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J. W. POWELL, DIRECTOR

MINERAL RESOURCES

OF THE

UNITED STATES

CALENDAR YEAR

1891

DAVID T. DAY

CHIEF OF DIVISION OF MINING STATISTICS AND TECHNOLOGY

WASHINGTON

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July 25, 1893.

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CONTENTS.

LETTER OF TRANSMITTAL.

UNITED STATES GEOLOGICAL SURVEY,
DIVISION OF MINING STATISTICS AND TECHNOLOGY,
Washington. D. C., December 19, 1892.

SIR: I have the honor to transmit herewith a report in continuation of the series "Mineral Resources of the United States," of which the present volume is the eighth and bears the title "Mineral Resources of the United States, 1891." In it the statistical data are brought forward uniformly to December 31, 1891, though much of the descriptive text is the result of developments of the year 1892. In accordance with your instructions, a report covering the statistics of 1892 is in active preparation and will be transmitted to the printer in May.

The several important chapters of the present report have been published in advance, and I beg to offer you my hearty thanks, especially for the coöperation which you have given in carrying out this new feature, as well as for the attention you have given in carrying out the general work.

Very respectfully, your obedient servant,

DAVID T. DAY,
Geologist in Charge.

HON. J. W. POWELL,
Director, U. S. Geological Survey.

INTRODUCTION.

This is the eighth volume of the series "Mineral Resources of the United States." The general object of the series is to show the progress made from year to year in the production of minerals. Of primary importance is the statement of the total quantity and value of every substance mined. This volume is entitled "Mineral Resources of the United States, 1891," because it contains a complete statement of the mineral products during that year. In order that such a statement may be intelligible it is accompanied by a considerable volume of secondary information concerning new discoveries of mineral deposits, new uses for these products, and improved technical processes by which minerals have been made more available, the yield increased, etc. This secondary information is not limited to the close of the statistical period under consideration. It is complete up to the latest date possible, frequently far into 1892. This is because of the impossibility of concluding a complete canvass of the product of huge industries like coal, iron ores, and building stone without a considerable delay after the close of the year reviewed.

The present volume deals with the mineral progress of the year 1891, and covers about the same range of subjects treated in the previous reports. The totals have already been published, and also the principal chapters in complete form as soon as compiled.

The sources of information have been in general the same as in previous volumes, but with a constant increase in the number of returns received direct from the producers.

The names of the contributors of the various sections appear in connection with the subjects treated.

In addition much information has been received from State geologists and other public officers, which is duly credited whenever possible. The statistics of imports and exports are published as usual from the records in the office of the Bureau of Statistics of the Treasury Department.

MINERAL RESOURCES OF THE UNITED STATES.

SUMMARY.

METALS.

Iron and steel.—The production of pig iron declined from 10,307,028 short tons in 1890 to 9,273,455 short tons in 1891. The production of most other manufactures of iron, notably steel ingots, steel rails, and cut nails, declined also. The product of pig iron was, however, greater than in any other country.

Gold and silver.—The output of gold aggregated 1,604,840 fine ounces (troy), with a value of $33,175,000; an increase of $330,000 over 1890. This product equaled that of 1888, and is larger than in any other year since 1881, with the single exception of 1886, when it reached $35,000,000. While there have been many new finds, notably in Oregon, Montana, and Colorado, there have been no rich strikes in the nature of bonanzas, and many old properties have been abandoned.

The silver product amounted to 58,330,000 ounces; a gain of 3,830,000 ounces over 1890. The coining value was $75,416,565. The commercial price of silver bullion averaged $0.988 per ounce.

The above statistics of gold and silver were collected by the Director of the Mint.

Copper.—Total product was 295,810,076 pounds, valued in New York at $38,455,300, against 265,115,133 pounds in 1890. Copper from imported pyrites is included in both years. The product is greater than in any previous year. The increase came from Lake Superior, Arizona, and California; Montana's output remained about the same as in 1890. The stock of copper declined in the United States.

Lead.—The product increased beyond all previous years to 202,406 short tons, worth in New York $17,609,322. The increase was in desilverized lead.

Zinc.—The total product was 80,337 short tons in 1891, against 63,683 short tons in 1890. Its value was $8,033,700. The product has been increasing each year since 1882. Nearly every important producer showed an increased output.

Quicksilver.—The product was practically the same in 1891 as in 1890. In 1889 it amounted to 26,484 flasks of 76½ pounds net. In 1890, 22,926 flasks were produced and 22,904 flasks in 1891. California was the only producing State. The largest producer, the New Almaden mine, declined to small proportions, but its decreased output was compensated by increases in others. In spite of decreased production over the world and also decreased stock the price declined. It is expected that the price will improve in 1892 but that the production will not increase.

Aluminum.—The amount made is constantly increasing. In 1890 47,881 pounds of metallic aluminum were made, besides 13,400 pounds of aluminum contained in ferro-aluminum and aluminum bronze. In 1891 this increased to 100,000 pounds of aluminum and 50,000 pounds in bronze and ferro-aluminum. The demand for experimental purposes increases. The total product in 1891, including that in alloys, is valued at $100,000.

Large deposits of bauxite have been found in Arkansas in addition to that which has already been mined in Georgia. Careful tests are being made to determine the availability of these new sources of supply.

Manganese.—The product declined from 25,684 long tons, worth $219,050, in 1890, to 23,416 long tons in 1891, worth $239,129. The decrease was in the Virginia mines, which was partly compensated by production in Colorado.

