

HAMPSHIRE FULLER'S EARTH IN ITS CHEMICAL ASPECTS.

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In the Proceedings of the Field Club for 1890, a paper on the "Clays of Hampshire," by Mr. Shore, refers to Fuller's earth found in this county.

A sample of earth found at a depth of 200 feet below the surface of Greystott Down was submitted to me for analysis and found to contain—

Water and volatile matter	..	18.80
Silicon Dioxide (Si O_2)	..	45.56
Aluminic Oxide ($\text{Al}_2 \text{O}_3$)	..	18.10
Ferric Oxide ($\text{Fe}_2 \text{O}_3$)	..	9.31
Calcic Oxide (Ca O)	..	5.44
Magnesian Oxide (Mg O)	..	6.21
Sodic Oxide ($\text{Na}_2 \text{O}$)	..	trace
Total	..	100.02

Accompanying Mr. Shore's paper was an analysis of Hampshire Fuller's earth by Bergman, from Outlines of Mineralogy, vol. i, p. 176, by Dr. Kidd, published in 1809. In Sowerby's British Mineralogy, vol. iii, p. 59, 1809, Dr. Thomson is quoted and says:—"I cannot find that any (Fuller's earth) has been discovered in Hampshire, and indeed the analysis usually quoted from Bergman does not appear to me to indicate Fuller's earth."

The analysis by Bergman as given by Dr. Kidd is—

Silica	..	..	51.8
Alumina	..	..	23.0
Magnesia	..	..	7.0
Carbonate of Lime	..	..	3.3
Oxide of Iron	..	..	3.7
Water and other volatile matter			5.5
Total	..		94.3

To show that the sample analysed by Bergman was Fuller's earth, I have referred to all the analyses of that substance

contained in general and scientific works of reference, and found other records of Bergman's analysis differing from the one quoted above, and of other analyses interesting in their relationship to Bergman's, and that of the sample from Grey-shott Down. These analyses in chronological order were—

(1) Bergman's, in Aiken's Dictionary of Chemistry and Mineralogy, vol. i, p. 449, 1807, which contains the following account:—

“The constituent parts of Fuller's earth of Hampshire, according to an analysis by Bergman, are—

Silex	..	..	51.8
Alumine	..	..	25.0
Lime	..	..	3.3
Magnesia	..	..	0.7
Oxyd of Iron	..	..	3.7
Water	..	..	15.5
Total	..	..	100.0

This analysis is also given in Herbert's Encyclopædia, vol. i, p. 570, 1840. From these two references it would appear that the one in Dr. Kidd's work is incorrect.

(2) An analysis of Fuller's earth from Reigate, by Dr. Thomson, in the Penny Cyclopædia, vol. xi, p. 13, 1838.

(3) Two ascribed to Klaproth in the Rural Cyclopædia, by the Rev. John M. Wilson, vol. vi, p. 382, 1847, one from Reigate and one from Nimptch in Silesia. This analysis of the Reigate earth is also given in Mitchell's Dictionary of Chemistry, Mineralogy, and Geology, p. 262, 1864, which adds “Bergman gives 24 of alumina,” and in the Encyclopædia Britannica, ninth edition, vol. ix, p. 816, 1879, with the addition that the sample contained a trace of potash.

(4 & 5) Two analyses given in Ure's Dictionary of Arts, Manufactures, and Mines, sixth edition, vol. ii, p. 412, 1867.

The article is by the late Director of Geological Survey, Mr. H. W. Bristow, F.R.S., &c. The name of the analyst is not recorded. They are analyses of the two varieties of earth found at Reigate, viz., an upper bed of greyish-red earth six feet thick, and a lower bed of bluish-grey earth ten feet in thickness.

For easy reference and comparison I have arranged these

analyses in two tables. Table I being the ordinary analysis of the moist earth. Table II the proportions of the constituents in the dry material.

TABLE I.—MOIST EARTH.

