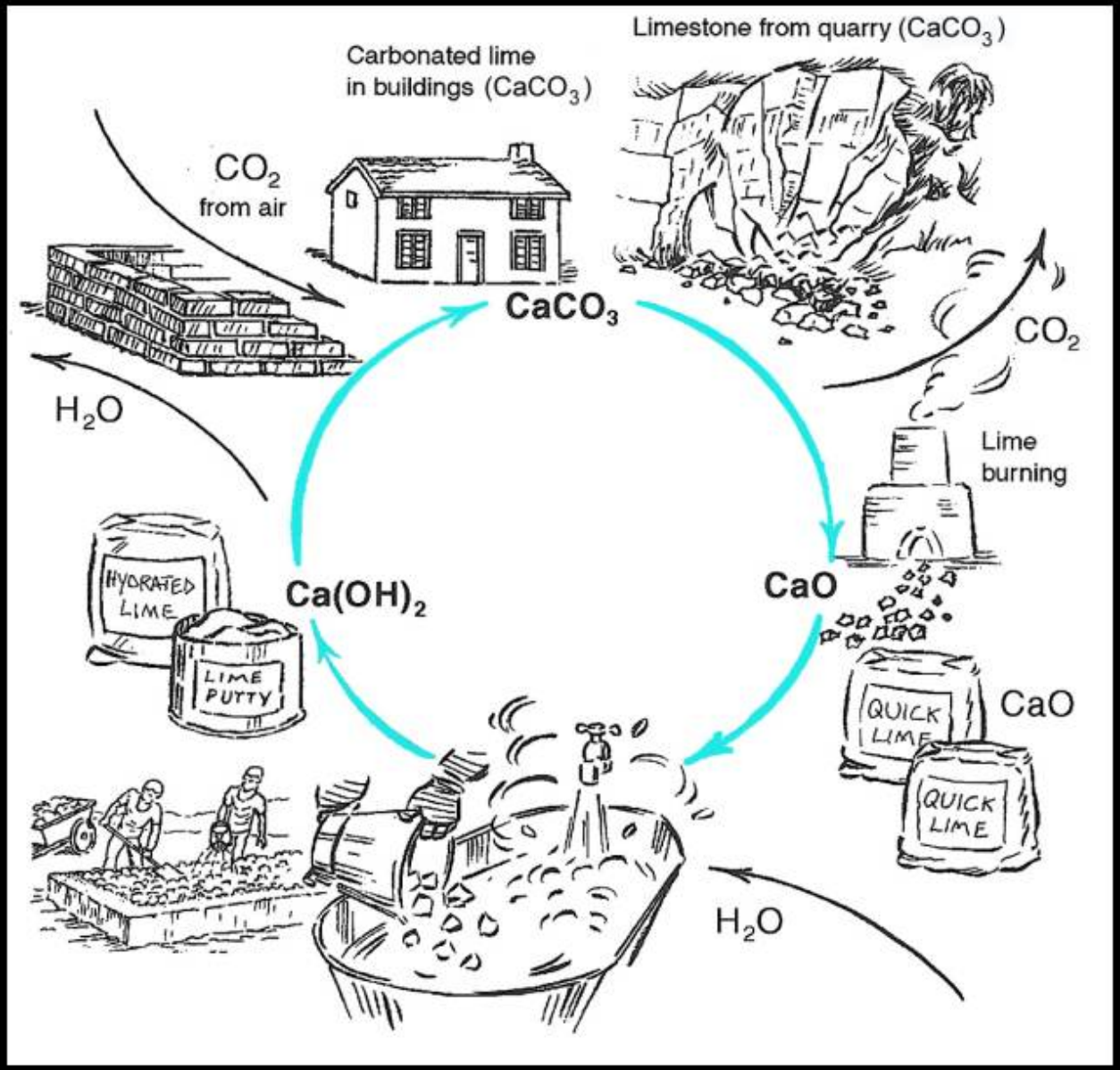
A Very Short History of UK Hydraulic Limes

