

The most noticeable changes in regard to the production of abrasive materials in the United States during 1905 were the large falling off in the value of the production of grindstones and pulpstones and of artificial abrasives as compared with the corresponding values of 1904, and the decided increase in all of the other natural abrasive materials, with the exception of crystalline quartz.

The aggregate value of the production of the natural abrasive materials during 1905 was \$1,127,980, which is an increase of \$20,870, as compared with \$1,107,101, the value of the production of these materials in the following table the values of the different abrasive materials produced in the United States from 1901 to 1905 inclusive.

ABRASIVE MATERIALS.

By JOSEPH HYDE PRATT.

Value of abrasives produced in the United States, 1901-1905.

1905.	1904.	1903.	1902.	1901.	Kind of abrasive.
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INTRODUCTION.

The abrasive materials that are included in this report are as follows: Oilstones and scythestones, grindstones and pulpstones, buhrstones and millstones, flint pebbles, pumice, infusorial earth and tripoli, crystalline quartz and feldspar, garnet, corundum and emery, carborundum, crushed steel and artificial corundum. Of these materials, there is in some cases but a small part of the entire production that is actually used for abrasive purposes, and in the following report there is included, with the exception of infusorial earth and tripoli, only that portion of the production that is actually used for abrasive purposes. Thus, under grindstones and pulpstones, which are obtained from sandstone, only a small percentage of the stone that is quarried is used in the manufacture of these abrasives, the remainder being used for building purposes. This is also true of certain of the materials from which oilstones and scythestones are manufactured. In the case of buhrstones and millstones, the larger part of the material that is taken out from the quarries is simply used in the manufacture of these stones. All of the pumice is used for abrasive purposes in one form or another. Of the crystalline quartz that is mined in the United States, only a very small part is used for abrasive purposes, and this is also true of feldspar. All of the garnet that is mined, except that which is of value as gems, is used as an abrasive material, and this is also true of corundum and emery.

Descriptions of the different abrasives have appeared in preceding reports of this Bureau. Thus, oilstones and whetstones were described fully in the report for 1901; and grindstones, buhrstones, millstones, and infusorial earth and tripoli in the reports for 1900 and 1901. Deposits of infusorial earth, in Pinal County, Ariz., were described by Mr. W. P. Blake^a in 1902. Pumice was treated in this report for 1901, and artificial abrasives in the same report. In the report for 1903 an article on carborundum by Mr. F. A. J. Fitzgerald was quoted from the Iron Age,^b and also an abstract on crushed steel, from the Proceedings of the American Association for the Advancement of Science.^c

More or less brief descriptions of the natural abrasives will be found in The Non-Metallic Minerals, by Mr. George P. Merrill.^d Corundum has been treated in the first volume of the North Carolina Geological Survey, and also in Bulletin No. 269 of the United States Geological Survey.^e

^a Am. Inst. Min. Eng., February meeting, 1902.

^b Iron Age, October 15, 1903.

^c Proc. Am. Assn. Adv. Sci., Pittsburg meeting, 1903.

^d Merrill, George P., The Non-Metallic Minerals, 1901.

^e Ann. Rept. North Carolina Geol. Surv., Vol. 1, 1905; Bull. U. S. Geol. Survey No. 269, 1905.

The most noticeable changes in regard to the production of abrasive material in the United States during 1905 were the large falling off in the value of the production of grindstones and pulpstones and of artificial abrasives as compared with the corresponding values of 1904, and the decided increase in all of the other natural abrasive materials, with the exception of crystalline quartz.

The aggregate value of the production of the natural abrasive materials during 1905 was \$1,427,980, which is an increase of \$20,879, as compared with \$1,407,101, the value of the 1904 production. There are given in the following table the values of the different abrasive materials produced in the United States from 1901 to 1905, inclusive:

Value of abrasives produced in the United States, 1901-1905.

Kind of abrasive.	1901.	1902.	1903.	1904.	1905.
Oilstones and scythestones	\$158,300	\$221,762	\$366,857	\$188,985	\$244,346
Grindstones and pulpstones	580,703	667,431	721,446	881,527	777,606
Buhrstones and millstones	57,179	59,808	52,552	37,338	37,974
Pumice		2,750	2,665	5,421	5,540
Infusorial earth and tripoli	52,950	53,244	76,273	44,164	64,637
Crystalline quartz	41,500	84,335	76,908	^a 74,850	^a 88,118
Garnet	158,100	132,820	132,500	117,581	148,095
Corundum and emery	146,040	104,605	64,102	57,235	61,464
Total	1,194,772	1,329,755	1,493,303	1,407,101	1,427,980

^aIncluding feldspar.

