SEMPLE ON LIME, MORTAR, AND GROUT.

"I have from my childhood been well acquainted with the nature of lime and sand made in mortar of all sorts that have been used in buildings in these countries, and tried numerous experiments with them, on which, together with what I have observed and learned from old experienced workmen during the course of sixty years, I think I can safely affirm that good mortar made of pure and well-burnt limestone, and properly made up with sharp clean sand, free from any sort of earth, loam, or mud, will within some considerable time actually petrify, and as it were turn to the consistence of stone. I remember I had of my remarks from an old Scotch mason, which I shall give you in his own identical words, that is: "When a hundred years are past and game, Then gude mortar is grown to a stane (stone)."

"My father (who was a workman about the year 1675) often told me, and my own repeated observations convince me, that the method masons practised in former times, in building churches, abbeys, castles, and other sumptuous edifices in this country was to this effect: After they laid the outside courses with large stones laid on the flat in swimming beds of mortar, they hearted their walls with their spawls and smallest stones; and as they laid them in, they poured plenty of boiling grout, or hot lime liquid, among them, so as to incorporate them together as it were with melted lead, whereby the heat of it exhausted the moisture of the outside mortar, and united most firmly both it and the stones, and filled every pore, which (as the masons termed it) set—that is, grew hard immediately; and this method was taught to our ancient masons by the Romish clergy that came to plant christianity in these countries, and I affirm that in many of such old buildings I have seen the mortar as it were run together and harder to break than the stones were. "But with respect to the matter in hand, I admit that mortar will not set or grow so soon hard in water as upon land; but I am fully convinced that good mortar will in reasonable time grow as firm and as substantial in water as upon dry land. But not dwelling upon mere reports I shall come to facts, and I do also affirm that in pulling down Essex Bridge, and repairing Ormond Bridge, we found the mortar of the lower using of wet bricks is very trying to the hands of workmen, and necessitates the wearing of pieces of leather to protect the inside of their fingers and their palms from being excoriated. There can be no doubt about wet bricks making a better bond with the mortar where it is good, and even with inferior mortar the walls would be the stronger by wetting the bricks before using.] "There are several sorts of limestones: some, indeed, set much sooner and harder under water than others, but any good lime properly mixed, and tempered with sharp clean sand, will bind and cement as effectually under water as above it, as I hinted before. What I mean by good lime, is that which is made of clean close-grained limestone. All marble is limestone, but all limestone is not marble. All marble will take a polish, but all stones that will burn to lime, will not take a polish. For instance, chalk will make lime, but it will neither polish nor make good lime for any purpose; therefore I advise you to choose the closest-grained, the hardest, and consequently the heaviest limestone for any work, but particularly for water-work. I need not explain what by sharp clean sand, but I shall give this caution, that it is better to put too much sand in your mortar than too little. I know workmen choose to have their mortar rich, because it works the pleasanter; but rich mortar will not stand the weather so well, nor grow so hard as poor mortar will do; if it were all lime it would have no more strength in comparison

than clay." [We will continue some further extracts from Semple's work in our next, on the above materials. It will be interesting to see how far the practice of a century or a century and a-half ago, differs from the present in the selection of lime and sand, and its manipulation. We will also have occasion to quote the opinions and experiences of another old native architect in sand and mortar—an architect who seems to have had much practice in his day, but about whose time and works very little particulars are accessible. The architect alluded to is spoken of in Rutty's "Natural History of Dublin," thus: "Thomas Covey a most ingenious and experienced architect, having been employed in building many of the noted forts and barracks in this kingdom." Covey seems to have been a contemporary of Semple's; and it occurs to us, that his practice extended farther back in the eighteenth century than the latter. With all the modern chemical knowledge of building materials that exist, yet the greater portion of the building mortar used at present is complete rubbish, and disgraceful in the extreme to architect and builder. The mortar of the old builders tells its own tale to day, and proves that those who made it valued their name and reputation.]

THE OLD BUILDERS: THEIR METHODS AND MATERIALS. [Being Extracts, with Notes, from "Building in Water," by George Semple, Architect.] WE here continue Semple's observations on limestone, sand, mortar, and his account of the experiments he made in testing the nature, qualities, and strength of these materials for certain uses, but particularly with a view to buildings in water.