Nickel and cobalt.—In 1891 the Gap mine in Pennsylvania was the only actual producer of nickel and cobalt. Its product was 118,498 pounds, worth $71,099. In 1890 the total product was 223,488 pounds, worth $134,093. In 1891 the quantity of nickel from Canadian matte smelted in the United States exceeded the domestic product.

Chrome-iron ore.—The production decreased from 3,599 long tons in 1890 to 1,372 long tons in 1891. It was valued at $15 per ton in San Francisco during 1891, but the price declined to $10 in 1892, and shipments stopped after 300 tons had been delivered.

Tin.—The industrial production of tin began in California and amounted to 125,289 pounds, worth at the New York price $25,058. Machinery was erected at the Virginia mines for testing the value of the ore, and the mill in South Dakota was nearly complete at the end of the year.

Antimony.—The product consisted of 278 short tons of metallic antimony and antimony contained in exported ores, all valued at $47,007. This all came from Nevada. The mines in Idaho, which produced in 1890, are closed by litigation. The product in 1890 aggregated 129 short tons of metallic antimony, worth $40,756.

FUELS.

Coal.—The product increased from 157,788,656 short tons in 1890, worth at the mines $176,804,573, to 168,566,669 short tons in 1891, valued at $191,133,135. The gain in tonnage was 10,778,013, and in value $14,328,562. The production of Pennsylvania anthracite increased from 46,468,641 short tons in 1890 to 50,665,431 in 1891. In spite of a decreased production in the Connellsville coke region the yield of Pennsylvania bituminous coal increased about 500,000 tons, owing chiefly to increased consumption by local trade. The notable increases were in West Virginia, where a gain of nearly 2,000,000 tons brings the product for 1891 to over 9,000,000, and in the Indian Territory, where the million-ton mark is touched for the first time. Ohio and Illinois, the two largest coal producers outside of Pennsylvania, report a somewhat larger output in 1890.

Coke.—A strike in the Connellsville region from February until May effected a decrease of over a million tons in the product from Pennsylvania. In the Flat Top region the product was also slightly less than in 1890.

Petroleum.—The discovery of the McDonald and several other new fields in Pennsylvania, together with the increase in Ohio, resulted in a product of 54,291,980 barrels, worth, at the average price of oil at the producing centers, $32,575,188. This is the greatest product of any year in the history of the oil industry in the United States. In 1890 the product amounted to 45,822,672 barrels, worth $35,365,105.

Natural gas.—The product declined from a value of $18,742,725 in 1890 to $15,500,084 in 1891. The value used is that of the coal displaced. Efforts have been made to utilize the natural gas which has been observed for years on the eastern shore of Great Salt lake.

STRUCTURAL MATERIALS.

Stone.—The stone product of all kinds was about the same as the preceding year, being valued at $47,000,000 in 1890 and $47,294,746 in 1891, not including the limestone used for lime. The lime amounted to 60,000,000 barrels, worth $35,000,000.

Cement.—The production of Portland cement is constantly increasing. In the year under review it amounted to 450,000 barrels. The total product of all kinds of cement aggregated 8,222,792 barrels, worth $6,680,951.

Limestone for iron flux.—This product declined with the pig-iron industry to 5,000,000 long tons, worth $2,300,000. In 1890 5,521,622 long tons were produced, worth $2,760,811.

MISCELLANEOUS.

Precious stones.—Turquois is now mined regularly in New Mexico. The sapphire mines in Montana are also to be opened systematically, and in the state of Washington a find of very valuable opals will be mined. The product in 1891 increased to a value of $235,300 from $118,833 in 1890. The gem mines of North Carolina and Paris, Maine, were not operated.

Phosphate rock.—South Carolina produced 332,414 long tons of land rock, valued at $2,071,693, and 130,528 tons of river rock, worth $760,977, as against 353,757 long tons of land rock and 110,241 tons of river rock, with an aggregate value of $2,875,605 in 1890. Phosphate mining in Florida had not settled down to a firm condition, and a great deal of rock was taken out without regard to the condition of the market. The consequence was that over 50,000 tons of land rock and 12,000 tons of river pebble were carried over January 1, 1892, having failed to find a remunerative demand. The Florida rock marketed consisted of 57,982 tons of land rock, worth $391,894, and 54,500 tons of river pebble, worth $285,890.

Marls.—The product in New Jersey is still declining; 135,000 tons, worth $67,500, comprised the output in 1891. The marls of Virginia were used to a slight extent.

Asphaltum.—The product consisted of 39,962 tons of bituminous rock from California, worth $154,164; 3,000 tons of the same material from Kentucky, valued at $6,000, and 1,732 tons of gilsonite from Utah. Part of this, sold at Salt Lake City, brought $2,000; the remainder was shipped to St. Louis for distribution and manufacture into varnishes, insulators, etc. The value at St. Louis is about $50 per ton. The total value for this portion of the product was $80,100. The combined value of bituminous rock and gilsonite was $242,264, against $190,416 in 1890, a gain of $51,848.

Salt.—Product in 1891, 9,987,945 barrels, worth $4,716,121; in 1890, 8,776,991 barrels, worth $4,752,286.

Bromine.—The product decreased from 387,847 pounds, worth $104,719, in 1890, to 343,000 pounds, worth $54,880 in 1891. The considerable decrease in value was caused by a decline in the price from 25 to 15 cents per pound. The decline was due to accumulated stocks.

Sulphur.—In Utah 1,200 tons were mined and sold at $33 per ton. No sulphur was mined in 1890.