As is seen in this table, there is considerable variation from year to year in the value of the different abrasive materials, and this represents in nearly all cases a corresponding variation in the quantity produced. The greatest gain during 1905 was in the value of the production of oilstones and scythestones, and there were also decided gains in value of the outputs of garnet, infusorial earth and tripoli, and crystalline quartz and feldspar. There was but a slight gain in pumice and buhrstones and millstones, and a more decided increase in corundum and emery. It often happens that in one year there will be a larger quantity of certain of the abrasive materials produced than is required, and thus a certain portion of this material is held over until the following year, and the actual production of that year is curtailed accordingly. As a rule, however, the actual quantity of abrasive materials produced and put on the market in one year, including the natural and artificial abrasives produced in this country and those imported, is gradually increasing in quantity.

The value of the artificial abrasive materials manufactured during 1905 is estimated at \$701,400 as compared with the estimated value of \$830,926 of the 1904 production, a decrease of \$129,526. This, however, is a large increase as compared with \$493,815 in 1903, and with \$390,245 in 1902. It will be noticed that in 1904 there was an increase of nearly 70 per cent in the value of the artificial abrasives as compared with 1903, and this exceptionally large increase in that year will account somewhat for the decrease in 1905. The quantity of the 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, 1901-1905.

[Pounds.]

Kind of abrasive.	1901.	1902.	1903.	1904.	1905.
Carborundum	3,838,175	3,741,500	4,759,890	7,060,380	5,596,000
Crushed steel	690,000	735,000	755,000	790,000	612,000
Alundum (artificial corundum)				4,020,000	3,612,000

The total estimated value of all abrasive materials consumed in the United States for the years 1900 to 1905, inclusive, are given in the table following:

Total value of all abrasive materials consumed in the United States, 1900-1905.

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	1,407,101	830,926	547,804	2,785,831
1905	1,427,980	701,400	654,821	2,784,201

There is a certain quantity of abrasive materials exported each year from the United States, and the total values given above should probably be reduced by \$75,000 to \$100,000 for each year.

There were 23 different States which contributed to the 1905 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 1905.

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|---|---|
| 1. OHIO: Grindstones, pulpstones, oilstones, and scythestones. | 11. WEST VIRGINIA: Grindstones. |
| 2. NEW YORK: Millstones, infusorial earth, crystalline quartz, garnet, and emery. | 12. INDIANA: Scythestones. |
| 3. MICHIGAN: Grindstones and scythestones. | 13. MASSACHUSETTS: Infusorial earth and emery. |
| 4. ARKANSAS: Oilstones. | 14. NORTH CAROLINA: Millstones, garnet, and corundum. |
| 5. PENNSYLVANIA: Millstones, crystalline quartz, and garnet. | 15. VIRGINIA: Millstones. |
| 6. MISSOURI: Grindstones and infusorial earth. | 16. WISCONSIN: Crystalline quartz. |
| 7. NEW HAMPSHIRE: Scythestones. | 17. NEBRASKA: Pumice. |
| 8. CONNECTICUT: Infusorial earth and crystalline quartz. | 18. CALIFORNIA: Infusorial earth. |
| 9. MINNESOTA: Feldspar. | 19. MONTANA: Grindstones and corundum. |
| 10. VERMONT: Scythestones. | 20. GEORGIA: Infusorial earth. |
| | 21. SOUTH DAKOTA: Pumice. |
| | 22. WYOMING: Grindstones. |
| | 23. IDAHO: Pumice. |

In 1904 there were 26 States that contributed to the production of abrasive materials, of which Florida, Kansas, Kentucky, and Maryland did not report any output during 1905. Idaho, however, was a new State added to the list.

BUHRSTONES AND MILLSTONES.

The American stone used in the manufacture of buhrstones and millstones varies from a sandstone to a quartz conglomerate rock which occurs along the eastern slopes of the Appalachian Mountains from New York to North Caro-

lina. It is known locally by different names as Esopus stone from Ulster County, N. Y.; Cocalico stone from Lancaster County, Pa.; Brush Mountain stone from Montgomery County, Va.; and Carolina stone from Rowan County, N. C. The buhrstones imported from France, Belgium, and Germany are decidedly different in character, and they are usually brought into this country in pieces and then made up into buhrstones.

