

Received November 12, 1772.

XIX. *Experiments upon the different Kinds of Marle found in Staffordshire, by*  
by Charles Morton, M. D. Sec. R. S.

Read Feb. 4, 1773.

| Number. | Description.  | Quantity of calcarious earth in half a dram, as separated by the nitrous acid, and precipitated by mild fixed alkaly. | What was left after the foregoing ( no longer acted upon by the nit being |              |
|---------|---|---|---|--------------|
|         |   | Grains.   | Mixed with water, became  | Wh           |
| 1.      | Red and blue intermixed, in small friable lumps.                                | 1   | Uniform and plastic.  | A hard rec   |
| 2.      | Red, in small friable lumps.  | 0 $\frac{3}{4}$   | Uniform and plastic.  | A hard rec   |
| 3.      | Grey, in large hard lumps.  | 5   | Plastic, but a little gritty.   | A soft yell  |
| 4.      | Red, hard, compact.   | 3   | Uniform and plastic.  | A hard red   |
| 5.      | Red, with grey spots, in large hard lumps, scarcely to be broken with a hammer. | 8 $\frac{1}{2}$   | Plastic.  | A soft pale  |
| 6.      | Light grey, like a grit stone.  | 8   | Gritty, no union.   | No union.    |
| 7.      | Brown, friable, in large lumps.   | 18  | No union.   | A little co. |
| 8.      | Red, in large friable lumps.  | 14  | Plastic, but a little gritty.   | A soft red   |
| 9.      | Brownish white, very hard, like calcarious incrustations.                       | 16  | No union, gritty.   | No union.    |
| 10.     | Lead colour, friable, flaky.  | 14 $\frac{1}{2}$  | No union, gritty.   | No union.    |
| 11.     | Brown grey, very hard, in irregular lumps.                                      | 16  | No union, gritty.   | No union.    |
| 12.     | Lead colour, in powder and in small hard lumps.                                 | 20 $\frac{1}{2}$  | Uniform and plastic.  | A soft whi   |

Half a dram of the marles being put into similar glafs cups, two drams of nitrous acid being added to each glafs, they all effervesced, and six drams of rain water being added to each glafs, the liquors were all filtered, and after filtration, changed violet paper to alkali, sufficient to saturate the acid, and precipitate all the earth it had dissolved. The precipitated earth being washed in rain water third. Column the fourth shews that, after the separation of the calcarious earth, there remained in N<sup>o</sup> 1, 2, 4, a red clay; in N<sup>o</sup> 3, whitish clay, with a portion of sand; in N<sup>o</sup> 6, 9, 10, 11. pure sand; and in N<sup>o</sup> 7. sand, with a small portion of clay. These residu- cipitated powders being mixed together, 82 grains thereof put into a crucible, and calcined with a strong hear, lost 35 grains in weight. pellicle upon the surface of the water; it tasted strongly of lime, and let fall a calcarious earth, upon the addition of mild fixed alkaly. made use of. They were all got out of marle pits in the neighbourhood of Stafford, except N<sup>o</sup> 12, which is found near the Duke of B part of clay is burnt to quick lime. All the above marles crack and fall to pieces, when exposed to the weather.

The foregoing experiments were undertaken with a view to ascertain how far it would be advisable to attempt burning the marles or likewise furnish us with some useful hints relative to the kind of marles proper to be used upon different kinds of lands. Perhaps the best for light sandy soil; and N<sup>o</sup> 6, 9, 10, 11, where the calcarious earth is united with sand, the most eligible where the land is air fixable air, or other volatile parts, contained in each of the marles, as shewn by column the fifth, will influence their preference in agr

by William Withering, M. D. Communicated  
R. S.

| When burnt   | Grains. | Loft grains. | Burnt to           | The calcined marles put into water, produced |
|--|---------|--------------|--------------------|--|
| One dram of each of the marles being calcined, weighed |         |              |                    |  |
| When burnt   |         |              |                    |  |
| A hard red brick.                                      | 52      | 8            | Red brick.         | No effect.                                   |
| A hard red brick.                                      | 53      | 7            | Red brick.         | No effect.                                   |
| A soft yellowish brick.                                | 49      | 11           | Soft yellow brick. | Weak lime water.                             |
| A hard red brick.                                      | 50      | 10           | Red brick.         | No effect.                                   |
| A soft pale red brick.                                 | 48      | 12           | Hard grey stone.   | Lime water.                                  |
| No union.  | 51      | 9            | Soft and stony.    | Lime water.                                  |
| A little cohesion.                                     | 46      | 14           | Soft stone.        | Lime water.                                  |
| A soft red brick.                                      | 48      | 12           | Soft stone.        | Strong lime water.                           |
| No union.  | 43      | 17           | Soft stone.        | Strong lime water.                           |
| No union.  | 48      | 12           | Soft stone.        | Strong lime water.                           |
| No union.  | 40      | 20           | Soft stone.        | Strong lime water.                           |
| A soft whitish brick.                                  | 29      | 31           | Powdery.           | Strong lime water.                           |

effervesced; N° 1 and 2 the least, N° 12 the most. The effervescence having set paper to a red colour. To the filtered colours was gradually added mild fixed rain water, till free from all saline matter, weighed, when dry, as in column the; in N° 12 a white clay; in N° 8 a red clay, and a portion of sand; in N° 3 a these residuums were all washed with rain water before they were burnt. The pre-in weight. Rain water was poured upon the calx; the next morning there was a d alkaly. The marles were kept for some weeks in a dry place before they were Duke of Bridgewater's canal, in a powdery form, and when mixed with one fourth

e marles of this country into quicklime, for the purposes of agriculture; they may Perhaps the calcarious earth united with clay, as in N° 1, 2, 4, &c. may be the and is already stiff, and abounding with clay. How far the different quantities of nce in agriculture, must be left to the experience of the farmer to determine.

