ABRASIVE MATERIALS.

By JOSEPH HYDE PRATT.

INTRODUCTION.

From year to year there is a noticeable variation in the quantity of the different kinds of abrasives produced, due partly to the replacement of a certain abrasive either by another natural product or by an artificial abrasive. In 1904 the noticeable changes are the decrease in the total value of the production of natural abrasives and the very large increase in the production of artificial abrasives. The only natural abrasives in which there was an increase of production in 1904 over previous years are grindstones, pulpstones, and pumice. Usually where there is a decrease in the domestic production there is an increase in the imports, but the imports were less in 1904 than in 1903. The large increase, however, in the production of artificial abrasives makes the total value of the consumption of abrasive materials greater in 1904 than in any previous year; and thus, in the aggregate, there is a gradual increase in the quantity of abrasive materials utilized each year in the United States, which is the natural outcome of the continuous growth of our manufacturing industries.

There are many kinds of abrasive materials on the market, some of which are natural products and others artificial. These are divided into three groups, as follows:

1. Those which occur as a rock formation and are cut and manufactured directly into the form desired while retaining their original rock structure and appearance, as grindstones, scythestones, etc.

2. Those which occur as a constituent of either a rock or a vein and have to be mechanically separated from the associated gangue and cleaned, as corundum, garnet, etc.

3. Artificial abrasives, as carborundum, crushed steel, etc.

The abrasive materials included under these three heads and treated in this report are as follows: Oilstones and scythestones, grindstones and pulpstones, buhrstones and millstones, pumice, infusorial earth and tripoli, crystalline quartz, garnet, corundum and emery, feldspar, carborundum, crushed steel, artificial corundum (alundum), and adamite.

In some cases only a small part of the production of the above products is actually used as an abrasive material, and in the following report there is included, with the exception of infusorial earth and tripoli, only that portion of the various abrasive materials that is actually used for abrasive purposes. In the case of infusorial earth and tripoli the total production is not large, and it is therefore all included under the head of Abrasive Materials.

In 1904 the aggregate value of the production of the natural abrasive materials was $1,406,851, which is a decrease of $86,452 as compared with $1,493,303, the value of the 1903 production. In the following table are given the values of the different abrasive materials produced in the United States from 1900 to 1904, inclusive:

Value of abrasives produced in the United States during 1900, 1901, 1902, 1903, and 1904.

Kind of abrasive.	1900.	1901.	1902.	1903.	1904.
Oilstones and scythestones	$174,087	$158,300	$221,762	$366,857	$188,985
Grindstones and pulpstones	710,026	580,703	667,431	721,446	881,527
Buhrstones and millstones	32,858	57,179	59,808	52,552	37,338
Pumice	.....	.....	2,750	2,665	5,421
Infusorial earth and tripoli	24,207	52,950	53,244	76,273	44,164
Crystalline quartz	40,705	41,500	84,335	76,908	74,600
Garnet	123,475	158,100	132,820	132,500	117,581
Corundum and emery	102,715	146,040	104,605	64,102	57,235
Total	1,208,073	1,194,772	1,326,755	1,493,303	1,406,851

As is seen from this table, there is considerable variation from year to year in the value of the different abrasives produced and this represents in nearly all cases a corresponding variation in the quantity. There was a large gain in the production of grindstones and pulpstones, and also in the production of pumice. As to all the other abrasives, however, there was a decided decrease, in some cases amounting to nearly 50 per cent, as compared with the 1903 production. As in 1903 there was again a decrease in the value of the prduction of corundum and emery, and the 1904 value is the lowest on record for any year. When, however, the imports of these abrasives and the artificial production of corundum are considered, their consumption in the United States in 1904 was greater than in 1903.

To the value of the natural abrasives should be added the value of the artificial abrasives, which in 1904 was estimated at $830,926, an increase of $337,111 as compared with the estimated value of $493,815 of the 1903 production. The quantity of artificial abrasives, carborundum, crushed steel, and alundum (artificial corundum), produced in the United States since 1900 is given in the following table:

Artificial abrasives produced in the United States during 1900, 1901, 1902, 1903, and 1904.

Kind of abrasive.	1900.	1901.	1902.	1903.	1904.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Carborundum	2,634,900	3,838,175	3,741,500	4,759,890	7,060,380
Crushed steel	700,000	690,000	735,000	755,000	790,000
Alundum (artificial corundum)					4,020,000

The total value of the abrasives used in the United States is still further increased by importation, and in 1904 the total value of the abrasives imported was $547,804, as compared with $621,575 in 1903, a decrease of $73,771. This brings the total value of the abrasive materials consumed in the United States during 1904 to $2,785,581, which is $176,888 more than the value $2,608,693 of the 1903 consumption. There is given in the table following the total estimated value of all the abrasive materials consumed in the United States for the years 1900 to 1904, inclusive:

Total value of all abrasive materials consumed in the United States, 1900–1904.