Pyrites.—The demand is more than equal to the supply, and new mines are being opened in Virginia. The old mines at Ducktown, Tennessee, will be reopened. Product, 119,320 tons in 1891, worth $338,880.

Graphite.—The product was limited to New York state and was valued at $110,000. The product in 1890 was worth $77,500.

Barytes.—The production continues to increase. The output, which came principally from Missouri and Virginia, and smaller amounts from North Carolina and South Carolina, was 31,069 tons in 1891. This was a gain of 9,158 tons over 1890, in which year the product was entirely from Missouri and Virginia.

Gypsum.—The product increased from 182,995 short tons in 1890 to 208,126 tons in 1891. The value increased from $574,523 to $628,051. The states producing it were California, Colorado, Iowa, Kansas, Michigan, New York, Ohio, South Dakota, Utah, Virginia, and Wyoming.

Mineral paints.—The product includes 25,142 short tons of metallic paint, worth $334,455; 18,294 short tons of ocher, umber, and sienna, worth $233,823; 4,091 tons of Venetian reds, valued at $90,000; and 25 tons of soapstone pigment, worth $200.

Mineral waters.—The amount sold in bottles, barrels, etc., aggregated 18,392,732 gallons, worth $2,996,259, against 13,907,418 gallons in 1890, worth $2,600,750.

Metallic products of the United States in 1891.

Products.	Quantity.	Value.
Pig iron ....long tons..	8, 279, 870	$128, 337, 985
Silver ....troy ounces..	58, 330, 000	75, 416, 565
Gold ....do....	1, 604, 840	33, 175, 000
Copper ....pounds..	295, 810, 076	38, 455, 300
Lead........................short tons..	202, 406	17, 609, 322
Zinc........................do....	80, 337	8, 033, 700
Quicksilver ....flasks..	22, 904	1, 036, 386
Nickel ....pounds..	118, 498	71, 099
Aluminum ....do....	150, 000	100, 000
Tin........................do....	125, 289	25, 058
Antimony ....short tons..	278	47, 007
Platinum ....troy ounces..	100	500
Total value........................	....	302, 307, 922

Non-metallic mineral products of the United States in 1891.

Products.	Quantity.	Value.
Bituminous coal........................long tons..	105, 268, 962	$117, 188, 400
Pennsylvania anthracite ....do....	45, 236, 992	73, 944, 735
Building stone........................	....	47, 294, 746
Petroleum ....barrels..	54, 291, 980	32, 575, 188
Lime ....do....	60, 000, 000	35, 000, 000
Natural gas........................	....	15, 500, 084
Cement........................barrels..	8, 222, 792	6, 680, 951
Salt ....do....	9, 987, 945	4, 716, 121
Phosphate rock ....long tons..	587, 988	3, 651, 150
Limestone for iron flux........................do....	5, 000, 000	2, 300, 000
Mineral waters ....gallons sold..	18, 392, 732	2, 996, 259
Zinc white........................short tons..	....	1, 600, 000
Potters' clay ....long tons..	400, 000	900, 000
Mineral paints ....do....	47, 652	658, 478
Borax ....pounds..	13, 380, 000	869, 700
Gypsum........................short tons..	208, 126	628, 051
Grindstones	....	476, 113
Fibrous talc ....short tons..	53, 054	493, 068
Pyrites ....long tons..	119, 320	338, 880
Soapstone ....short tons..	16, 514	243, 981
Manganese ore ....long tons..	23, 416	239, 129
Asphaltum ....short tons..	45, 054	242, 264
Precious stones........................	....	235, 300
Bromine........................pounds..	343, 000	54, 880
Corundum........................short tons..	2, 265	90, 230
Barytes (crude) ....long tons..	31, 069	118, 363
Graphite ....pounds..	....	110, 000
Millstones	....	16, 587
Novaculite ....pounds..	1, 375, 000	150, 000
Marls ....short tons..	135, 000	67, 500
Flint ....long tons..	15, 000	60, 000
Fluorspar ....short tons..	10, 044	78, 330
Chromic iron ore ....long tons..	1, 372	20, 580
Infusorial earth ....short tons..	....	21, 988
Feldspar ....long tons..	10, 000	50, 000
Mica ....pounds..	75, 000	100, 000
Ozocerite, refined........................do....	50, 000	7, 000
Cobalt oxide........................do....	7, 200	18, 000
Slate ground as a pigment............long tons..	2, 000	20, 000
Sulphur ....short tons..	1, 200	39, 600
Asbestos ....do....	66	3, 960
Rutile ....pounds..	300	800
Lithographic stone ....short tons..	....	....
Total value........................	....	353, 790, 416

Résumé.

Metals........................	$302, 307, 922
Non-metallic mineral substances named in foregoing table............	353, 790, 416
Estimated value of mineral products, unspecified........................	10, 000, 000
Grand total........................	666, 105, 837