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|---------|---|---|---|-------------------------|--|--------------|--------------------|--|
|         |   | Grains.   | Mixed with water, became  | When burnt              | Grains.  | Loft grains. | Burnt to           |  |
| 1.      | Red and blue intermixed, in small friable lumps.                                | 1   | Uniform and plastic.  | A hard red brick.       | 52   | 8            | Red brick.         | No effect.                                   |
| 2.      | Red, in small friable lumps.  | 0 $\frac{1}{2}$   | Uniform and plastic.  | A hard red brick.       | 53   | 7            | Red brick.         | No effect.                                   |
| 3.      | Grey, in large hard lumps.  | 5   | Plastic, but a little gritty.   | A soft yellowish brick. | 49   | 11           | Soft yellow brick. | Weak lime water.                             |
| 4.      | Red, hard, compact.   | 3   | Uniform and plastic.  | A hard red brick.       | 50   | 10           | Red brick.         | No effect.                                   |
| 5.      | Red, with grey spots, in large hard lumps, scarcely to be broken with a hammer. | 8 $\frac{1}{2}$   | Plastic.  | A soft pale red brick.  | 48   | 12           | Hard grey stone.   | Lime water.                                  |
| 6.      | Light grey, like a grit stone.  | 8   | Gritty, no union.   | No union.               | 51   | 9            | Soft and stony.    | Lime water.                                  |
| 7.      | Brown, friable, in large lumps.   | 18  | No union.   | A little cohesion.      | 46   | 14           | Soft stone.        | Lime water.                                  |
| 8.      | Red, in large friable lumps.  | 14  | Plastic, but a little gritty.   | A soft red brick.       | 48   | 12           | Soft stone.        | Strong lime water.                           |
| 9.      | Brownish white, very hard, like calcarious incrustations.                       | 16  | No union, gritty.   | No union.               | 43   | 17           | Soft stone.        | Strong lime water.                           |
| 10.     | Lead colour, friable, flaky.  | 14 $\frac{1}{2}$  | No union, gritty.   | No union.               | 48   | 12           | Soft stone.        | Strong lime water.                           |
| 11.     | Brown grey, very hard, in irregular lumps.                                      | 16  | No union, gritty.   | No union.               | 40   | 20           | Soft stone.        | Strong lime water.                           |
| 12.     | Lead colour, in powder and in small hard lumps.                                 | 20 $\frac{1}{2}$  | Uniform and plastic.  | A soft whitish brick.   | 29   | 31           | Powdery.           | Strong lime water.                           |

Half a dram of the marles being put into similar glass cups, two drams of nitrous acid being added to each glass, they all effervesced; N<sup>o</sup> 1 and 2 the least, N<sup>o</sup> 12 the most. The effervescence having ceased, and six drams of rain water being added to each glass, the liquors were all filtered, and after filtration, changed violet paper to a red colour. To the filtered colours was gradually added mild fixed alkali, sufficient to saturate the acid, and precipitate all the earth it had dissolved. The precipitated earth being washed in rain water, till free from all saline matter, weighed, when dry, as in column the third. Column the fourth shews that, after the separation of the calcarious earth, there remained in N<sup>o</sup> 1, 2, 4, a red clay; in N<sup>o</sup> 12 a white clay; in N<sup>o</sup> 8 a red clay, and a portion of sand; in N<sup>o</sup> 3 a whitish clay, with a portion of sand; in N<sup>o</sup> 6, 9, 10, 11, pure sand; and in N<sup>o</sup> 7, sand, with a small portion of clay. These residuums were all washed with rain water before they were burnt. The precipitated powders being mixed together, 82 grains thereof put into a crucible, and calcined with a strong hear, lost 35 grains in weight. Rain water was poured upon the calx; the next morning there was a pellicle upon the surface of the water; it tasted strongly of lime, and let fall a calcarious earth, upon the addition of mild fixed alkaly. The marles were kept for some weeks in a dry place before they were made use of. They were all got out of marle pits in the neighbourhood of Stafford, except N<sup>o</sup> 12, which is found near the Duke of Bridgewater's canal, in a powdery form, and when mixed with one fourth part of clay is burnt to quick lime. All the above marles crack and fall to pieces, when exposed to the weather.

The foregoing experiments were undertaken with a view to ascertain how far it would be advisable to attempt burning the marles of this country into quicklime, for the purposes of agriculture; they may likewise furnish us with some useful hints relative to the kind of marles proper to be used upon different kinds of lands. Perhaps the calcarious earth united with clay, as in N<sup>o</sup> 1, 2, 4, &c. may be the best for light sandy soil; and N<sup>o</sup> 6, 9, 10, 11, where the calcarious earth is united with sand, the most eligible where the land is already stiff, and abounding with clay. How far the different quantities of fixable air, or other volatile parts, contained in each of the marles, as shewn by column the fifth, will influence their preference in agriculture, must be left to the experience of the farmer to determine.