

**RUDIMENTARY TREATISE  
ON LIMES, CEMENTS,  
MORTARS, CONCRETES,  
MASTICS, PLASTERING, ETC.**

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Rudimentary Treatise on Limes, Cements, Mortars, Concretes, Mastics, Plastering, Etc. by  
George R. Burnell

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**GEORGE R. BURNELL**

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## PREFACE.

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THE object the author of the following treatise has proposed to himself has been to put into as condensed a form as was consistent with the nature of the subject the knowledge and information dispersed through a numerous collection of authors who have treated thereupon. They are mostly in foreign languages; for it is much to be regretted that our own scientific authorities have not thought it worth their while to occupy themselves with this highly important branch of practical chemistry.

The author has endeavoured, as conscientiously as possible, to avoid any questionable theory, or to quote as practical results any cases of whose correctness reasonable doubts might be entertained. There are, it is true, some theories propounded, some practices recommended, which are in direct contradiction to those usually received in England. They have not, however, been so advanced, unless the long experience of the most distinguished foreign engineers has warranted him in believing that our own practice is based entirely upon prejudice. We are, whether for good or for evil, essentially a practical nation—we have a dislike to theory, almost to analysis—we examine reluctantly any habit we have long followed. As in politics, so

we are even in building. Our forefathers made mortar in one way, as perfect as their knowledge admitted, and doubtlessly that way was all that was practically necessary to secure the results then sought for—so we continue without examination in the track they beat for us. Our requirements are, however, very different. Railroads, and the constructions they necessitate, have modified very materially the science of construction. In England, especially of late years, works have been executed which so immeasurably surpass in boldness anything which had been previously attempted, that we may be justified in expressing our surprise that so few attempts have been made to ascertain the real nature of the materials dealt with. Is it not to this neglect that we may attribute the numerous failures we read of?

Some of these failures have been so remarkable, and some recent business transactions have displayed so singular an inattention to the nature and properties of lime, that the author deems it his right to provoke a discussion upon the subject, trusting that abler heads and hands will complete what he has so imperfectly begun. This branch of chemical knowledge has been so entirely "revolutionised" of late, so much uncertainty still remains to overshadow it, that it would be worse than folly to make any assertion which would lead to a belief that even the very fundamental principles were not, even now, susceptible of modification. That which is to be desired above all things is to rouse the professions of engineers and architects from the apathy with which they treat such subjects as the one before us—the very alpha and omega of their business. There is, however, something so invidious in attacking

openly a generally received opinion, as the author has done with respect to the mode of making mortar practised in this country, page 66 and subsequently, that he throws himself upon the consideration of his professional brethren, in the hope that they will excuse his boldness on the score of his sincere desire to advance the true interests of science.

At the same time the author would beg to protest very energetically against the "rule-of-thumb" methods which prevail in England in the manipulation of mortars. Architects and engineers, it is true, prescribe certain proportions of lime and sand to be employed; but in practice "the foreman of the pug-mill," as the labourers call the person entrusted with this work, is the only authority, and he mixes the ingredients precisely as it suits his fancy. In reality, mortar-making is a branch of practical chemistry—on a large scale, it is true—one which does not admit of the care and exactness of the laboratory. But the safety of a building often depends upon the perfection with which this operation is executed, and a certain amount of scientific acquirements is necessary to insure that perfection. For more than twenty-five years the author has been employed in building operations; but in the whole course of his experience he never saw in any construction, in England, a measure used to ascertain the proportions of the ingredients employed for making mortar.

We have seen of late years far too many accidents happen, too many absurdities committed, not to render it necessary to protest loudly against the carelessness with which the use of limes is regarded. One of the most important works executed of late years in London

was built upon concrete made of stone lime, to which iron filings were added at a most tremendous and useless expense. Another large work was described in the specification to be executed with hydraulic lime; and the engineer allowed common Medway stone lime to be used, although it is very far from being what is properly called an hydraulic lime. We have known viaducts with piers 100 feet high executed with chalk lime; they have fallen, and been rebuilt with the hydraulic lime which only ought to have been employed; and we hear of pozzolana being used still in sea works. Surely, therefore, any examination of the nature of the materials to be used, which will hereafter prevent a repetition of such mistakes, must be of service.

The different scientific associations connected with building would confer a great boon upon the public if they would undertake a series of investigations upon the still undecided questions connected with the chemistry of their respective professions, and also if they would make a statistical statement of our mineral wealth, as far at least as building materials are concerned. We require a series of observations upon the geological and geographical distribution of the rocks able to furnish hydraulic limes. A synopsis of the building stones is also a desideratum; for the Parliamentary report upon the subject was very far indeed from being a satisfactory solution of its difficulties. Such an inquiry should be undertaken under the auspices of the united bodies of the engineers and architects.




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ON LIMES, CALCAREOUS CEMENTS,  
MORTARS, STUCCOS, AND CONCRETES.

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CHAPTER I.

CURSORY VIEW OF THE PROGRESS OF DISCOVERY IN  
THE SCIENCE CONNECTED WITH LIMES, ETC.

THE use of some cementing material to bind together the small stones or other materials employed in the construction of walls, and also for the purpose of giving them a smooth surface adapted to receive polychromic or other decoration, dates from a very high antiquity. It is, however, probable that it was subsequently to the discovery of the art of brickmaking, that the ancients arrived at that of burning lime. Indeed, the use of moistened clay, which was found to have a certain ductility, and to harden also in drying, was likely to have preceded that of lime, as a cement; for the qualities and the mode of obtaining the latter were of a nature to require long study and great experience.

The Assyrians and Babylonians appear to have employed either moistened clay, or the bitumen so plentifully supplied by the springs in their country. Some doubt, however, exists as to whether these people did ever really use mortar. Captain Mignan sometimes