Mineral products of the United States

	Products.	1880.		1881.	
		Quantity.	Value.	Quantity.	Value.
	METALLIC.				
1	Pig iron, value at Philadelphia ....long tons..	3, 375, 912	$89, 315, 569	4, 144, 254	$87, 029, 334
2	Silver, coining value.................. troy ounces..	30, 320, 000	39, 200, 000	33, 077, 000	43, 000, 000
3	Gold, coining value..........................do....	1, 741, 500	36, 000, 000	1, 676, 300	34, 700, 000
4	Copper, value at New York City ....pounds..	60, 480, 000	11, 491, 200	71, 680, 000	12, 175, 600
5	Lead, value at New York City........short tons..	97, 825	9, 782, 500	117, 085	11, 240, 160
6	Zinc, value at New York City ....do....	23, 239	2, 277, 432	26, 800	2, 680, 000
7	Quicksilver, value at San Francisco.......flasks..	59, 926	1, 797, 780	60, 851	1, 764, 679
8	Nickel, value at Philadelphia.............pounds..	329, 968	164, 984	265, 668	292, 235
9	Aluminum, value at Pittsburg ....do....	....	....	....	....
10	Tin..do....	....	....	....	....
11	Antimony, value at San Francisco....short tons..	50	10, 000	50	10, 000
12	Platinum, value (crude) at San Francisco.. ....troy ounces..	100	400	100	400
13	Total value of metallic products	....	190, 039, 865	....	192, 892, 408
	NON-METALLIC (spot values).				
14	Bituminous coal.........................long tons..	38, 242, 641	53, 443, 718	48, 179, 475	60, 224, 344
15	Pennsylvania anthracite.....................do....	25, 580, 189	42, 196, 678	28, 500, 016	64, 125, 036
16	Building stone..	....	18, 356, 055	....	20, 000, 000
17	Petroleum.................................barrels..	26, 286, 123	24, 183, 233	27, 661, 238	25, 448, 339
18	Lime..do....	28, 000, 000	19, 000, 000	30, 000, 000	20, 000, 000
19	Natural gas	....	....	....	....
20	Cement.....................................barrels..	2, 072, 943	1, 852, 707	2, 500, 000	2, 000, 000
21	Salt..do....	5, 961, 060	4, 829, 566	6, 200, 000	4, 200, 000
22	Phosphate rock ....long tons..	211, 377	1, 123, 823	266, 734	1, 980, 259
23	Limestone for iron flux......................do....	4, 500, 000	3, 800, 000	6, 000, 000	4, 100, 000
24	Mineral waters.....................gallons sold..	2, 000, 000	500, 000	3, 700, 000	700, 000
25	Zinc-white ....short tons..	10, 107	763, 738	10, 000	700, 000
26	Potters' clay ....long tons..	25, 783	200, 457	25, 000	200, 000
27	Mineral paints ....do....	3, 604	135, 840	6, 000	100, 000
28	Borax ....pounds..	3, 692, 443	277, 233	4, 046, 000	304, 461
29	Gypsum...................................short tons..	90, 000	400, 000	85, 000	350, 000
30	Grindstones	....	500, 000	....	500, 000
31	Fibrous talc............................short tons..	4, 210	54, 730	5, 000	60, 000
32	Pyrites ....long tons..	2, 000	5, 000	10, 000	60, 000
33	Soapstone ....short tons..	8, 441	66, 665	7, 000	75, 000
34	Manganese ore..........................long tons..	5, 761	86, 415	4, 895	73, 425
35	Asphaltum...............................short tons..	444	4, 440	2, 000	8, 000
36	Precious stones	....	100, 000	....	110, 000
37	Bromine....................................pounds..	404, 690	114, 752	300, 000	75, 000
38	Corundum...............................short tons..	1,044	29, 280	500	80, 000
39	Barytes (crude)..........................long tons..	20, 000	80, 000	20, 000	80, 000
40	Graphite ....pounds..	....	49, 800	400, 000	30, 000
41	Millstones	....	200, 000	....	150, 000
42	Novaculite ....pounds..	420, 000	8, 000	500, 000	8, 580
43	Marls.....................................short tons..	1, 000, 000	500, 000	1, 000, 000	500, 000
44	Flint ....long tons..	20, 000	80, 000	25, 000	100, 000
45	Fluorspar................................short tons..	4, 000	16, 000	4, 000	16, 000
46	Chromic iron ore ....long tons..	2, 288	27, 808	2, 000	30, 000
47	Infusorial earth ....short tons..	1, 833	45, 660	1, 000	10, 000
48	Feldspar ....long tons..	12, 500	60, 000	14, 000	70, 000
49	Mica..pounds..	81. 669	127, 825	100, 000	250, 000
50	Ozocerite, refined.............................do....	....	....	....	....
51	Cobalt oxide....................................do....	7, 251	24, 000	8, 280	25, 000
52	Slate ground as a pigment..............long tons..	1, 000	10, 000	1, 000	10, 000
53	Sulphur ....short tons..	600	21, 000	600	21, 000
54	Asbestos ....do....	150	4, 312	200	7, 000
55	Rutile ....pounds..	100	400	200	700
56	Lithographic stone ....short tons .	....	....	50	1, 000
57	Total value of non-metallic mineral products.	....	173, 279, 135	....	206, 783, 144
58	Total value of metallic products	....	190, 039, 865	....	192, 892, 408
59	Estimated value of mineral products unspecified.	....	6, 000, 000	....	6, 500, 000
60	Grand total	....	369, 319, 000	....	406, 175, 552

for the calendar years 1880 to 1891.