PRODUCTION.

The production of buhrstones and millstones in the United States during 1905 was valued at \$37,974, a very slight increase over \$37,338, the value in 1904. The production of 1905 is only about one-third of what it was in 1887, at the time of the introduction of the roller-mill process for grinding wheat flour. The demand for these stones for use in grinding mineral paints, barytes, drugs, paste, mustard, cement, plaster, fertilizers, glucose, chocolate, spices, etc., is not very large, although wherever such stones have been used they have for the most part given satisfaction. There are a number of States in which rock of the right texture and quality for manufacturing into buhrstones can be obtained, but there were only four States reporting a production of buhrstones or millstones in 1905, with a total of 25 producers, as follows: New York, 14; Pennsylvania, 5; Virginia, 4; North Carolina, 2.

There is given in the following table the values of the productions for the years 1902 to 1905, inclusive, by States.

Value of buhrstones produced in the United States, 1902-1905, by States.

State.	1902.	1903.	1904.	1905.
New York	\$30,570	\$5,441	\$24,585	\$25,915
Virginia	11,435	9,812	4,759	8,486
North Carolina and Vermont	6,825	5,902	6,500	2,522
Pennsylvania	1,978	1,397	1,494	1,351
Total	59,808	52,552	37,338	37,974

^a No production of buhrstones from Vermont in 1904 and 1905.

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

Value of buhrstones produced in the United States, 1880-1905.

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	1905	37,974

IMPORTS.

The value of the imports of buhrstones into the United States varies considerably from year to year. The following table gives the imports for the last five years.

Value of buhrstones and millstones imported into the United States, 1901-1905.

Year.	Rough.	Made into mill- stones.	Total.	Year.	Rough.	Made into mill- stones.	Total.
1901	\$40,885	\$1,302	\$42,187	1904	\$30,117	\$2,269	\$32,386
1902	15,243	915	16,158	1905	30,478	938	31,416
1903	21,160	8,481	29,641				

GRINDSTONES AND PULPSTONES.

The production of grindstones and pulpstones in the United States is almost entirely from Ohio and Michigan, and it is particularly from the former State that the chief supply is obtained. There are also smaller quantities of grindstones produced in West Virginia, Montana, Missouri, and Wyoming. The grindstones produced in the three last-named States are used simply for local purposes, and the industry has not yet assumed any considerable importance in them. The most extensive grindstone district in the United States is in the northern part of Ohio, and is included in Lorain, Cuyahoga, and Summit counties, with Cleveland as a center. In the southern part of Ohio, in Washington and Athens counties, there is another grindstone district, and between these

^a Eng. and Min. Jour., January 6, 1906.

two, in Stark and Harrison counties, nearer the center of the State, there is a third district. A fourth district has more recently been developed in the extreme eastern part of the State, in Jefferson and Trumbull counties. The stone from which the grindstones and pulpstones are manufactured is the sandstone that is found so extensively in the Lower Carboniferous series of Ohio. There is, however, considerable local variation in this sandstone as it has been encountered in the different quarries, and there are seven grits that are recognized as distinctive.

In Michigan the grindstone quarries are near Grindstone City, Huron County, and the sandstone from which they are manufactured belongs to the Lower Carboniferous, the same as that observed in Ohio. This is also true of the sandstone in Wood and Jackson counties in West Virginia, from which there are small amounts of grindstones produced each year. The Missouri grindstone locality is located 5 miles from Collins, St. Clair County. The Montana locality is located near Columbus, Yellowstone County, and the Wyoming locality is near Rawlins, Carbon County. There have also been a few grindstones produced in South Dakota, near Edgemont, Fall River County, but for the last few years no work has been done at these quarries for grindstones.

PRODUCTION.

The production of grindstones and pulpstones during 1905 was obtained from Ohio, Michigan, West Virginia, Montana, Missouri, and Wyoming, given in the order of the value of their production. 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 1905 was \$777,606, which was \$103,921 less than the value, \$881,527, of the 1904 production. Of the total value of the 1905 production, the sum of \$51,070 is due to pulpstones, a decrease of \$10,250 as compared with the value, \$61,320, in 1904; this, however, was an increase of \$17,100 as compared with the value, \$33,970, in 1903.

The value of the grindstone production was \$726,536, a decrease of \$93,671 as compared with \$820,207, the value in 1904.

