

TABLE OF CONTENTS.

	Page
Introduction	17
CHAPTER I.	
The occurrence, extent, and economic classification of the limestones of Ohio....	20
Geological scale of Ohio	21
Eastern group.....	22
Western group	23
CHAPTER II.	
Methods employed in sampling and testing limestones	25
CHAPTER III.	
The composition of the limestones of Ohio, with special reference to their fitness for portland cement manufacture, considered by counties	31
Adams county	32
Hudson River series.....	32
The Clinton formation	33
The Niagara formation	33
Other horizons	35
Allen county.....	36
Lucas limestone	36
Athens county	37
Freeport limestone.....	37
Pittsburg limestone	38
Belmont county	40
Brown county.....	47
Butler county	48
Clark county.....	50
Clermont county.....	52
Clinton county	53
Columbiana county	56
Crawford county.....	58
Darke county	58
Defiance county	59
Delaware county	60
Erie county.....	61
Fayette county.....	63
Franklin county.....	63

	Page
Gallia county	66
Greene county.....	66
Guernsey county	69
Hamilton county	71
Hancock county.....	73
Hardin county	74
Highland county	74
Hocking county	79
Holmes county.....	81
Jackson county	82
Jefferson county.....	84
Lawrence county	85
Licking county.....	88
Logan county	89
Lucas county	90
Mahoning county.....	92
Marion county	93
Mercer county	96
Miami county	96
Monroe county	98
Montgomery county.....	100
Morgan county.....	102
Muskingum county	104
Noble county	106
Ottawa county	107
Perry county	111
Preble county.....	115
Sandusky county	119
Scioto county	122
Seneca county	124
Shelby county	125
Stark county.....	126
Tuscarawas county	127
Van Wert county.....	127
Warren county.....	128
Washington county	129
Wood county	132
Counties having unused limestone assets.....	134
Auglaize county	134
Henry county	134
Madison county	134
Paulding county.....	135
Pickaway county	135
Putnam county.....	135

	Page
Union county	135
Wyandot county	135
Counties having poor limestone resources	135
Counties devoid, or practically devoid of limestone resources	136

CHAPTER IV.

The composition, physical character, and uses of the limestones of Ohio, considered by geological formations	137
The Lower Silurian formation or Hudson River group	137
The Trenton	138
Formations above the Trenton	138
Areal development	138
Physical character	139
Chemical character	139
Table of analyses	140
Uses	142
The Clinton formation	143
Physical character	143
Chemical character	143
Table of analyses	144
Uses	146
The Niagara group	147
The Dayton limestone	147
The West Union limestone	148
The Springfield limestone	148
The Cedarville limestone	149
Chemical composition	149
Table of analyses	150
Uses	154
The Lower Helderburg, or Monroe formation	155
Physical character	155
Chemical character	155
Table of analyses	156
Uses	158
The Corniferous or Devonian limestones	158
Chemical composition	159
Table of analyses	160
Correlation by composition	164
Uses	166
The Maxville limestone	168
Physical character	171
Chemical character	171
Table of analyses	170
Uses	172

	Page
The Mercer limestones	172
The Putnam Hill limestone	173
The Ferriferous limestone.....	174
Lawrence county	175
Upper township	175
Hamilton township	176
Elizabeth township, Range 18.....	176
Elizabeth township, Range 19.....	177
Decatur township	178
Washington township	178
Scioto county	179
Gallia county	180
Jackson county	180
Jefferson township.....	180
Franklin township	180
Lick township.....	180
Madison township	181
Bloomfield township	181
Milton township	181
Vinton county.....	182
Wilkesville township	182
Vinton township	182
Clinton township	182
Madison township	182
The winning of the Ferriferous limestone and its economic value.....	182
Benching	183
Mining	185
Yield per acre	190
Rate of exhaustion by a cement plant.....	190
The Lower Kittanning	191
The Middle Kittanning.....	191
The limestones of the Monongehala formation	192
Pittsburg horizon, group A.....	201
Groups B, C, D, E and F	202
Meigs Creek horizon, group G.....	203
Group H	203
Group I	204
Chemical composition	204
Table of analyses	206
Uses	210

CHAPTER V.

	Page
The uses of the Limestones of Ohio	212
Building stone.....	212
The quarrying or winning of limestone for building material	213
Crushed stone.....	216
Lime.....	222
Classification of limes	225
Distribution of the lime industry	225
Effect of centralization	226
Recent history of the industry in Ohio.....	227
Lime production	229
New forms of lime	231
The marketing of Ohio lime	232
Cost of production	232
Hydrated lime ..	233
Hydrated lime for agricultural purposes	234
Hydrated lime in mortars.	237
Hydrated lime in cold-water paints	241
Calcimines.....	241
Sorel cements.....	241
The glass industry	242
Various minor uses.....	243
Table of production of limestone, by counties for the year 1902.....	247

CHAPTER VI.

Technology of the lime industry	249
Definition of lime.....	249
Classification of limes ..	251
Special suitability of various limes	254
Stone work	254
Brick-laying and plastering	255
Influence of machine mixing	257
Slaking of dolomite lime ..	258
Slaking of hot lime	259
Processes of manufacture	257
Quarrying limestone for lime burning	260
Quarry costs.....	264
Transportation to the kiln	264
Burning	265
The kiln	265
The fuel	267
Use of producer gas	276
Kiln capacities	289
Quantity of fuel used	289

	Page
Fuel costs	290
Temperature of burning	293
Experimental investigations, made by the writer.....	295
Methods of measurement of temperatures in lime kilns.....	298
The thermo-electric telescope, or the radiation pyrometer.....	303
Duration of burning	304
Amount of heat required.....	305
The available heat of the fuel	306
Heat required to produce lime	307
Draft	310
Cooling.....	311
Air-slaked lime.....	313
Drawing.....	315
Testing the product.....	316
Patent processes and appliances	318
Subsequent treatment of the oxides.....	319
Lump lime	319
Ground lime	319
Prepared or hydrated lime	319
Patents on hydrating processes or apparatus	322
Hydrating equipment	327
Elevating and carrying machinery	333
Separating or screening machinery	333
Grinding.....	333
Storage	333
Packing	334
Physical properties of hydrated lime.....	335
Unsolved problems	341

APPENDIX.