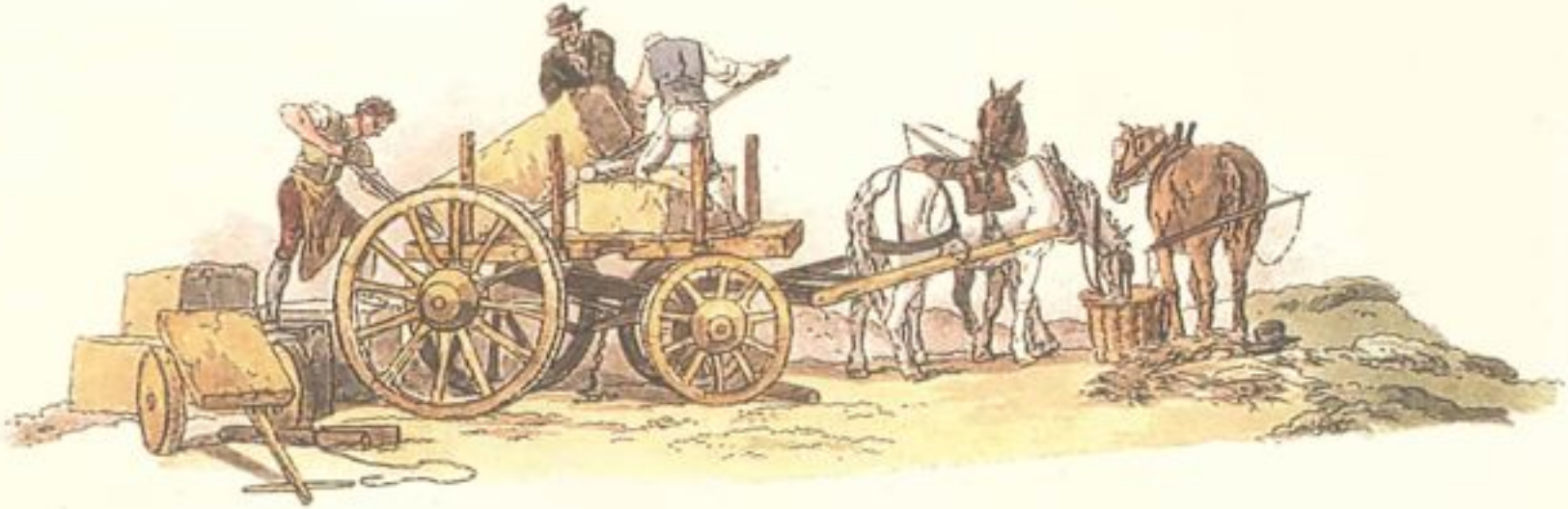
Stafford Holmes

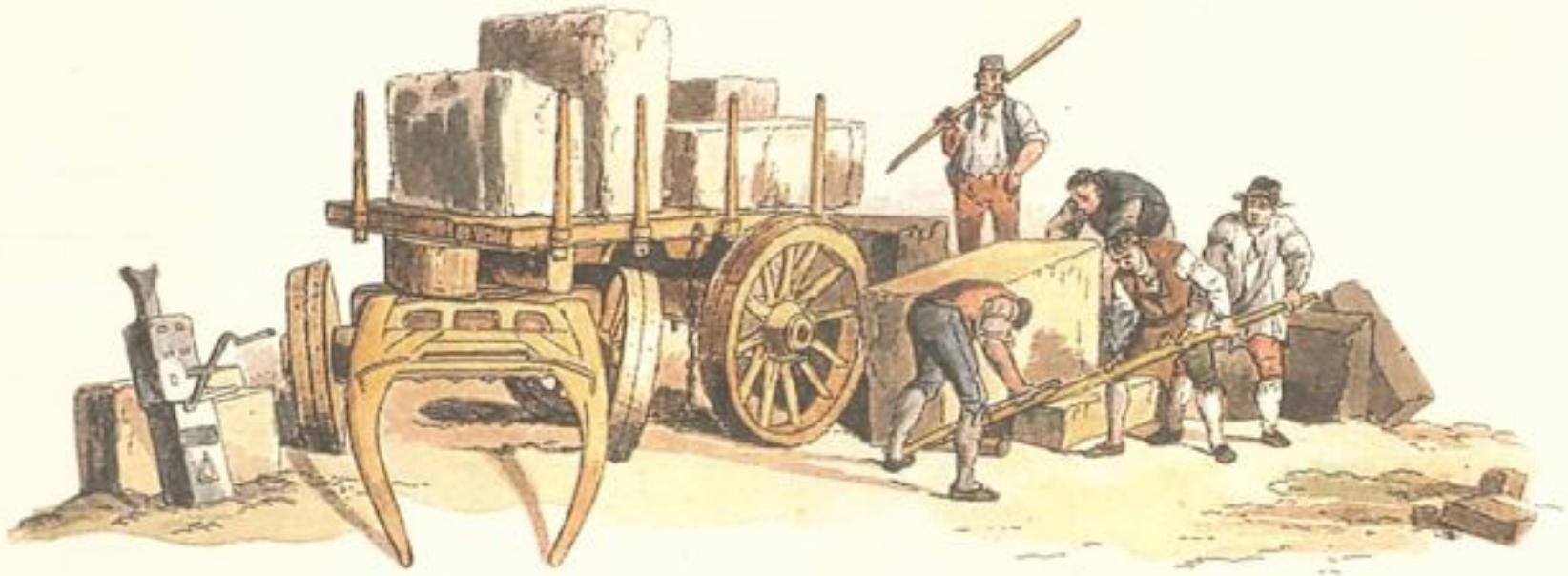
2019



