ART. LV.—*On the Relative Commercial Values of Pumice and Charcoal for Purposes of Insulation.*

By W. T. FIRTH.

[*Read before the Auckland Institute, 6th September, 1897.*]

A VERY interesting series of experiments, to ascertain the relative values of pumice and charcoal, was performed by Professor Brown, and the results detailed in diagram form, and explained in a lecture delivered by the professor at the Auckland Institute on the evening of Monday, the 12th July.* From his observations it will be seen that in the three first results charcoal shows itself to be a much more active conductor of heat than pumice, the figures in favour of pumice as an insulator being 15·0, 14·4, 13·1.

The professor stated he obtained these samples from the New Zealand Shipping Company, and it is to be presumed that they were in the condition in which they are used for insulation purposes.

As stated in Professor Brown's lecture, the coarser samples of both pumice and charcoal were then dried for a whole day in the laboratory, and, on being put through a similar test for transmission of heat, showed a conductivity of—charcoal, 31·3; pumice, 38·2.

Deducting these figures respectively from those obtained from similar samples in commercial condition, viz.:—

Charcoal	...	52·1	Pumice	...	39·0
"	...	31·3	"	...	38·2
		20·8			0·8

there results a difference in insulating power in the case of charcoal of 20·8 between the commercial article and the laboratory-dried sample; while in the case of pumice the increase in the insulating power amounts to only 0·8 when treated in a similar way.

To avoid wearying you by bringing any further calculations before you I may state that this amounts to a change in conductivity of charcoal as 100 is to 60·08, and pumice as 100 is to 97·95.

Now, charcoal, when freshly burnt, contains no moisture, but when exposed to the atmosphere rapidly absorbs from 9 to 18 per cent. of its weight in water, of which the commercial article usually contains about 12 per cent. This accounts for

* See Art. VI., above.

the condition in which the commercial charcoal is nearly always found, as no matter how many times it may be dried it always rapidly reabsorbs moisture to the percentage indicated above.

The pumice, on the other hand, is subjected to a red heat for a period of ten minutes, which expels all but an exceedingly small fraction of the water originally in the pumice. And it is shown by Professor Brown's experiments that it does not reabsorb water from the atmosphere, as the sample of pumice experimented upon had been stored for a period of over twelve months.

As we have already seen, charcoal contains no moisture when freshly burnt, but has such a tendency to absorb water that commercial charcoal always contains about 12 per cent. of it. It also absorbs various gases, condensing them within its pores. Of oxygen it is capable of absorbing nine and a quarter volumes. This may so increase the tension between the absorbed oxygen and the carbon of the charcoal that spontaneous ignition may occur if there is not a sufficient amount of absorbed water present. This indicates that it is highly dangerous to put freshly-burnt charcoal into the walls of refrigerating-chambers before it has had an opportunity of absorbing moisture from the atmosphere.

On the other hand, when water is absorbed the charcoal is rendered a conductor in the ratio of 31·3 (freshly-burnt charcoal) to 52·1 (commercial charcoal), or, to reduce to unity, from 1·0 to 1·66.

As is well known, charcoal is an absorber of noxious gases arising from animal and vegetable matter. An accumulation of organic matter is thereby formed in the charcoal, which thus gradually becomes a breeding-ground for microbes. Dealing with the moisture contained in commercial charcoal, as every refrigerating engineer knows, the lining-boards in freezing-chambers insulated with charcoal become damp in a short time, which sooner or later will rot the boards, keeping the air of the insulating-chamber contaminated. This water that saturates the lining-boards is drawn from the moisture contained in the charcoal.

The charcoal on losing its moisture absorbs oxygen, thus creating a tendency to spontaneous combustion. Thus we see that charcoal becomes charged with either water, oxygen, or organic matter, or a combination of all three, and if it contains less of one substance there will be a corresponding increase of the others. The objections to charcoal may be summed up thus: If water is absorbed it becomes an inefficient insulator; if condensation of oxygen occurs it is liable to spontaneous combustion; if organic matter is accumulated it becomes a reservoir of contagion.

Calcined pumice, which is absolutely sterilised in the process of treatment, is free from any and all of these objections, and, as a commercial article, has entirely driven charcoal out of New Zealand and Australia, and is now being largely used in South Africa. This preference for calcined pumice by the proprietors of freezing-works is sufficient answer to the question as to which is the best insulator, and, if further proof is required, it is furnished by the fact that a well-known pioneer in the frozen-meat trade is at the present moment replacing charcoal in his freezing-works with calcined pumice.

ART. LVI.—*Notes on the Vertical Component of the Motions of the Earth's Atmosphere.*

By Major-General SCHAW, C.B. (late R.E.).

[*Read before the Wellington Philosophical Society, 13th October, 1897.*]

Plate XLV.

THE very exhaustive observations which have been made in a great number of places on the earth's surface on the varying conditions of the atmosphere have resulted in a very great advance in our knowledge of the laws which govern its motions; but hitherto meteorologists have mainly investigated the horizontal motions in their velocity and direction, and in their relation to the atmospheric pressures as evidenced by the barometer. The isobaric charts compiled from the recorded facts at the same hour at a number of stations scattered over a wide area are most valuable in forecasting the probable weather conditions for a day or two in advance, and in giving us some insight into the horizontal circulations of the atmosphere. Complicated as these motions are, they are probably more simple and regular in the Australasian district than in any district of similar area (about 70° of longitude by 40° of latitude) where regular observations are established in any other part of the world.

Situated on the borderland between the two great belts of anticyclonic and cyclonic circulations in the Southern Hemisphere, and without any land-surfaces to interfere with the full development of the latter until the south-eastern part of the Australian Continent and Tasmania are reached, and with a fresh set of observations on the line of advance of the cyclones and anticyclones along the extensive barrier of New Zealand, and finally at Chatham Island, the conditions are