The Seneca White Lime Company	343
The Scioto Stone and Lime Company	351
The Woodville White Lime Company	355
The Standard Lime Company	360

ILLUSTRATIONS.

	Page
Map of the limestone formations of economic importance in Ohio	31
Figure 1. Section of the Clinton limestone at Lynchburg, Clinton county	54
Figure 2. Section of the Lower Niagara and Clinton limestones at New Jasper, Greene county.....	68
Figure 3. Section of the limestone and underlying shale at Leesburg, Highland county	76
Figure 4. Showing ideal structure of hill, and conditions governing bench- winning of limestone	183
Figure 5. Showing section of Ferriferous limestone mine at Eifort, Scioto county, and method of working.....	187
Figure 6. Showing section of Ferriferous limestone at Burke's mine, Steece P. O., Lawrence county	188
Figure 7. Showing an ideal cross-section of the limestones of the Monongahela formation of southeastern Ohio	194
Figure 8. Quarry bar or line drill	214
Figure 9. Showing quarry bars at work in a southern marble quarry	215
Figure 10. Channelling machine at work.....	217
Figure 11. Casparis quarries, Columbus, O. Loading the product of a blast into cars.....	218
Figure 12. Casparis quarries, Columbus, O. Hauling the rock to the crusher ...	219
Figure 13. Casparis quarries, Columbus, O. The crushing plant, showing tracks for the incoming coarse rock	221
Figure 14. Casparis quarries, Columbus, O. The crushing plant, showing the outgoing or delivery side, where the railroad cars are loaded with the various grades of product	223
Figure 15. Panoramic view of the Casparis quarries and crushing plant, Colum- bus, Ohio.....	224
Figure 16. View of the working face of a typical lime quarry.....	262
Figure 17. Showing lime quarry of the Seneca White Lime Company, Fostoria, Ohio, and the system of moving the limestone from the quarry to the kilns by tramcars, portable tracks and incline hoist	266
Figure 18. Shaft-kilns, of the type formerly universal in Ohio, and now nearly everywhere abandoned	268
Figure 19. Duff's Patents Company's water-seal gas producer	278
Figure 20. Firing floor of the Standard Lime Company, Gibsonburg, Ohio, show- ing producer gas mains and inlet valves	280

	Page
Figure 21. Cross section of a gas-producer widely used in the metallurgical industries	281
Figure 22. Sketch illustrating the Eldred system.....	283
Figure 23. Theodore Gerhard's limekiln	285
Figure 24. Showing calorimeter used in studying heat of hydration of limes....	296
Figure 25. Cooling floor of the Woodville White Lime Company, Woodville, Ohio.	312
Figure 26. Cooling floor of the Seneca White Lime Company, Fostoria, Ohio	314
Figure 27. Drawing lime	315
Figure 28. Specific gravity apparatus, according to Le Chatelier	317
Figure 29. Ground lime on the floor, ready for shipment, Standard Lime Co., Gibsonburg, O.....	320
Figure 30. Ground lime and cooling floor at Standard Lime Co., Gibsonburg, O..	323
Figure 31. Clyde hydrator, general view	329
Figure 32. Clyde hydrating plant	330
Figure 33. Reaney hydrator, made by the American Hydrating Company.....	331
Figure 34. Old form of hydrator, used by the Standard Lime Company	333
Figure 35. Bates-Valve bag packing machine at Woodville White Lime Co.'s plant	334
Figure 36. General view of the works of the Seneca White Lime Company, Fostoria, Ohio	345
Figure 37. Ground plan of works, Seneca White Lime Company, Fostoria, Ohio...	346
Figure 38. Cross section of buildings of Seneca White Lime Company	347
Figure 39. Longitudinal section of buildings of Seneca White Lime Company	348
Figure 40. Vertical view and section of Kilns of Seneca White Lime Company	349
Figure 41. View of top of kilns and charging track, Seneca White Lime Company	350
Figure 42. View of kilns at level of firing floor, Seneca White Lime Company....	350
Figure 43. General ground plan of the works of the Scioto Lime and Stone Company, Delaware, Ohio	352
Figure 44. Longitudinal and cross sections of the works of the Scioto Lime Stone Company, Delaware, Ohio.....	353
Figure 45. Details of kilns, Scioto Lime & Stone Company	354
Figure 46. General ground plan of the works of the Woodville White Lime Company, Woodville, Ohio.....	357
Figure 47. Third floor plan, Woodville White Lime Company	358
Figure 48. Elevation and section of buildings and kilns, Woodville White Lime Company.....	359
Figure 49. Old plant of the Standard Lime Company, at Gibsonburg, O., now destroyed by fire	361
Figure 50. Present plant of the Standard Lime Company, Gibsonburg, O.....	362
Figure 51. Ground plan of the Standard Lime Company	363
Figure 52. First floor plan, Standard Lime Company.....	364
Figure 53. Cross section of building and kiln, Standard Lime Company	365