In the following table is given the value of the productions of grindstones and pulpstones for the years 1901 to 1905, inclusive:

Value of the production of grindstones and pulpstones, 1901-1905.

	1901.	1902.	1903.	1904.	1905.
Grindstones	\$561,903	\$644,343	\$687,476	\$820,207	\$726,536
Pulpstones.....	18,800	23,088	33,970	61,320	51,070
Total.....	580,703	667,431	721,446	881,527	777,606

In making their reports to the Survey, some of the producers used the ton as the unit of measurement, while others give the actual number of grindstones manufactured. In 1905 the number of grindstones reported, exclusive of pulpstones, aggregated 33,772, valued at \$448,799, as against 53,572 stones, valued at \$652,717, in 1904. The product reported by weight amounted to 24,429 long tons, valued at \$277,737, as against 15,755 tons, valued at \$167,490, in 1904. The average value of that portion of the 1905 product reported by weight was \$11.37 per ton, an increase of 74 cents per ton as compared with the average value, \$10.63 per ton, in 1904. The price per ton reported for the 1905 product varied from \$6.67 to \$16.50.

In the following table are given the values of the grindstones and pulpstones produced in the United States from 1903 to 1905, by States:

Value of grindstones and pulpstones produced in the United States, 1903-1905, by States.

State.	1903.	1904.	1905.
Ohio	\$646,776	\$767,552	\$644,315
Michigan	70,550	112,500	111,500
West Virginia, Missouri, and Montana	4,120	a 1,475	a 21,791
Total	721,446	881,527	777,606

^a Including a small production from Wyoming in 1904 and 1905.

The productions of West Virginia, Missouri, Montana, and Wyoming were all very small as compared with those of Michigan and Ohio. There were a total of 23 producers of grindstones reporting in 1905, of whom 15 were in Ohio, 3 in Michigan, 2 in Missouri, and 1 each in Montana, West Virginia, and Wyoming.

The value of the production of grindstones and pulpstones in the United States from 1880 to 1905, inclusive, is shown in the following table:

Value of grindstones produced in the United States, 1880-1905.

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	1905.....	777,606

IMPORTS.

The imports consist principally of pulpstones and a few grindstones that are used in the glass and optical trades and are obtained from Newcastle-upon-Tyne, and from Wales and Scotland. In 1905 the value of the imports of grindstones amounted to \$113,752, as against \$93,152 in 1904. 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 following table is given the value of the grindstones imported into the United States in the last five years:

Grindstones imported and entered for consumption in the United States, 1901-1905.

Year.	Value.	Year.	Value.
1901.....	\$88,871	1904.....	\$93,152
1902.....	76,906	1905.....	113,752
1903.....	85,705		

CANADIAN PRODUCTION.

The grindstone production of Canada has not yet become a very important industry, and in 1905 it only amounted to 5,172 short tons, valued at \$57,200, as against 4,509 tons, valued at \$42,782, in 1904. The average price per ton in 1905 was \$11.06 as against \$9.49 in 1904 and \$8.73 in 1903.

Production of grindstones in Canada, 1903-1905.

[Short tons.]

Year.	Quantity.	Value.	Average value per ton.
1903.....	5,538	\$48,302	\$8.73
1904.....	4,509	42,782	9.49
1905.....	5,172	57,200	11.06

INFUSORIAL EARTH AND TRIPOLI.

Although but a small portion of the infusorial earth produced in the United States is used for abrasive purposes, the total production is included under abrasives, as it represents but a small mineral industry. Under this head are included all porous, siliceous earths of organic origin, which are perhaps better described by the term diatomaceous earth on account of the microscopic, siliceous shells of diatoms which they contain. This material is marketed, however, under the name of infusorial earth or tripoli, and abroad by the names of "kieselguhr" and fossil meal. The material, after it is mined, goes through a process of purification in which it is washed, calcined, and pulverized; and it is put on the market in America in a number of forms according to its purity, as shown by varying from pure white to pinkish-white or brownish.

PRODUCTION.

The production of infusorial earth in 1905 amounted to 10,977 short tons, valued at \$64,637. This is an increase of 4,703 tons in quantity and of \$20,473 in value as compared with the production of 6,274 short tons, valued at \$44,164 in 1904. This is the largest quantity reported for any one year since these statistics have been collected. The greatest value was for the production of 1903, when 9,219 tons were valued at \$76,273. The States from which this production was obtained, given in the order of their productions and with the number of producers in each, were as follows: Missouri, 2; California, 1; Georgia, 1; New York, 1; Connecticut, 1; Massachusetts, 1; a total of seven producers in six States. Florida, Maryland, New Hampshire, and Virginia, which had outputs in 1904, did not report any in 1905.