1882.		1883.		1884.		1885.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,623,323	$106,336,429	4,595,510	$91,910,200	4,097,868	$73,761,624	4,044,525	$64,712,400	1
36,197,695	46,800,000	35,733,622	46,200,000	37,744,605	48,800,000	39,910,279	51,600,000	2
1,572,186	32,500,000	1,451,249	30,000,000	1,489,949	30,800,000	1,538,376	31,800,000	3
91,646,232	16,038,091	117,151,795	18,064,807	145,221,934	17,789,687	170,962,607	18,292,999	4
132,890	12,624,550	143,957	12,322,719	139,897	10,537,042	129,412	10,469,431	5
33,765	3,646,620	36,872	3,311,106	38,544	3,422,707	40,688	3,539,856	6
52,732	1,487,042	46,725	1,253,632	31,913	936,327	32,073	979,189	7
281,616	309,777	58,800	52,920	64,550	48,412	277,904	179,975	8
....	....	83	875	150	1,350	283	2,550	9
....	....	....	....	....	....	....	....	10
60	12,000	60	12,000	60	12,000	50	10,000	11
200	600	200	600	150	450	250	187	12
....	219,755,109	....	203,128,859	....	186,109,599	....	181,586,587	13
60,861,190	76,076,487	68,531,500	82,237,800	73,730,539	77,417,066	64,840,668	82,347,648	14
31,358,264	70,556,094	34,336,469	77,257,055	33,175,756	66,351,512	34,228,548	76,671,948	15
....	21,000,000	....	20,000,000	....	19,000,000	....	19,000,000	16
30,510,830	24,065,988	23,449,633	25,790,252	24,218,438	20,595,966	21,847,205	19,198,243	17
31,000,000	21,700,000	32,000,000	19,200,000	37,000,000	18,500,000	40,000,000	20,000,000	18
....	215,000	....	475,000	....	1,460,000	....	4,857,200	19
3,250,000	3,672,750	4,190,000	4,293,500	4,000,000	3,720,000	4,150,000	3,492,500	20
6,412,373	4,320,140	6,192,231	4,211,042	6,514,937	4,197,734	7,038,653	4,825,345	21
332,077	1,992,462	378,380	2,270,280	431,779	2,374,784	437,856	2,846,064	22
3,850,000	2,310,000	3,814,273	1,907,136	3,401,930	1,700,965	3,356,956	1,678,478	23
5,000,000	800,000	7 529,423	1,119,603	10,215,328	1,459,143	9,148,401	1,312,845	24
10,000	700,000	12,000	840,000	13,000	910,000	15,000	1,050,000	25
30,000	240,000	32,000	250,000	35,000	270,000	36,000	275,000	26
7,000	105,000	7,000	84,000	7,000	84,000	3,950	43,575	27
4,236,291	338,903	6,500,000	585,000	7,000,000	490,000	8,000,000	480,000	28
100,000	450,000	90,000	420,000	90,000	390,000	90,405	405,000	29
....	700,000	....	600,000	....	570,000	....	500,000	30
6,000	75,000	6,000	75,000	10,000	110,000	10,000	110,000	31
12,000	72,000	25,000	137,500	35,000	175,000	49,000	220,500	32
6,000	90,000	8,000	150,000	10,000	200,000	10,000	200,000	33
4,532	67,980	6,155	92,325	10,180	122,160	23,258	190,281	34
3,000	10,500	3,000	10,500	3,000	10,500	3,000	10,500	35
....	150,000	....	207,050	....	222,975	....	209,900	36
250,000	75,000	301,100	72,264	281,100	67,464	310,000	89,900	37
500	80,000	550	100,000	600	108,000	600	108,000	38
20,000	80,000	27,000	108,000	25,000	100,000	15,000	75,000	39
425,000	34,000	575,000	46,000	....	....	327,883	26,231	40
....	200,000	....	150,000	....	150,000	....	100,000	41
600,000	10,000	600,000	10,000	800,000	12,000	1,000,000	15,000	42
1,080,000	540,000	972,000	486,000	875,000	437,500	875,000	437,500	43
25,000	100,000	25,000	100,000	30,000	120,000	30,000	120,000	44
4,000	20,000	4,000	20,000	4,000	20,000	5,000	22,500	45
2,500	50,000	3,000	60,000	2,000	35,000	2,700	40,000	46
1,000	8,000	1,000	5,000	1,000	5,000	1,000	5,000	47
14,000	70,000	14,100	71,112	10,900	55,112	13,600	68,000	48
100,000	250,000	114,000	285,000	147,410	368,525	92,000	161,000	49
....	....	....	....	....	....	....	....	50
11,653	32,046	1,096	2,795	2,000	5,100	68,723	65,373	51
2,000	24,000	2,000	24,000	2,000	20,000	1,975	24,687	52
600	21,000	1,000	27,000	500	12,000	715	17,875	53
1,200	36,000	1,000	30,000	1,000	30,000	300	9,000	54
500	1,800	550	2,000	600	2,000	600	2,000	55
....	....	....	....	....	....	....	....	56
....	231,340,150	....	243,812,214	....	221,879,506	....	241,312,093	57
....	219,755,109	....	203,128,859	....	186,109,599	....	181,586,587	58
....	6,500,000	....	6,500,000	....	5,000,000	....	5,000,000	59
....	457,595,259	....	453,441,073	....	412,989,105	....	427,898,680	60