Year.	Natural abrasives.	Artificial abrasives.	Imports.	Total value.
1900	$1,208,073	$275,641	$400,307	$1,884,021
1901	1,194,772	383,386	490,712	2,068,870
1902	1,326,755	390,245	426,736	2,143,736
1903	1,493,303	493,815	621,575	2,608,693
1904	1,406,851	830,926	547,804	2,785,581

It is probable that the totals in this table should be reduced by from $75,000 to $100,000 for each year, which would represent the value of the abrasive materials exported from the United States. This table brings out strikingly the constant increase in the total value of the abrasive materials consumed in the United States during the last five years.

There were 26 different States which contributed to the 1904 production of natural abrasive materials, and they are given below in the order of the importance of the value of their respective productions, together with the kind of abrasive mined.

List of States producing abrasives in 1904.

1. Ohio: Grindstones, pulpstones, oilstones, and scythestones.
2. New York: Millstones, infusorial earth, crystalline quartz, garnet, and emery.
3. Michigan: Grindstones.
4. Arkansas: Oilstones.
5. New Hampshire: Scythestones and infusorial earth.
6. Wisconsin: Crystalline quartz.
7. Missouri: Grindstones and infusorial earth.
8. Massachusetts: Infusorial earth and emery.

9. PENNSYLVANIA: Millstones, crystalline quartz, and garnet.
10. CONNECTICUT: Crystalline quartz.
11. VERMONT: Scythestones.
12. INDIANA: Oilstones.
13. NORTH CAROLINA: Millstones, garnet, and corundum.
14. VIRGINIA: Millstones and infusorial earth.
15. MARYLAND: Infusorial earth.
16. MONTANA: Grindstones and corundum.
17. NEBRASKA: Pumice.
18. CALIFORNIA: Infusorial earth
19. FLORIDA: Infusorial earth.
20. KENTUCKY: Oilstones and crystalline quartz.
21. KANSAS: Emery.
22. SOUTH DAKOTA: Pumice.
23. WYOMING: Grindstones.
24. WEST VIRGINIA: Grindstones.
25. GEORGIA: Infusorial earth.
26. MINNESOTA: Feldspar.

In 1903 there were but 21 States that contributed to the production of abrasive materials, the new States producing in 1904 being Minnesota, South Dakota, West Virginia, Wisconsin, and Wyoming.

OILSTONES AND SCYTHESTONES.

PRODUCTION.

The production of oilstones and scythestones in 1904 was from old localities in Arkansas, Indiana, Kentucky, Ohio, New Hampshire, and Vermont. Michigan, which produced this kind of abrasive material in 1903, made no report of any production in 1904. In New Hampshire and Vermont the material used in manufacturing the oilstones and scythestones is a quartz schist, and in all the other States it is a sandstone, which varies in texture, the novaculite variety being the most valuable of any of the abrasives of this class on the market. Under this head are included all kinds of oilstones, whetstones, water hones, knife sharpeners, and all varieties of razor hones, dental points, etc. There was a large falling off in the production of oilstones and scythestones in the United States in 1904 as compared with the productions of 1902 and 1903. The value of this production in 1904 was $188,985, a decrease of $177,872 as compared with $366,857, the value of the 1903 production; as compared with the 1902 production, the value of which was $221,762, it is a decrease of $32,777. In nearly every instance the producers of the materials used in the manufacture of oilstones and scythestones are also the manufacturers of the finished or marketable product, and for this reason it is the value of the finished stones instead of the raw material that is given in these statistics.

The value of the Arkansas oilstones was greater than that of any of the States producing this class of abrasive. New Hampshire produced

the largest quantity. The States producing oilstones and scythestones in the order of the value of their productions, are as follows: Arkansas, New Hampshire, Ohio, Vermont, Indiana, and Kentucky. There were 11 producers of oilstones and scythestones in these States, as against 18 producers in 1903.

There is given in the following table the value of the oilstones and scythestones produced in the United States from 1891 to 1904, inclusive:

Value of oilstones and whetstones produced in the United States, 1891–1904.

