emery wheels and sensitive drills used in the steel stamp-making, and to the right of this bench is a routing machine for the manufacture of brass name plates, all of them being driven by a powerful electric motor. On the left is the rubber stamp-making department, and further on is the polishing benches and water-tap overhanging—all surplus water being carried away by pipe connections. The stencil-plate and wood-block engraving is done at the rear of the shop, and is served by an exceedingly good light. Messrs Moller & Young have spared no expense to make their workshops as up-to-date as possible, and they are indebted to their architect, W V Wilson for the creditable manner in which he has carried out the required arrangements in the construction

HOW TO USE PORTLAND CEMENT.

FROM THE GERMAN OF L. GOLINELLI.

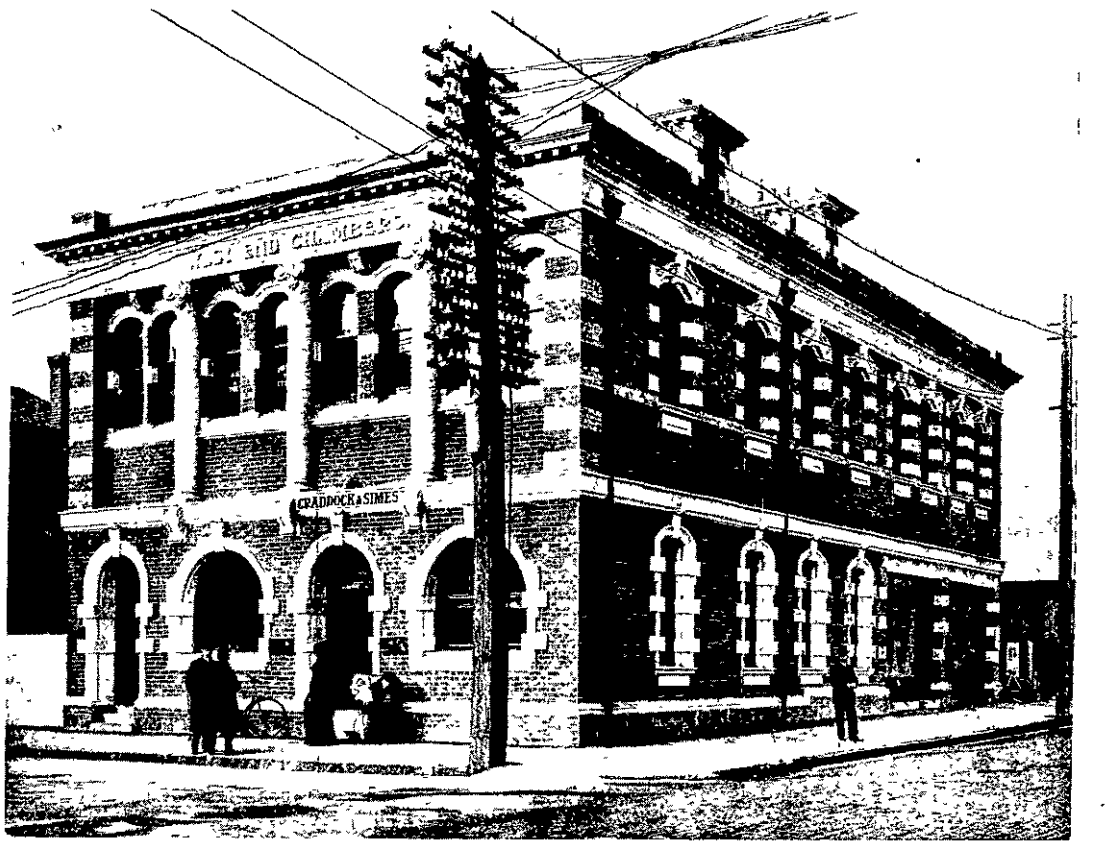
SECOND PAPER.