In the table following is given the quantity and value of infusorial earth produced in the United States since 1880.

Production of infusorial earth, 1880-1905.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1880.....	1,833	\$45,660	1893.....		\$22,582
1881.....	1,000	10,000	1894.....	2,584	11,718
1882.....	1,000	8,000	1895.....	4,954	20,514
1883.....	1,000	5,000	1896.....	3,846	26,792
1884.....	1,000	5,000	1897.....	3,833	22,835
1885.....	1,000	5,000	1898.....	2,733	16,601
1886.....	1,200	6,000	1899.....	4,334	37,032
1887.....	3,000	15,000	1900.....	3,615	24,207
1888.....	1,500	7,500	1901.....	4,020	52,950
1889.....	3,466	23,372	1902.....	5,665	53,244
1890.....	2,532	50,240	1903.....	9,219	76,273
1891.....		21,988	1904.....	6,274	44,164
1892.....		43,655	1905.....	10,977	64,637

IMPORTS.

There is each year imported into the United States a small quantity of infusorial earth or tripoli, which, however, is not separately recorded, but is included with rotten stone, which is used for similar purposes. In 1905 the value of the imports of rotten stone and tripoli amounted to \$18,986, as against \$23,022 in 1904, \$34,977 in 1903, and \$39,296 in 1902. No record is kept by the Bureau of Statistics of the number of tons of this material imported.

OILSTONES AND SCYTHESTONES.**PRODUCTION.**

There were no new quarries that produced any oilstones or scythestones during 1905, and the total production was from the old localities in Arkansas, Indiana, Michigan, New Hampshire, Ohio, and Vermont. In New Hampshire and Vermont the material used in manufacturing scythestones is a quartz schist, and in all the other States it is a sandstone which varies widely in texture; the novaculite variety, which is obtained from Arkansas, is the most valuable of any of the abrasives, and the demand for it is in some respects greater than the supply. 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 decided increase in the production of oilstones and scythestones in the United States in 1905 as compared with the production in 1904, but it was far below the production of 1903. The value of the 1905 production was \$244,546, which is an increase of \$55,561 as compared with \$188,985, the value of the production in 1904. As compared, however, with the 1903 production, the value of which was \$366,857, it is a decrease of \$122,511. 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 in nearly every instance also, with the exception of the novaculite, the raw material would have no value whatever for shipment in the crude condition. It is the value of the finished stones, and not that of the raw material, that is given in these statistics.

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 Michigan. This is the same order as for 1904, with the exception that Kentucky reported no production in 1905 and that there was a small production from Michigan, which did not report any output for 1904.

There is given in the following table the value of the oilstones and scythestones produced in the United States from 1891 to 1905, inclusive:

Value of oilstones and whetstones produced in the United States, 1891-1905.

1891.....	\$150,000	1899.....	\$208,283
1892.....	146,730	1900.....	174,087
1893.....	135,173	1901.....	158,300
1894.....	136,873	1902.....	221,762
1895.....	155,881	1903.....	366,857
1896.....	127,098	1904.....	188,985
1897.....	149,970	1905.....	244,546
1898.....	180,486		

IMPORTS.

The value of the imports of oilstones and scythestones during 1905 amounted to \$65,753, as compared with \$61,609 in 1904, an increase of \$4,144. The 1905 imports were about one-fourth the value of the domestic production; in 1904 they were about one-third, and in 1903 about one-fifth; and since 1891 the variation in value of imports to domestic production has been from about one-fifth to one-third. The following table shows the total value of all kinds of hones, oilstones, and whetstones imported into the United States in the last five years:

Value of imports of hones and whetstones, 1901-1905.

1901.....	\$64,655	1904.....	\$61,609
1902.....	56,456	1905.....	65,753
1903.....	65,763		

EXPORTS.

There is still a large demand abroad for American scythestones and oilstones, especially for the Arkansas oilstones and the New Hampshire scythestones, which, with smaller quantities of the Indiana oilstones, represent the greater part of the exports. There is no separate record kept of the exports of these stones and therefore no definite valuation can be given, but, as far as can be ascertained, the exports equal or exceed the imports in value.