The Lime Cycle

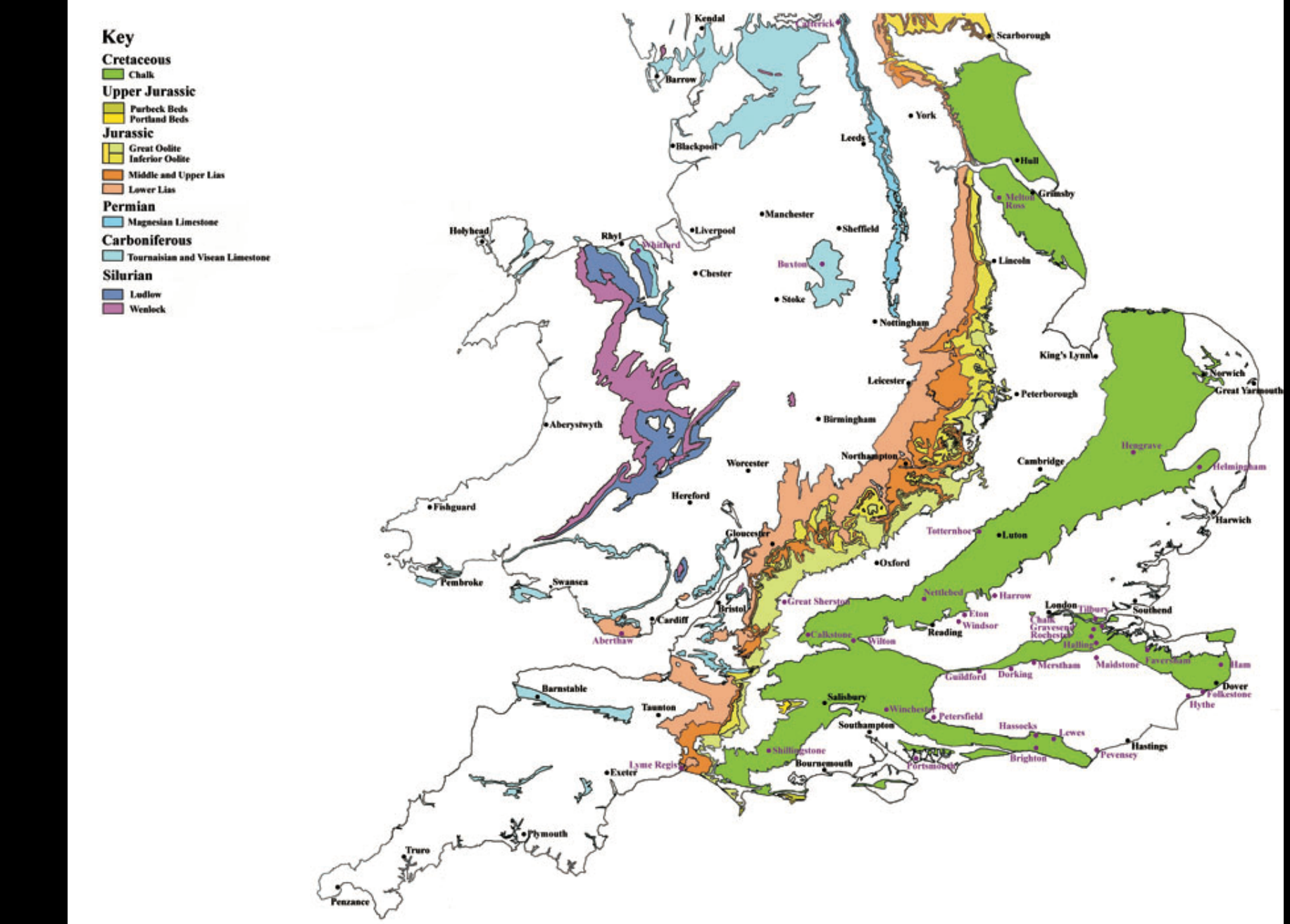
Source: Building with Lime, IT Publications, London, 2002