Mineral products of the United States for the

	Products.	1886.		1887.	
		Quantity.	Value.	Quantity.	Value.
	METALLIC.				
1	Pig iron, value at Philadelphia.....long tons..	5,683,329	$95,195,760	6,417,148	$121,925,800
2	Silver, coining value..............troy ounces..	39,445,312	51,000,000	41,269,240	53,350,000
3	Gold, coining value.........................do....	1,881,250	35,000,000	1,596,500	33,000,000
4	Copper, value at New York City.....pounds..	161,235,381	16,527,651	185,227,331	21,115,916
5	Lead, value at New York City....short tons..	135,629	12,667,749	160,700	14,463,000
6	Zinc, value at New York City............do....	42,641	3,752,408	50,340	4,782,300
7	Quicksilver, value at San Francisco...flasks..	29,981	1,060,000	33,825	1,429,000
8	Nickel, value at Philadelphia ....pounds..	214,992	127,157	205,566	133,200
9	Aluminum, value at Pittsburg...........do....	3,000	27,000	18,000	59,000
10	Tin...do....	....	....	....	....
11	Antimony, value at San Francisco.short tons..	35	7,000	75	15,000
12	Platinum, value (crude) at San Francisco, ...troy ounces..	50	100	448	1,838
13	Total value of metallic products.........	....	215,364,825	....	250,275,054
	NON-METALLIC (spot values).				
14	Bituminous coal.....................long tons..	65,810,676	78,481,056	78,470,857	98,004,656
15	Pennsylvania anthracite ....do....	34,853,077	76,119,120	37,578,747	84,552,181
16	Building stone..................................	....	19,000,000		25,000,000
17	Petroleum ....barrels..	28,064,841	19,996,313	28,278,866	18,877,094
18	Lime ....do....	42,500,000	21,250,000	46,750,000	23,375,000
19	Natural gas....................................	....	10,012,000	....	15,817,500
20	Cement.....................................barrels..	4,500,000	3,990,000	6,692,744	5,674,377
21	Salt ....do....	7,707,081	4,736,585	7,831,962	4,093,846
22	Phosphate rock ....long tons..	430,549	1,872,936	480,558	1,836,818
23	Limestone for iron flux...................do....	4,717,163	2,830,297	5,377,000	3,226,200
24	Mineral waters ....gallons sold..	8,950,317	1,284,070	8,259,609	1,261,463
25	Zinc-white ....short tons..	18,000	1,440,000	18,000	1,440,000
26	Potters' clay ....long tons..	40,000	325,000	43,000	340,000
27	Mineral paints ....do....	15,800	285,000	20,000	310,000
28	Borax ....pounds..	9,778,290	488,915	11,000,000	550,000
29	Gypsum...............................short tons..	95,250	428,625	95,000	425,000
30	Grindstones	....	250,000	....	224,400
31	Fibrous talc..........................short tons..	12,000	125,000	15,000	160,000
32	Pyrites..................................long tons..	55,000	220,000	52,000	210,000
33	Soapstones..........................short tons..	12,000	225,000	12,000	225,000
34	Manganese ore.......................long tons..	30,193	277,636	34,524	333,844
35	Asphaltum...........................short tons..	3,500	14,000	4,000	16,000
36	Precious stones................................	....	119,056	....	163,600
37	Bromine....................................pounds..	428,334	141,350	199,087	61,717
38	Corundum...........................short tons..	645	116,190	600	108,000
39	Barytes (crude) ....long tons..	10,000	50,000	15,000	75,000
40	Graphite ....pounds..	415,525	33,242	416,000	34,000
41	Millstones	....	140,000	....	100,000
42	Novaculite ....pounds..	1,160,000	15,000	1,200,000	16,000
43	Marls ....short tons..	800,000	400,000	600,000	300,000
44	Flint ....long tons..	30,000	120,000	32,000	185,000
45	Fluorspar ....short tons..	5,000	22,000	5,000	20,000
46	Chromic iron ore......................long tons..	2,000	30,000	3,000	40,000
47	Infusorial earth ....short tons..	1,200	6,000	3,000	15,000
48	Feldspar ....long tons..	14,900	74,500	10,200	56,100
49	Mica ....pounds..	40,000	70,000	70,000	142,250
50	Ozocerite, refined ....do....	....	....	....	....
51	Cobalt oxide..................................do....	35,000	36,878	18,340	18,774
52	Slate ground as a pigment..........long tons..	3,000	30,000	2,000	20,000
53	Sulphur ....short tons..	2,500	75,000	3,000	100,000
54	Asbestos ....do..	200	6,000	150	4,500
55	Rutile ....pounds..	600	2,000	1,000	3,000
56	Lithographic stone ....short tons..	40	700	....	....
57	Total value of non-metallic mineral products.	....	245,139,469	....	287,416,320
58	Total value of metallic products.........	....	215,364,825	....	250,275,054
59	Estimated value of mineral products unspecified.	....	5,000,000	....	5,000,000
60	Grand total	....	465,504,294	....	542,691,374

calendar years 1880 to 1891—Continued.