SUBSTANCES.	HAMPSHIRE.			SURREY, REIGATE.				SILESIA, NIMPTCH.
	BERGMAN. Two Accounts.		BRIERLEY.	THOMSON.	KLAPROTH.			KLAPROTH.
	Aikin's Diction- ary, 1807, Vol. i., p. 449.	Dr. Kidd's Outlines Miner- alogy, 1809, Vol. i., p. 176.	From Greyshot, 1891	Penny Cyclo- pædia, 1838, Vol. xi., p. 13.	Rural Cyclo- pædia, 1847, Vol. vi., p. 382.	Ure's Diction- ary, 1867, Vol. ii., p. 412. H.W.B.	Ure.	Rural Cyclo- pædia, 1847, Vol. xi., p. 382.
	Herbert's Encyclo- pædia, 1840, Vol. i., p. 570.				Mitchell's Diction- ary, 1864, p. 262. Encyclo- pædia Britan- nica, 1874, Vol. ix., p. 816.	Blue.	Yellow	
Silica (Si O ₂) ..	51. 8	51. 8	45.56	44.00	53.00	42	44	48. 5
Alumina (Al ₂ O ₃) ..	25. 0	23. 0	14.70	23.06	10.00	18	11	15. 5
Oxide of Iron (Fe ₂ O ₃) ..	3. 7	3. 7	9.31	2.00	9.75	6	10	7. 0
Lime (Ca O) ..	3. 3	—	5.44	4.08	0.50	4	5	—
Carbonate of Lime } (Ca C O ₃)	—	3. 3	—	—	—	—	—	—
Magnesia (Mg O) ..	0. 7	7. 0	6.21	2.00	1.25	2	2	1. 5
Soda (Na ₂ O) ..	—	—	trace	—	—	5	5	—
Sodic Chloride (Na Cl) ..	—	—	—	—	0.10	—	—	—
Potash (K ₂ O.) ..	—	—	—	—	trace	—	—	—
Moisture and Vol. ..	15. 5	5. 5	18.80	24.95	24.00	23	23	25. 5
Loss	—	5. 7	—	—	1.40	—	—	2. 0
TOTAL ..	100. 0	100. 0	100.02	100.09	100.00	100	100	100

TABLE II.—DRY EARTH.

	BERGMAN.	BERGMAN.	BRISTOW.	THOMSON.	KLAPROTH.				KLAPROTH.
Silica	61.03	54.90	56.11	58.62	69.74	54.54	57.14	65.10	
Alumina	29.58	24.33	18.10	30.72	13.15	23.35	14.28	20.80	
Oxide of Iron..	4.37	3.91	11.47	2.66	12.70	7.79	13.00	9.39	
Lime	3.90	—	6.70	5.44	0.66	5.20	6.49	—	
Carbonate of Lime ..	—	3.49	—	—	—	—	—	—	
Magnesia	0.82	7.41	7.65	2.66	1.64	2.59	2.59	2.01	
Soda	—	—	trace	—	—	6.49	6.49	—	
Soda Chloride ..	—	—	—	—	0.13	—	—	—	
Potash	—	—	—	—	trace	—	—	—	
Loss	—	5.95	—	—	1.98	—	—	2.6	
TOTAL. ..	99.97	99.99	100.03	100.10	100	99.96	99.99	100	

If we compare the analysis of Bergman with that of Thomson, and remember the samples were from different sources, there is no greater difference than is found between the two analyses of Klaproth. The only reason for Thomson's statement, is found in his own theory that Fuller's earth consists of two parts of silica united with one part of alumina, and that the silicates of lime, iron and magnesia are accidental impurities. Bergman's analysis does not square with this assumption, but those of Klaproth are still less in accordance with it. Thomson's analysis exhibits all the sources of error incidental to those of Bergman and Klaproth, which were due to the methods used being imperfect. The large quantity of silica could be accounted for by the sample being more of a sandy nature, or by having undergone imperfect fusion in the process of analysis, &c.

The greatest objection would apply to the analyses given by Bristow in Ure's Dictionary where such a large proportion of soda is found,

With the exception of the soda, which is replaced by magnesia, the analysis of the sample from Greyshott is intermediate between those of the two kinds obtained at Reigate.

The cleansing properties of Fuller's earth are ascribed in some works to the magnesia it contains, and in others to the proportion of silicate of alumina. If, as given by Bristow, the Reigate samples contain the large quantity of soda stated, the superiority of the Fuller's earth from that district would be accounted for, but this is doubtful. Its detergent properties are no doubt due to its possessing the absorbent power, which characterises all clays to a very marked extent, also to some of the silicates being soluble, and that by its easy disintegration it exercises a powerful mechanical action in the mill.

Since writing the above I have found Bergman's analysis as given by Aikin and Herbert, in Gregory's Dictionary of Arts and Sciences, published in 1807, the year in which Aikin's Dictionary was published.