RESISTANCE TO WEATHER AND BEHAVIOUR UNDER EXTREME HEAT AND COLD

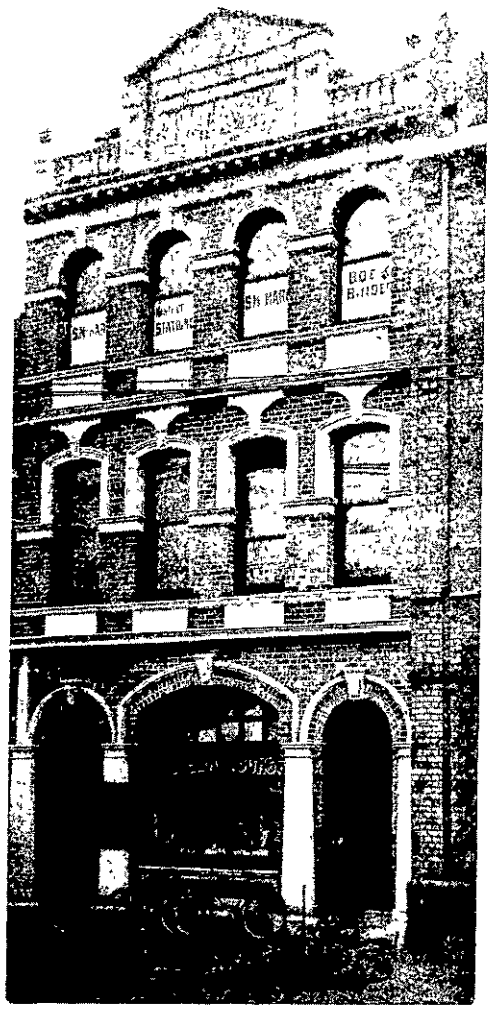
Mortar made from pure cement is, strictly speaking, not weatherproof, owing to its tendency to form shrinkage cracks and hair cracks. Repeated expansion and shrinkage increases the number and size of these cracks, until finally under the action of water and frost the cement breaks to pieces. Complete weather-resisting qualities can be given to cement mortar only by the addition of sand. One part sand to one part cement will be found sufficient.

The temperatures which are reached in warm, or even hot, climates have no bad influence on the hardening of Portland cement. The only precaution necessary is to see that the water necessary for hardening is not removed too soon ; or, in other words, that the work is kept sufficiently moist during the earlier stages of hardening. Even the temperature of boiling water is harmless to the strength of Portland cement, and a heat of 400 degrees to 500 degrees F may be borne without injury. At a red heat it becomes soft and friable. Nevertheless, it has been proved by long experience with Portland cement concrete that this material shows a high degree of strength and safety when exposed to fire.

Portland cement is less affected by frost than any other hydraulic material. If the cement is once fully set it may be exposed to strong freezing without any ill effect. It is only during the setting that injury can take place, and this chiefly to be feared in case the mortar was made too wet, so that the freezing of the water forces the mass asunder. If water is sparingly used, masonry and concrete work may be done in extremely cold weather with good results. It must be remembered, however, that the setting and hardening of cement are much delayed by cold. Cement work done in freezing weather shows, therefore, but little strength at first, but finally reaches its normal hardness. Addition of salt to mortar in cold weather is generally to be avoided on account of the unsightly efflorescences which often result. It is better, when work in extreme heat or cold cannot be avoided, to warm the water and sand used and to reduce the water to the smallest possible quantity in order to hasten the setting of the mortar. If care is taken to allow no free water to separate, or that any excess of water is absorbed by dry stone, there is nothing to be feared even from extreme cold. Surface plastering with cement should, however, not be attempted in freezing weather.