Year.	Value.	Year.	Value.
1891	$150,000	1898	$180,486
1892	146,730	1899	208,283
1893	135,173	1900	174,087
1894	136,873	1901	158,300
1895	155,881	1902	221,762
1896	127,098	1903	366,857
1897	149,970	1904	188,985

From 1880 to 1890, inclusive, the production and value of the rough stones have been published in these reports, except in the case of the output of 1890, when the value of the unfinished product was given for the novaculite of Arkansas, while in all other cases the value of the finished stone was given. The annual production from 1880 to 1890 was as follows:

Production of oilstones and whetstones, 1880–1890.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Pounds.			*Pounds.*	
1880	420,000	$8,000	1886	1,160,000	$15,000
1881	500,000	8,580	1887	1,200,000	16,000
1882	600,000	10,000	1888	1,500,000	18,000
1883	600,000	10,000	1889	5,982,000	32,980
1884	800,000	12,000	1890	.....	69,909
1885	1,000,000	15,000			

IMPORTS.

There was also a slight falling off in the value of the imports of oilstones and scythestones during 1904. The value of these imported stones in 1904 amounted to $61,609, as compared with $65,763 in 1903, a decrease of $4,154. The 1904 imports are about one-third the value of the domestic production; in 1903 they were about one-fifth; and the variation that has been noted in the imports of oilstones and whetstones from year to year has, since 1891, ranged in value from one-fifth to one-third as compared with the value of the domestic produc-

tion. In the following table there is given the total value of all kinds of hones and oilstones imported into the United States since 1880:

Imports of hones and whetstones, 1880–1904.

Year ending—	Value.	Year ending—	Value.
June 30—		December 31—	
1880	$14,185	1892	$33,420
1881	16,631	1893	25,301
1882	27,882	1894	26,671
1883	30,178	1895	32,439
1884	26,513	1896	50,588
1885	21,434	1897	34,485
December 31—		1898	30,856
1886	21,141	1899	34,510
1887	24,093	1900	39,316
1888	30,676	1901	64,655
1889	27,400	1902	56,456
1890	37,454	1903	65,763
1891	35,344	1904	61,609

EXPORTS.

There is a considerable demand abroad for American scythestones and oilstones, especially for the New Hampshire scythestones and the Arkansas oilstones. These stones represent the greater part of the stones exported, smaller quantities of the Indiana oilstones being also exported. While there has been no separate record kept of the exports of these stones and no definite valuation can be given, it is not improbable that the exports now exceed the imports in value.

GRINDSTONES AND PULPSTONES.

PRODUCTION.

In 1904 the production of grindstones and pulpstones was confined to Ohio, Michigan, Wyoming, West Virginia, Montana, and Missouri, given in the order of the value of their productions. By far the largest quantity was obtained from Ohio, and this was the only State that produced any pulpstones. The total value of all kinds of grindstones produced in 1904 was $881,527, which is $160,081 greater than the value, $721,446, of the 1903 production. This is the greatest value recorded for the production of grindstones during any year since these statistics were first collected in 1880. This represents a very large increase in tonnage as compared with the earlier productions, for it must be borne in mind in comparing the values of the productions of the earlier years with those of the last few years that the average value per ton for the grindstones which was from about $15 to $18 per

ton has decreased to from $8 to $11 per ton, these values not including pulpstones. Thus the actual tonnage of grindstones produced annually in the last five years is greater than for any previous year. Of the total value of the 1904 production the sum of $61,320 is due to pulpstones, an increase of $27,350 as compared with the value $33,970 of the 1903 production, which in turn was an increase of $10,882 over the 1902 value of $23,088. The value of the grindstone production was $820,207, an increase of $132,731 as compared with $687,476, the value of the 1903 production, which in turn was an increase of $43,133 over the value of the 1902 production, $644,343. In the following table is given the value of the production of grindstones and pulpstones for the years 1901 to 1904, inclusive:

Value of the production of grindstones and pulpstones, 1901–1904.

	1901.	1902.	1903.	1904.
Grindstones	$561,903	$644,343	$687,476	$820,207
Pulpstones	18,800	23,088	33,970	61,320
Total	580,703	667,431	721,446	881,527

Some of the producers in making their reports to the Survey use the ton as the unit of measurement, while others give the actual number of grindstones made. In 1904 the number of grindstones reported, exclusive of pulpstones, aggregated 53,572 pieces, valued at $652,717, as against 52,383 pieces, valued at $501,500, in 1903. The product reported by weight amounted to 15,755 tons, valued at $167,490, in 1904, as against 16,891 tons, valued at $185,976, in 1903. The average value of that portion of the 1904 product, reported by weight, was $10.63 per ton. The price per ton reported varied from $10 to $18.20.