S B Wyvenhoe

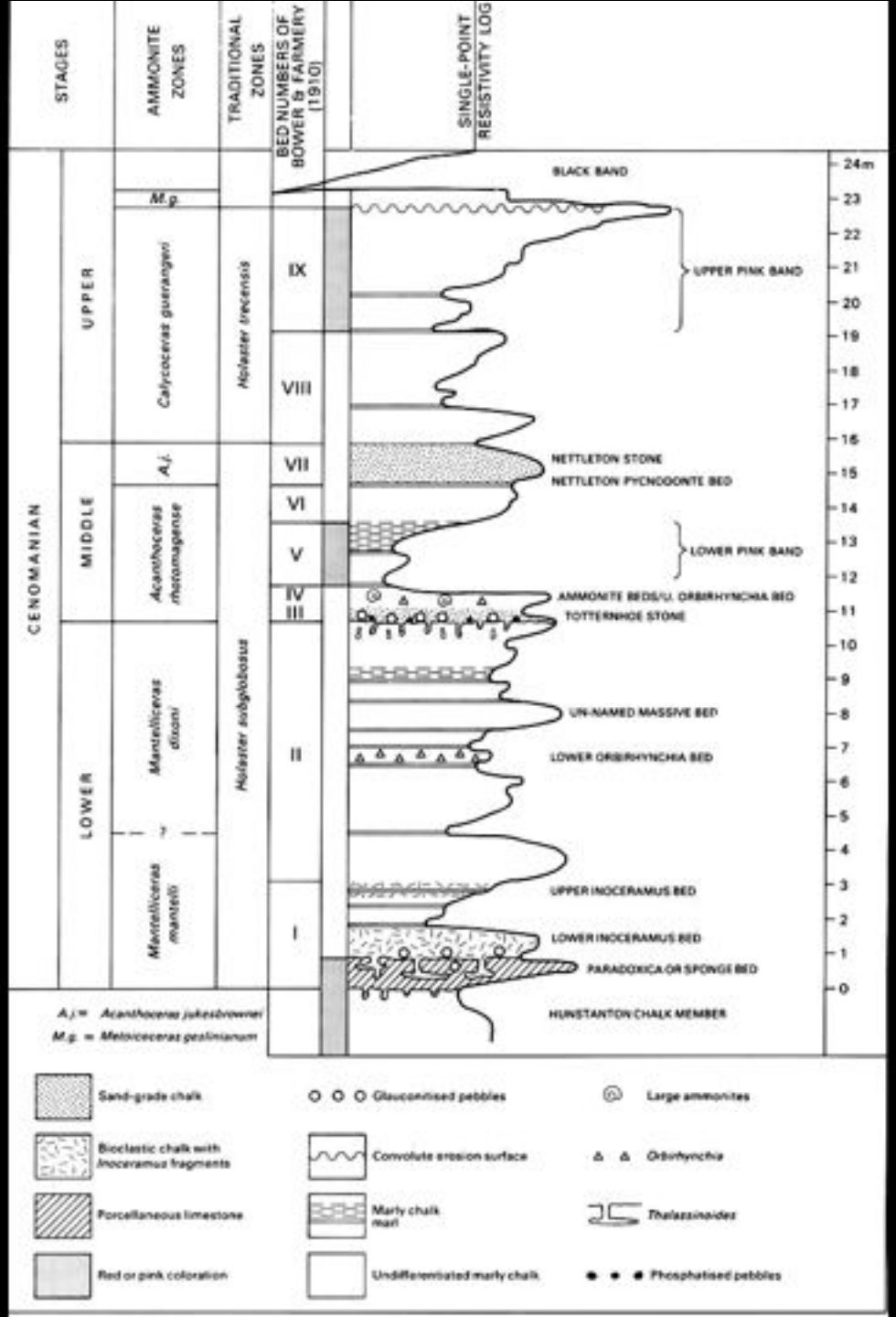
Photograph by M.Wignall 21.7.07

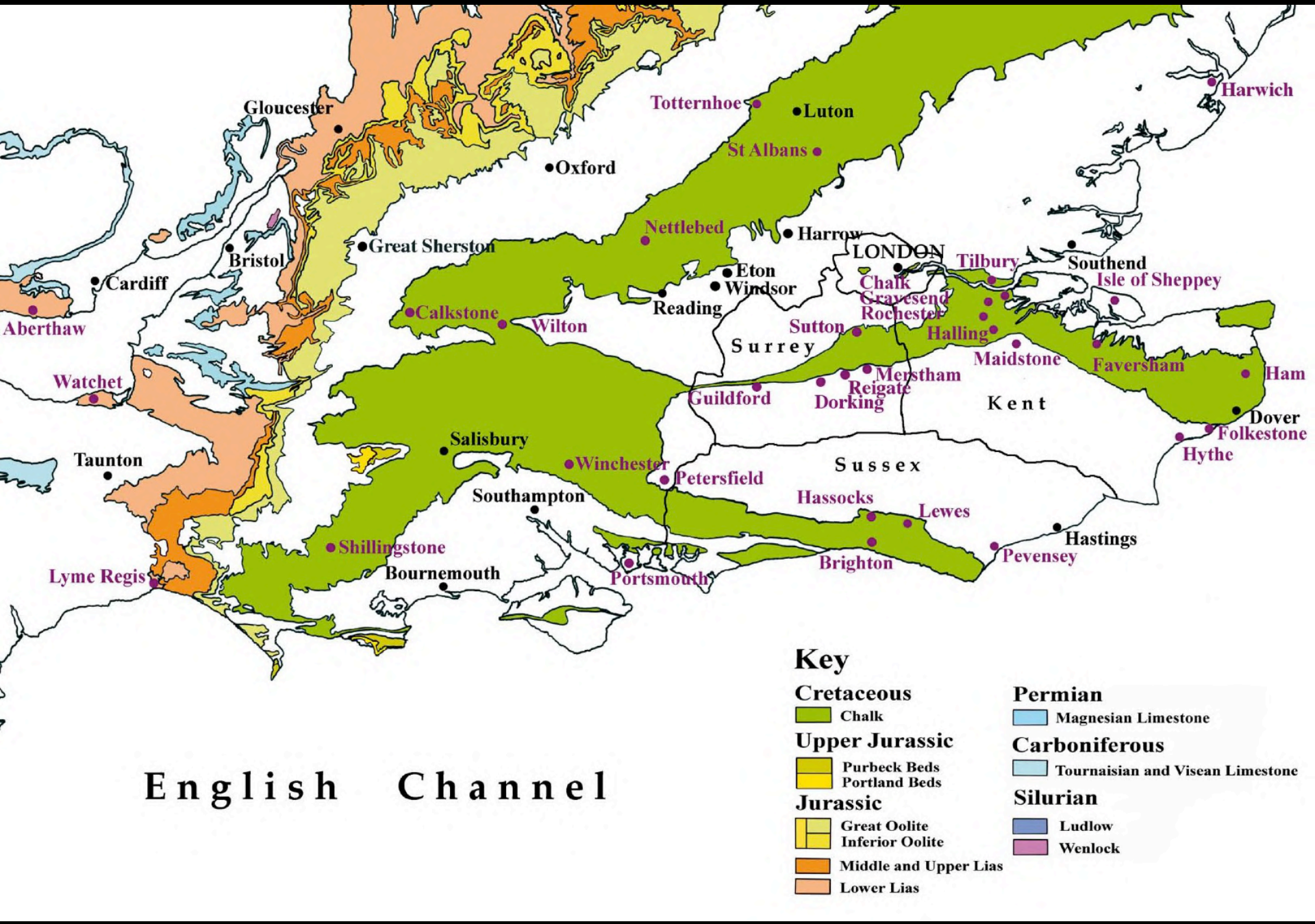


Principal Limestone Formations

in England and Wales South of Catterick

Based on information from the IGS Geological Survey


STAGES
AMMONITE ZONES
TRADITIONAL ZONES
BED NUMBERS OF BOWER & FARMERY (1910)
SINGLE-POINT RESISTIVITY LOG
CENOMANIAN
UPPER
MIDDLE
LOWER
M.g.
Calycoceras guerangeri
Holaster trecensis
A.j.
Acanthoceras rhotomagense
Mantelliceras dixoni
Mantelliceras mantelli
Holaster subglobosus
IX
VIII
VII
VI
V
IV
III
II
I
BLACK BAND
UPPER PINK BAND
NETTLETON STONE
NETTLETON PYCNODONTE BED
LOWER PINK BAND
AMMONITE BEDS/U. ORBIRHYNCHIA BED
TOTTERNHOE STONE
UN-NAMED MASSIVE BED
LOWER ORBIRHYNCHIA BED
UPPER INOCERAMUS BED
LOWER INOCERAMUS BED
PARADOXICA OR SPONGE BED
HUNSTANTON CHALK MEMBER
24m
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
A.j. = Acanthoceras jukesbrowneri
M.g. = Metoicoceras geslinianum
Sand-grade chalk