1888.		1889.		1890.		1891.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
6,489,738	$107,000,000	7,603,642	$120,000,000	9,202,703	$151,200,410	8,279,870	$128,337,985	1
45,783,632	59,195,000	51,354,851	66,396,988	54,500,000	70,464,645	58,330,000	75,416,565	2
1,604,927	33,175,000	1,590,869	32,886,744	1,588,880	32,845,000	1,604,840	33,175,000	3
231,270,622	33,833,954	231,246,214	26,907,809	265,115,133	30,848,797	295,810,076	38,455,300	4
180,555	15,924,951	182,967	16,137,689	161,754	14,266,703	202,406	17,609,322	5
55,903	5,500,855	58,860	5,791,824	63,683	6,266,407	80,337	8,033,700	6
33,250	1,413,125	26,484	1,190,500	22,926	1,203,615	22,904	1,036,386	7
204,328	127,632	252,663	151,598	223,488	134,093	118,498	71,099	8
19,000	65,000	47,468	97,335	61,281	61,281	150,000	100,000	9
....	....	....	....	....	....	125,289	25,058	10
100	20,000	115	28,000	129	40,756	278	47,007	11
500	2,000	500	2,000	600	2,500	100	500	12
....	256,257,517	....	269,590,487	....	307,334,207	....	302,307,922	13
91,106,998	101,860,529	85,383,059	94,346,809	99,392,871	110,420,801	105,268,962	117,188,400	14
41,624,611	89,020,483	40,714,721	65,879,514	41,489,858	66,383,772	45,236,992	73,944,735	15
....	25,500,000	....	42,809,706	....	47,000,000	....	47,294,746	16
27,612,025	17,947,620	35,163,513	26,963,340	45,822,672	35,365,105	54,291,980	32,575,188	17
49,087,000	24,543,500	68,474,668	33,217,015	60,000,000	35,000,000	60,000,000	35,000,000	18
....	22,629,875	....	21,097,099	....	18,742,725	....	15,500,084	19
6,503,295	5,021,139	7,000,000	5,000,000	8,000,000	6,000,000	8,222,792	6,680,951	20
8,055,881	4,374,203	8,005,565	4,195,412	8,776,991	4,752,286	9,987,945	4,716,121	21
448,567	2,018,552	550,245	2,937,776	510,499	3,213,795	587,988	3,651,150	22
5,438,000	2,719,000	6,318,000	3,159,000	5,521,622	2,760,811	5,000,000	2,300,000	23
9,578,648	1,679,302	12,780,471	1,748,458	13,907,418	2,600,750	18,392,732	2,996,259	24
20,000	1,600,000	16,970	1,357,600	....	1,600,000	....	1,600,000	25
36,750	300,000	294,344	635,578	350,000	756,000	400,000	900,000	26
24,000	380,000	32,307	463,766	45,732	661,992	47,652	658,478	27
7,589,000	455,340	8,000,000	500,000	9,500,000	617,500	13,380,000	869,700	28
110,000	550,000	267,769	764,118	182,995	574,523	208,126	628,051	29
....	281,800	....	439,587	....	450,000	....	476,113	30
20,000	210,000	23,746	244,170	41,354	389,196	53,054	493,068	31
54,331	167,658	93,705	202,119	111,836	273,745	119,320	338,880	32
15,000	250,000	12,715	231,708	13,670	252,309	16,514	243,981	33
29,198	279,571	24,197	240,559	25,684	219,050	23,416	239,129	34
53,800	331,500	51,735	171,537	40,841	190,416	45,054	242,264	35
....	139,850	....	188,807	....	118,833	....	235,300	36
307,386	95,290	418,891	125,667	387,847	104,719	343,000	54,880	37
589	91,620	2,245	105,565	1,970	89,395	2,265	90,230	38
20,000	110,000	19,161	106,313	21,911	86,505	31,069	118,363	39
400,000	33,000	....	72,662	....	77,500	....	110,000	40
....	81,000	....	35,155	....	23,720	....	16,587	41
1,500,000	18,000	5,982,000	32,980	....	69,909	1,375,000	150,000	42
300,000	150,000	139,522	63,956	153,620	69,880	135,000	67,500	43
30,000	175,000	11,113	49,137	13,000	57,400	15,000	60,000	44
6,000	30,000	9,500	45,835	8,250	55,328	10,044	78,330	45
1,500	20,000	2,000	30,000	3,599	53,985	1,372	20,580	46
1,500	7,500	3,466	23,372	2,532	50,240	....	21,988	47
8,700	50,000	6,970	39,370	8,000	45,200	10,000	50,000	48
48,000	70,000	49,500	50,000	60,000	75,000	75,000	100,000	49
43,500	3,000	50,000	2,500	350,000	26,250	50,000	7,000	50
8,491	15,782	13,955	31,092	6,788	16,291	7,200	18,000	51
2,500	25,000	2,000	20,000	2,000	20,000	2,000	20,000	52
....	....	1,150	7,850	....	....	1,200	39,600	53
100	3,000	30	1,800	71	4,560	66	3,960	54
1,000	3,000	1,000	3,000	400	1,000	300	800	55
....	....	18	243	....	....	....	....	56
....	303,241,114	....	307,640,175	....	339,270,491	....	353,790,416	57
....	256,257,517	....	269,590,487	....	307,334,207	....	302,307,922	58
....	5,000,000	....	10,000,000	....	10,000,000	....	10,000,000	59
....	564,498,631	....	587,230,662	....	656,604,698	....	666,105,837	60

IRON ORES.

By John Birkinbine.

Iron ores are used in the production of iron, either as pig metal in the blast furnaces or to a limited extent as wrought iron in forges, bloomaries, or other direct processes; also as a flux in silver smelting, as a fix or fettling in heating and puddling furnaces, and in the manufacture of paint; but not more than 5 per cent. of the iron ores mined in the United States are employed for other purposes than the production of iron by smelting. It therefore follows that any advance or decline in the pig-iron industry quickly influences the consumption of iron ore. While the consumption of iron ore decreases with any restriction of the pig-iron output; some of the smaller mines suspending work, the larger ones either continuing operations on a contracted scale, or else stocking the ore at the mines or at convenient shipping points; the production of increased quantities of iron ore does not necessarily immediately follow an improvement. In order to work large mines profitably, it is necessary to take out large amounts of iron ore, and if this is not promptly sold, owing to a poor demand for ore, it is stocked and drawn upon when a revival in the pig-iron manufacture increases the demand.