MESSRS. CRADDOCK AND SIMES' NEW BUILDING AT THE CORNER OF OXFORD TERRACE AND HEREFORD STREET, CHRISTCHURCH. [*Architects, Clarkson & Ballantyne ; Contractor, F. E. Shaw.*



MESSRS. MOLLER AND YOUNG'S NEW PREMISES IN WORCESTER STREET, CHRISTCHURCH. [*W. V. Wilson, Architect.*

On mixing cement with sea water the setting is delayed and decreased strength results. This is chiefly due to the action of the magnesium sulphate and chloride of the sea water on a portion of the cement ; the hardening value of this part is therefore lost and the strength attained is less than with the use of fresh water. One might suppose that this action of the sea-water salts would cause the strength of the cement to continue to fall off and that the work would finally fall to pieces. This is, however, not the case, owing to the fact that the penetration of the sea water into the mass is prevented by the great and constantly increasing density of the Portland cement mortar. A deposit of magnesia is also formed in the pores of the mass, and gives further protection against the entrance of the sea water. Portland cement is therefore unequalled for marine constructions. In all cases in which this work has been intelligently done, Portland cement concrete has fulfilled all requirements satisfactorily. In work exposed to sea water it is of the highest importance to give to concrete as dense and close-grained a surface as possible, since only such a surface is capable of permanently resisting the chemical action of the salt water and the mechanical force of the waves.

Portland cement is especially suitable for work of this kind, since uniform tests of tensile and compression strength are a guarantee of a uniform material which can safely be relied upon. This is by no means true in the case of puzzuolana cements, so-called slag cements and hydraulic limes, which are often of very variable quality.

Substances added to Portland cement may be divided into those which are intended to give it certain valuable qualities, and others which are added for the purpose of fraud. In the first group are found *gypsum* and colouring matters.

The addition of gypsum (sulphate of lime) which should not exceed 2 per cent. is made for the purpose of causing naturally quick-setting cements to set more slowly In this way the quality of the cement is improved and its strength increased Additions of a higher proportion of gypsum are not admissable, as it tends to cause swelling.

Colouring matters are sometimes added to cement in order to make it suitable for decorative purposes. Mineral colours are practically always used. To give the cement a somewhat darker tint, especially for use in making cement wares, a few per cent. of lamp black is added. Nearly all colouring matters reduce the strength of the cement ; ultramarine, however, in small quantities, increases it. The red iron oxide of commerce, often used to produce a red colour, frequently contains a considerable amount of sulphuric acid, and may cause swelling. Care should be taken in the choice of the colouring matters employed.

In regard to the production of white Portland cement it may be said that this has not hitherto proved successful, on account of impurities contained in the raw materials or derived from the fuel. The so-called white cements of commerce are for the most part inferior products which do not deserve the name of Portland cement. In consequence of its gray colour, Portland cement cannot be made white by the addition of pigments.

From fraudulent and avaricious motives, blast furnace slag, limestone, shale, basalt, ashes, sand, etc., are added to cement. These are simply adulterations, which always injure the quality of the product. These substances may be more or less easily detected, and their use, in consequence of the close watch kept by the association upon the product of its members, has of late practically ceased.

USE OF PORTLAND CEMENT.

PACKING AND WEIGHT.

Portland cement is packed in barrels and sacks. The barrel is of 400 lbs. weight and contains 380 lbs. (about 3½ cubic ft.) of cement. Sacks are generally one-fourth barrel, or 95 lbs. Since empty barrels and sacks are received by the manufacturer at a certain price, care should be taken to preserve them in an orderly manner. Empty sacks are most conveniently returned in bundles of ten each.

Barrels and sacks should be marked by the manufacturer with name, trade-mark and gross weight of package. Loss by sifting out and variations from standard weight to the amount of 2 per cent are allowable.

STORAGE (SEASONING) OF CEMENT.

Storage of cement improves its quality. If well protected and kept dry the cement gains in strength and becomes more slow-setting and more constant in volume. This so-called seasoning results from the action of the moisture and carbonic acid of the air. At the same time, owing to the disintegration of the coarser grains, the cement increases in fineness. If, however, cement is stored in a damp place it becomes caked, lumpy,