Bioclastic chalk with Inoceramus fragments
Porcellaneous limestone
Red or pink coloration
Glauconitised pebbles
Convolute erosion surface
Marly chalk marl
Undifferentiated marly chalk
Large ammonites
Orbirhynchia
Thalassinoides
Phosphatised pebbles


Gloucester
Totternhoe
Luton
Harwich
St Albans
Oxford
Nettlebed
Harrow
Great Sherston
Bristol
LONDON
Tilbury
Southend
Cardiff
Eton
Windsor
Chalk
Gravesend
Rochester
Isle of Sheppey
Reading
Calkstone
Wilton
Sutton
Halling
Aberthaw
Surrey
Maidstone
Faversham
Watchet
Merstham
Reigate
Ham
Guildford
Dorking
Kent
Dover
Folkestone
Salisbury
Hythe
Taunton
Winchester
Petersfield
Sussex
Southampton
Hassocks
Lewes
Hastings
Shillingstone
Brighton
Pevensey
Lyme Regis
Bournemouth
Portsmouth
English Channel
Key
Cretaceous
Chalk
Upper Jurassic
Purbeck Beds
Portland Beds
Jurassic
Great Oolite
Inferior Oolite
Middle and Upper Lias
Lower Lias
Permian
Magnesian Limestone
Carboniferous
Tournaisian and Visean Limestone
Silurian
Ludlow
Wenlock