In the following tables are given the values of the grindstones and pulpstones produced in the United States during 1903 and 1904, and during 1902, by States:

Value of grindstones and pulpstones produced in the United States during 1903 and 1904, by States.

State.	1903.	1904.
Ohio	$646,776	$767,552
Michigan	70,550	112,500
West Virginia, Missouri, and Montana	4,120	[a] 1,475
Total	721,446	881,527

[a] Including a small production from Wyoming in 1904.

Value of grindstones and pulpstones produced in the United States during 1902, by States.

State.	1902.
Ohio	$560,412
Michigan, Montana, and Wyoming	[a] 84,672
West Virginia	22,347
Total	667,431

[a] The greater part of the value of this production was from Michigan.

As is seen from these tables, there was an increase of $120,776 in the value of the Ohio production, and of $41,950 in the value of the Michigan production in 1904 over 1903. The productions of West Virginia, Missouri, Montana, and Wyoming were all small. There were a total of 22 producers of grindstones in 1904, of whom 15 were in Ohio, 3 in Michigan, and 1 each in Missouri, Montana, West Virginia, and Wyoming.

The value of the production of grindstones and pulpstones in the United States from 1880 to 1904, inclusive, is shown in the following table, which illustrates very clearly the depression and the revival of this industry, and consequently of the manufacturing industries of the country during and since the financial depression of 1893 and of the years immediately following:

Value of grindstones produced in the United States, 1880–1904.

Year.	Value.	Year.	Value.
1880	$500,000	1893	$338,787
1881	500,000	1894	223,214
1882	700,000	1895	205,768
1883	600,000	1896	326,826
1884	570,000	1897	368,058
1885	500,000	1898	489,769
1886	250,000	1899	675,586
1887	224,400	1900	710,026
1888	281,800	1901	580,703
1889	439,587	1902	667,431
1890	450,000	1903	721,446
1891	476,113	1904	881,527
1892	272,244		

IMPORTS.

There still continues to be a certain amount of grindstones imported into the United States each year, principally pulpstones, and a few grindstones that are used in the glass and optical trades. These stones are obtained from Newcastle-upon-Tyne, and from Wales, Scotland, and Bavaria. In 1904 the value of the imports of grindstones

amounted to $93,152 as against $85,705 in 1903. This is the largest value of grindstones imported since 1883, and represents a larger tonnage than that year on account of the decrease in value of these stones. The Bureau of Statistics of the Department of Commerce and Labor, in reporting the imports of grindstones, has not made any separation of the quantity of the finished and of the unfinished products since 1883. In the table below are given the quantity and the value of the grindstones imported into the United States from 1868 to 1883, inclusive, and of the value since 1884:

Grindstones imported and entered for consumption in the United States, 1868–1904.

Year ending—	Finished.		Unfinished or rough.		Total value.
	Quantity.	Value.	Quantity.	Value.	
June 30—	*Long tons.*		*Long tons.*		
1868	.....	$25,640	.....	$35,215	$60,855
1869	.....	15,878	.....	99,715	115,593
1870	.....	29,161	.....	96,444	125,605
1871	385	43,781	3,957	60,935	104,716
1872	1,202	13,453	10,775	100,494	113,947
1873	1,437	17,033	8,377	94,900	111,933
1874	1,443	18,485	7,721	87,525	106,010
1875	1,373	17,642	7,656	90,172	107,814
1876	1,681	20,262	6,079	69,927	90,189
1877	1,245	18,546	4,980	58,575	77,121
1878	1,463	21,688	3,669	46,441	68,129
1879	1,603	24,904	4,584	52,343	77,247
1880	1,573	24,375	4,579	51,899	76,274
1881	2,064	30,288	5,045	56,840	87,128
1882	1,705	30,286	5,946	66,939	97,225
1883	1,755	28,055	6,946	77,797	105,852
1884	.....	.....	.....	.....	[a]86,286
1885	.....	.....	.....	.....	50,579
December 31—					
1886	.....	.....	.....	.....	39,149
1887	.....	.....	.....	.....	50,312
1888	.....	.....	.....	.....	51,755
1889	.....	.....	.....	.....	57,720
1890	.....	.....	.....	.....	45,115
1891	.....	.....	.....	.....	21,028
1892	.....	.....	.....	.....	61,052
1893	.....	.....	.....	.....	59,569
1894	.....	.....	.....	.....	52,688
1895	.....	.....	.....	.....	54,276
1896	.....	.....	.....	.....	66,195
1897	.....	.....	.....	.....	49,496
1898	.....	.....	.....	.....	62,973
1899	.....	.....	.....	.....	63,852
1900	.....	.....	.....	.....	92,581
1901	.....	.....	.....	.....	88,871
1902	.....	.....	.....	.....	76,906
1903	.....	.....	.....	.....	85,705
1904	.....	.....	.....	.....	93,152

[a] Since 1883 not separately classified.

