof. Dalby, the method differed from that described in the Paper in that a steady *internal* temperature was maintained, the heat being allowed to escape from the outside of the material into the air. The current was regulated until a steady internal temperature was produced, from which, by reading the instruments, the amount of heat escaping in a given time could be found. Using the same thicknesses of different materials, the relative insulating values at the same temperature are proportional to the watts expended in keeping the temperature constant. These experiments were conducted only at steam temperatures (say up to  $200^{\circ}\text{C.}$ ), and no results to compare with those obtained by the authors are therefore available. The method, however, would appear to be applicable at high temperatures, and would be more in accordance with furnace conditions than that described in the Paper.

A precaution which should always be adopted in testing heat insulators is that they should be thoroughly dried before taking observations. I have found, particularly in the case of powdered magnesia, that the insulating power is much lower when the normally-retained moisture is present than when it has been expelled. This may account, to some extent, for the anomalous results obtained by the authors when not using a water-jacket, as the conditions would then be favourable for the expulsion of the moisture.

The suggestion made with respect to the use of a refractory lining, backed by a good insulator, is a valuable one, and should result in economy if adopted. In addition to the substances mentioned as suitable for casing-in a refractory lining, Canadian mica might be added. This substance is now being extensively used as an insulator for heat, and is at least equally as good an insulator as the other substances used in the experiments. It will also withstand a temperature of  $1,200^{\circ}\text{C.}$ , and is therefore well adapted for the purpose suggested.

The authors are to be complimented on having called attention to a matter of considerable commercial importance.

**Dr. Hutton**, in reply, said he had tried the method suggested by Mr. Darling but had not found it suitable for these higher temperatures. This was probably due to the great length of time necessary to attain equilibrium, unless an external surface at some steady temperature was employed. He thought that such curves as those given enabled the characteristic behaviour of any material to be much more clearly seen than was possible if only the power corresponding to one definite internal temperature was measured.

He was well acquainted with the disturbing influence of moisture which had been taken account of in the experiments described. In conclusion, he desired to thank Mr. Darling for his contribution to the discussion and for the several interesting points which he had emphasised.