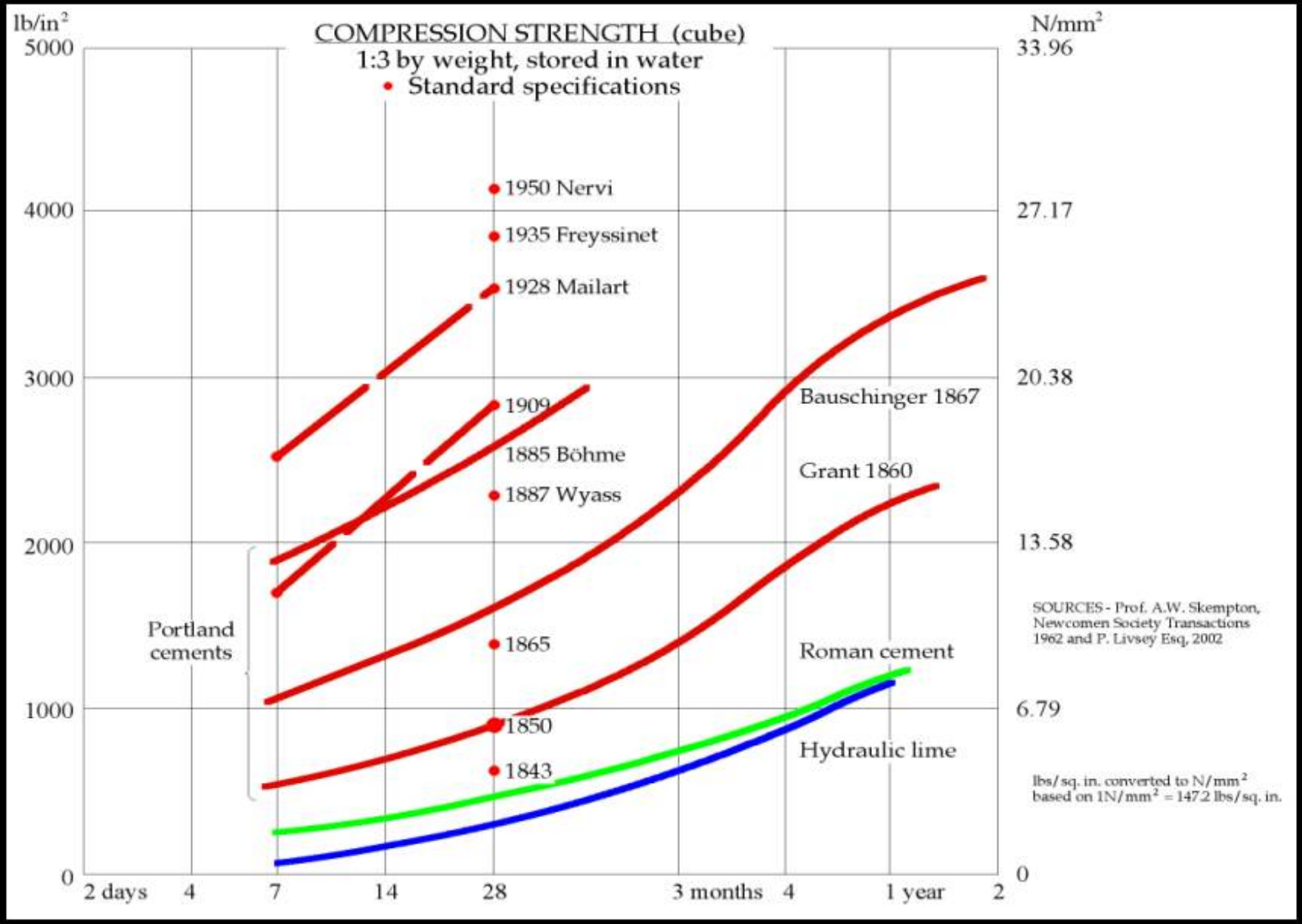
outh ELEVATION of the STONE LIGHTHOUSE compleated upon the EDYSTONE in 1759.

John Smeaton

By 1759 The Eddystone Lighthouse was completed and although Smeaton's narrative of the building and construction of the lighthouse was not published until 1793, his research into building limes was carried out in 1757.

No.	Species of Limestone	Proportion of Clay	Clay Percentage	Colour of the Clay
1	Aberthaw	$^{3}/_{23}$	13.0	Lead
2	Watchat	$^{3}/_{25}$	12.0	Lead
3	Barrow	$^{3}/_{14}$	21.4	Lead
4	Long Bennington	$^{3}/_{22}$	13.6	Lead
5	Sussex Clunch	$^{3}/_{16}$	18.7	Ash
6	Dorking	$^{1}/_{17}$	5.9	Ash
7	Berryton Grey Lime	$^{1}/_{12}$	8.3	Ash
8	Guilford	$^{2}/_{19}$	10.5	Ash
9	Sutton	$^{3}/_{16}$	18.7	Brown

Table 1: Limestones analyzed by Smeaton and tabulated on page 117 of his book on the design and construction of the Eddystone lighthouse. [Percentage conversions of the proportions of clay, originally given in fractions, added by the author.]



Historical Development of Binders

Source: Prof. A.W.Skempton, Newcomen Society Transactions 1962 and P. Livesey Esq, 2002

№ 11.
1908 9

SPECIFICATION

with which is incorporated

the

MUNICIPAL ENGINEERS' SPECIFICATION

for *Architects, Surveyors & Engineers* when specifying

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Editorial & Advertising Offices:—Caxton House Westminster.

Publishing Offices 6 Great New Street London E.C.

Fat Lime Mortar.

27. Fat lime mortar must not under any circumstances be used for the purposes of the Specification.

NOTE.—*For one exception see "Weak Cement Mortar."*

Stone Lime Mortar.

28. The stone lime mortar for brickwork above ground level shall be composed of one part of grey chalk lime (obtained from .....), and two (three) parts of sand, mixed with a sufficiency of water and thoroughly incorporated together (in a mortar mill). (The lime and sand shall be mixed together in their dry state before being put into the mortar mill.)

Lias Lime Mortar.

29. The lias lime mortar shall be composed of one part of blue lias lime (obtained from ....), and one part of sand, mixed with a sufficiency of water and thoroughly incorporated together (in a mortar mill). (The lias lime mortar for brickwork above ground level shall be made in the same manner, but in the proportions of one part of the lime to two parts of the sand.) (The lime and sand in their dry state shall be mixed together on a proper stage before being put into the mortar mill.)