CANADIAN PRODUCTION.

The production of grindstones in Canada has not as yet become a very important industry, and in 1904 it amounted to only 4,509 tons, valued at $42,782, as against 5,538 tons, valued at $48,302, in 1903. The average price per ton in 1904 was $9.49, as against $8.72 in 1903, this being considerably less than the average price of $10.63 per ton received for the United States production.

BUHRSTONES AND MILLSTONES.

PRODUCTION.

From 1894 up to 1903 there had been a general increase from year to year in the value of the production of buhrstones in the United States, but in 1903 there began a decline in the demand for buhrstones, and the decrease in 1904 was twice what it was in 1903. The total value of the production of buhrstones in 1904 was $37,338, a decrease of $15,214 as compared with $52,552, the value of the production in 1903, which in turn was a decrease of $7,256 as compared with $59,808, the value of the 1902 production. It had been expected that the production of buhrstones in 1904 would exceed that in 1903, as the demand for these stones to be used for grinding mineral paints, barytes, drugs, paste, mustard, cement, plaster, fertilizers, glucose, chocolate, spices, etc., has been steadily growing, and wherever such stones have been used they have for the most part given perfect satisfaction. There are a number of States in which rock of the right texture and quality for manufacturing buhrstones can be obtained. There were, however, only four States having a production of buhrstones or millstones in 1904, with a total of 26 producers, as follows: New York, 17; Pennsylvania, 4; Virginia, 3, and North Carolina, 2. Vermont, which was a producer in 1903, reported nothing in 1904. The following table gives the values of the productions for the years 1902, 1903, and 1904, by States:

Value of buhrstones produced in the United States in 1902, 1903, and 1904, by States.

State.	1902.	1903.	1904.
New York	$39,570	$35,441	$24,585
Virginia	11,435	9,812	4,759
North Carolina and Vermont	6,825	5,902	[a]6,500
Pennsylvania	1,978	1,397	1,494
Total	59,808	52,552	37,338

[a] No production of buhrstones from Vermont in 1904.

The following table gives the value of buhrstones produced in the United States since 1880:

Value of buhrstones produced in the United States, 1880–1904.

Year.	Value.	Year.	Value.
1880	$200,000	1893	$16,639
1881	150,000	1894	13,887
1882	200,000	1895	22,542
1883	150,000	1896	22,567
1884	150,000	1897	25,932
1885	100,000	1898	25,934
1886	140,000	1899	28,115
1887	100,000	1900	32,858
1888	81,000	1901	57,179
1889	35,155	1902	59,808
1890	23,720	1903	52,552
1891	16,587	1904	37,338
1892	23,417		

IMPORTS.

The value of the imports of buhrstones into the United States varies considerably from year to year, as is shown in the following table, which gives the buhrstones imported since 1868:

Value of buhrstones and millstones imported into the United States, 1868–1904.

Year ending—	Rough.	Made into millstones.	Total.	Year ending—	Rough.	Made into millstones.	Total.
June 30—				December 31—			
1868	$74,224	.....	$74,224	1886	$29,273	$662	$29,935
1869	57,942	$2,419	60,361	1887	23,816	191	24,007
1870	58,601	2,297	60,898	1888	36,523	705	37,228
1871	35,406	3,698	39,104	1889	40,432	452	40,884
1872	69,062	5,967	75,029	1890	32,892	1,103	33,995
1873	60,463	8,115	68,578	1891	23,997	42	24,039
1874	36,540	43,170	79,710	1892	33,657	529	34,186
1875	48,068	66,991	115,059	1893	29,532	729	30,261
1876	37,759	46,328	84,087	1894	.....	.....	[a] 18,087
1877	60,857	23,068	83,925	1895	.....	.....	[a] 20,316
1878	87,679	1,928	89,607	1896	.....	.....	[a] 26,965
1879	101,484	5,088	106,572	1897	.....	.....	[a] 22,956
1880	120,441	4,631	125,072	1898	22,974	1,025	23,999
1881	100,417	3,495	103,912	1899	18,368	513	18,881
1882	103,287	747	104,034	1900	27,960	944	28,904
1883	73,413	272	73,685	1901	40,885	1,302	42,187
1884	45,837	263	46,100	1902	15,243	915	16,158
1885	35,022	455	35,477	1903	21,160	8,481	29,641
				1904	30,117	2,269	32,386

[a] Not separately classified.