MORTAR, GROUT, AND CONCRETE; EXPERIMENTS. "As I have desired you to preserve and use even the powder or smallest fragments of the limestone, I shall here assign my reason for it, which is, that the powder of fresh quarried limestone (which you will find to have a sulphureous smell, partaking greatly of the smell of gunpowder) has this petrifying quality to a very high degree, and that calcination heightens that quality, is universally agreed to ; but yet it does operate in that manner used alone. For instance, if lime be left to lie by itself, either on land or in water for thousands of years, it would neither petrify nor come to any degree of hardness, nor would sand alone petrify, but when these two unite, they begin to operate powerfully upon one another. "In order to come at a thorough knowledge of this petrifying quality, I would recommend the following experiment :—**Take ten pounds of limestone, fresh quarried, pound it into very fine powder, and take the like quantity of sharp, clean, and fine sand; get thoroughly burnt roach lime hot from the kiln, the like quantity, put it into a vessel, and pour water upon it leisurely, and stir it gently till you find it is all dissolved, and as it were melted into a hot liquid; rub and thoroughly mix the flour of limestone with the sand, and <u>without letting the lime liquid have time either to cool or evaporate,</u> stir in and most effectually mix and work them all together very stiff, and beat them thoroughly on a clean boarded floor,** and then make this mortar into blocks, about the size of a brick; bury one of these blocks in very damp or wet ground, put another entirely in water, and keep a third in some dry place. Now I am confident that each of these three blocks will, in a reasonable time, actually petrify into stone, and become as much so as if they had been cut or wrought out of a rock, and that they will endure calcination, and become good lime afterwards, but not so rich as that from whence they were derived. And with respect to lime, that which is deposited in the bowels of its own natural mother, will grow the first into stone; that laid in the water will be the second; and that which is kept in a dry place will be the last, and of a short brittle

nature. But the first, if in a large block, will not only become hard but stout and stubborn, and would stand and give stout resistance to a hammer or punch. The second would be more free, and the third fly off short. I apprehend that this little experiment is worthy of attention, because by ascertaining the time of these deposits, and trying the blocks from time to time afterwards with a tool or the point of a pen-knife, some useful knowledge might be obtained; but be that as it may, these are some of my reasons for recommending limestone.

However, where that cannot be conveniently got, you must make use of such hard stones as you can get, but be sure to have them broke to the sizes above mentioned, for such will most assuredly cement and unite together with the lime and gravel, and each of the stones will contribute to sustain the confidence reposed in them. Whereas, if one large stone was put in among them, it would not unite, but stand stiff, and thereby be a great means of shifting the weight from itself, and throwing it on the small stones that surround it, and consequently would overturn instead of supporting the weight which it was destined to bear.

For these, therefore, and many other reasons, I must earnestly recommend it to your practice to use no other but small stones in your stuffing. “You are also to take particular care that your sandy gravel is sharp and clean, and of that degree of fineness as may contribate proportionably to the solidity of the whole, **and not to throw your stones in one place, and your lime and sand in another, but let them be all equally mixed throughout the work,** and all this can be easily done, for let the water be what depth it will, or your hurry ever so great, this you may do, and you are not to neglect it ; and, observe also, that this sort of work can be much more effectually done in water than upon dry land, even admitting that it was to be done with wet grout, because these three materials being thrown in proportionably together, each stone and every particle of the gravel and sand will take possession of a place suitable to it, but the sand in particular will continue in quick motion till it finds out a place of rest proportionable to its size, and instantly fill up the most minute vacancy (provided that you observe these directions properly) and immediately become as compact and as solid as a bank of a gravel-pit that has been formed by nature.”

Semple's observations may be deemed old fashioned, but the facts they embody are worthy of attention at this day when worse lime, sand, or mortar in globo is used systematically than has hitherto ever been used in the progress or history of the building art. The making of good mortar does not receive the attention from modern builders that it deserves, and there are but few architects who bother themselves whether their works are carried out by the use of the cement or mortar they specify. Indeed, it is not too much to say that numbers of architects as well as builders do not know the constituent elements of good mortar. The theory of the hardening of mortar is even at present very imperfectly understood—the generally received idea being that a combination of silicate of lime and a compound of the carbonate with the hydrate is formed which, together, set in the solid mass. **Mortar is commonly prepared by mixing one part of freshly slaked lime, and two or three parts of sand with sufficient water to form them into a paste.** These quantities—if the lime be good and the sand sharp and clear—would make mortar of a good quality, but in the speculative buildings of the present day, and even in others where there exists no necessity for “scamping,” the sand that is used is little better than loam or

“riddlings,” and the lime is poor and deficient in quantity. **Though these old builders had little or no knowledge of the chemistry of the components of good mortar, yet, by experience, they knew what good mortar was, and made it.** Their works still standing testify the fact, the mortar being harder than the stone. The cause of so many buildings falling at the present day before finished or immediately after being finished, may be attributed, in many cases, to the wretched mortar or cement used, which is a mere make-believe. Tall chimneys topple over, sacrificing many human lives, and putting their proprietors and builders to thousands of pounds expense: The cause may be summed up—bad work and bad materials.

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