Blue Mortar.

30. The blue mortar shall be composed of three parts of fine foundry ashes, two parts of ground stone lime, and two parts of sand.

THE COMPOSITION AND STRENGTH OF MORTARS

REPORT ON THE RESULTS OF THE EXPERIMENTAL INVESTIGATION CONDUCTED FOR THE SCIENCE STANDING COMMITTEE OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS

BY

W. J. DIBDIN, F.I.C., F.C.S., ETC.

LONDON

THE ROYAL INSTITUTE OF BRITISH ARCHITECTS

9 CONDUIT STREET, REGENT STREET, W.

1911

Price Five Shillings

TABLE IV

Proportion of Lime to Sand.	Results of Two Years' Tests.			
	1 to 2.		1 to 3.	
	Tensile.	Crushing.	Tensile.	Crushing.
Without Clay.				
White Chalk and Standard Sand	43	218	53	240
,, ,, Fine Charlton Sand	53	300	55	260
,, ,, Pit Sand	73	247	50	253
,, ,, Thames Sand	100	297	68	202
,, ,, Ground Brick	60	213	40	312
Dorking Greystone and Standard Sand	97	257	103	228
,, ,, Fine Charlton Sand	50	143	35	140
,, ,, Pit Sand	62	333	75	200
,, ,, Thames Sand	88	243	58	228
,, ,, Ground Brick	38	123	27	162
Blue Lias and Standard Sand	58	538	38	188
,, ,, Fine Charlton Sand	40	257	26	156
,, ,, Pit Sand	75	605	77	650
,, ,, Thames Sand	80	785	102	507
,, ,, Ground Brick	133	910	87	657
With 5% Clay.				
White Chalk and Standard Sand	—	—	50	230
,, ,, Fine Charlton Sand	—	—	35	70
,, ,, Pit Sand	—	—	57	163
Dorking Greystone and Standard Sand	—	—	48	177
,, ,, Fine Charlton	—	—	20	82
,, ,, Pit Sand	—	—	67	140
Blue Lias and Standard Sand	—	—	168	876
,, ,, Fine Charlton Sand	—	—	34	79
,, ,, Pit Sand	—	—	121	550

Lime and Lime Mortars

A D Cowper

First published in 1927 for
the Building Research Station
by HM Stationery Office, London

DONHEAD

Notes

Class A limes (*e.g.*, white chalk, mountain, " Buxton," etc.) should not be used in any exacting masonry work without pozzolanic additions.

Above ground level, Class C 1 (feebly hydraulic) limes may be used alone in positions where high stresses, particularly tensile or shearing stresses, are unlikely, However, Classes C 2 and C 3 limes, or pozzolanic mixtures, are preferable here.

For exacting positions and below ground level or water level, either a Class C 2 or C 3 hydraulic lime or a pozzolanic mixture should be specified, unless indeed a lime-cement mixture is adopted here. The pozzolanic mortar may be made with either a Class A or B, or Class C 1 (feebly hydraulic) lime, approved pozzolanic additions being made to these.

REPAIR OF ANCIENT BUILDINGS

BY

A. R. POWYS

formerly
Secretary of the Society for the Protection of Ancient Buildings

WITH

A NEW INTRODUCTION

AND

ADDITIONAL NOTES AND APPENDICES

1981

This book was reprinted with the help of The Monument Trust, for which the Society is most grateful

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In this reprint photographs have been repositioned for economy and in several cases are now closer to their references than formerly. In addition blank pages and chapter half-titles have been omitted; these are pages x, xiv, 1, 2, 8–10, 17, 18, 26–28, 37, 38, 107–108, 130–132, 150–152, 160–162, 170–172, 176–178, and 184–186.

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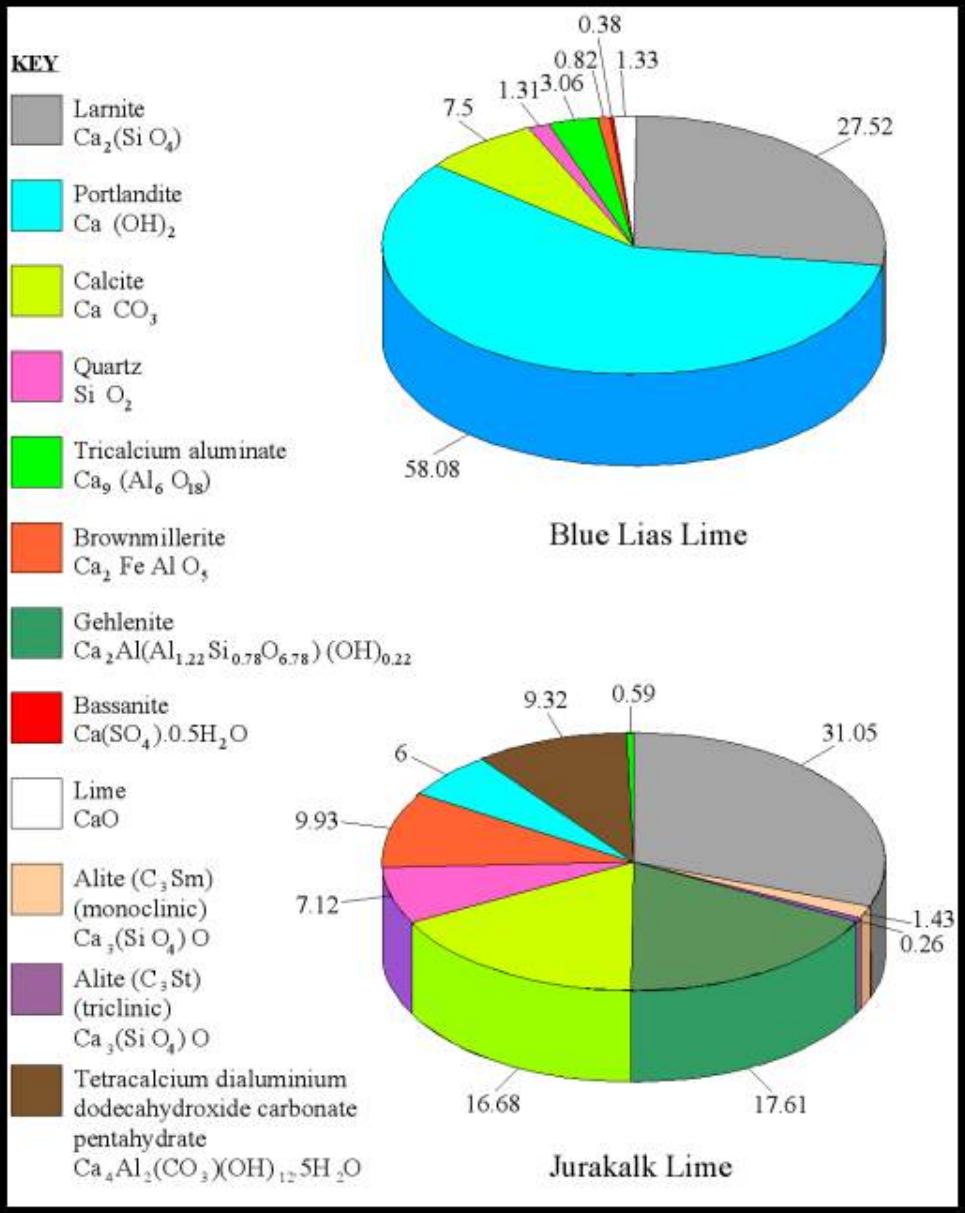
The proportions for this mortar are chosen for these reasons: Cement mortar as ordinarily used contains too much cement; this causes it to crack and gives it an unpleasant colour. If made with too little cement, although it will set well, it is difficult to handle, as it is "short" off the trowel, and is apt to "weep" from the joints. The addition of a little lime "fattens" the mortar, that is, it makes it easy to handle, and also improves the colour.

The London County Council uses a mortar made in the following proportions: sand, eight parts; hydrated lime, one and a half parts, and Portland cement, one part.

Mortar made from cement and sand in proportions of one and three or one and four is to be avoided for surface pointing, because its colour is unpleasant, and because it is apt to crack, and these are the proportions commonly used by builders when left to themselves because of the belief that the more the cement the better the mortar.



Comparative Chemical Composition of Hydraulic Limes

Source: The Foresight Lime Research Programme

EN459 -Building Limes

Or ask us at

www.naturalhydrauliclime.com

Singleton Birch
Natural Hydraulic lime

Cement: lime: sand mortars with equivalent 28 day compressive strengths	Traditional Building Limes In common use up to the beginning of the 20th century			European Standard for Building Limes BS EN 459-1, 2 and 3, 2001		
	Class	Description	Anticipated compressive strength of mortar (N/mm^2)	BS EN 459 Classification		
	A	Fat lime (pure, non-hydraulic)	0.75 at 28 days 1.5 at 2 years	Air lime - CL90, CL80, CL70		
	Hydraulic Limes			Hydraulic Limes		
1:3:12 - 1:2:9	C1	Feebly (slightly) hydraulic (Grey Chalk Limes)	0.7 - 2	Slightly Hydraulic, grey chalk limes Only given in BS890 now withdrawn		
1:2:9 - 1:1:6	C2	Moderately hydraulic	2 - 6	NHL 2 2 - 7 N/mm^2		
1:1:6 - 1:½:4	C3	Eminently hydraulic	6 - 10	10 N/mm^2 upper limit	NHL 3.5 3.5 - 10 N/mm^2	NHL 5 5 - 15 N/mm^2
1:1:6 - 1:½:4		Natural cement (Roman cement)	10 - 15+		14 N/mm^2 upper limit	
1:½:4 - 1:¼:3						20 N/mm^2 upper limit
1:¼:3 with selected aggregate						

Relationship of the Compressive Strength of Traditional Building Limes to the Current Standards

Source: Building with Lime, IT Publications, London, 2002