In this connection attention is directed to the fact that the iron ore reports of the U. S. Geological Survey indicate the production of iron ore only, independently of either shipments or consumption. By production is meant the amounts of marketable ore actually taken out of the ground during the year covered by the report, and of lean ore mined that is subsequently enriched sufficiently to make it salable, irrespective of whether the stocks at the mines are increased or decreased. Shipments include the product of the mine which was sent forward, and may be either greater or less than the amount produced, according to whether the stock pile is augmented or diminished. The shipments may be made direct from mines to furnaces, or, as is the case in the Lake Superior region, to the lower lake ports, from which points the ores are either sent to destination by rail or stocked on the docks. These docks have at times from 3,500,000 to 4,000,000 tons of ore in store at the close of a shipping season, and the stocks, which are sometimes decreased more than a million tons between the commencement of one shipping season and that of another, become an intermediate factor of no mean importance to the iron-ore trade. While the blast furnace companies, as a rule, keep stocks of ore, they depend largely upon the mine or dock-piles, and furnace stocks may be considered as practically fixed quantities. As this report is confined to the output of the mines, the figures given may vary from some published elsewhere, of ship-shipments or of consumption.

The total amount of iron ore produced in the United States in the calendar year 1891 was 14,591,178 long tons, and that of 1890 was 16,036,043 long tons, or including an allowance of 1½ per cent for the smaller mines not reporting, 14,810,046 tons in 1891, against 16,276,584 tons in 1890, a falling off of 1,466,538 long tons, or 9.01 per cent.

The years 1889 and 1890 are both notable for large productions of pig iron, the latter year showing a greater output of metal for the United States than ever recorded previously, but in the year 1891 there was a marked decline. The result of this condition of affairs was to greatly stimulate iron-ore mining, particularly in 1890, and to depress it in 1891 more rapidly than the decrease in the pig-iron output would suggest.

The iron ores of this country have been subdivided as in the 1890 report, into the following general classes:

1. *Red hematite*, being all anhydrous hematites, although known by various names, such as red hematite, specular, micaceous, fossil, slate iron ore, martite, blue hematite, etc.

2. *Brown hematite*, including the varieties of hydrated sesquioxide of iron, and recognized as limonite, göthite, turgite, bog ores, pipe ores, etc.

3. *Magnetite:* those ores in which the iron occurs as magnetic oxide, and including some martite, which is mined with the magnetite.

4. *Carbonate:* Those ores which contain a considerable amount of carbonic acid, such as spathic ore, blackband, siderite, clay-iron stone, etc.

The following table exhibits the amounts of the different characters of iron ore produced, and also the total outputs during the year 1891, for various States and Territories. From this table it will be seen that the quantity of red hematite produced, viz., 9,327,398 long tons, was 63.92 per cent. of the total ore mined during 1891, indicating a decline from the output of 1890 (10,527,650 long tons) of 1,200,252 long tons or of 11.40 per cent. The brown hematites, of which 2,757,564 tons were produced, or 18.90 per cent. of the total ore supply, exceeded the 1890 output of 2,559,938 tons by 197,626 tons or 7.72 per cent. The magnetite mined in 1891 was 2,317,108 long tons—that is, 15.88 per cent. of the total output of iron ore—as against 2,570,838 tons in 1890, a decline of 253,730 long tons or 9.87 per cent. But 189,108 tons of carbonate ore, or 1.30 per cent. of the total ore output, were produced in 1891, a falling off of 188,509 tons, or 49.92 per cent., from the 1890 output of 377,617 tons.

In the table the States are arranged in their order of precedence as producers of iron ore.

The iron ore product of the United States in 1891, distributed by classes and States.

States.	Red hematite.	Brown hematite.	Magnetite.	Carbonate.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Michigan	5, 445, 371	457, 507	224, 123	....	6, 127, 001
Alabama	1, 524, 783	462, 047	....	....	1, 986, 830
Pennsylvania	162, 683	363, 894	727, 299	19, 052	1, 272, 928
New York	153, 723	53, 152	782, 729	27, 612	1, 017, 216
Minnesota	945, 105	....	....	....	945, 105
Virginia	3, 274	653, 342	2, 300	....	658, 916
Wisconsin	527, 705	61, 776	....	....	589, 481
Tennessee	396, 883	147, 040	....	....	543, 923
New Jersey	3, 850	3, 840	517, 922	....	525, 612
Georgia	45, 027	205, 728	....	....	250, 755
Colorado	6, 940	99, 253	4, 749	....	110, 942
Missouri	99, 518	7, 431	....	....	106, 949
Ohio	....	....	....	104, 487	104, 487
Kentucky	....	45, 111	....	19, 978	65, 089
Texas	....	51, 000	....	....	51, 000
Massachusetts	....	47, 502	....	....	47, 502
New Mexico	....	1, 000	38, 776	....	39, 776
Maryland	....	19, 400	....	17, 979	37, 379
Connecticut	....	30, 923	....	....	30, 923
Oregon	....	29, 018	....	....	29, 018
North Carolina	....	....	19, 210	....	19, 210
Montana	8, 536	4, 000	....	....	12, 536
Utah	4, 000	8, 000	....	....	12, 000
West Virginia	....	6, 200	....	....	6, 200
Idaho	....	400	....	....	400
Total of United States	9, 327, 398	2, 757. 564	2, 317, 108	189, 108	14, 591, 178

Comparison with previous years.—To compare the percentages of the total output of the different kinds of iron ore produced in the United States in the years 1880, 1889, 1890 and 1891 the following statement is presented (the figures for 1880 and 1889 are taken from census returns):

Percentages of different classes of iron ores produced in the United States in 1880, 1889, 1890 and 1891.

Character of ore produced.	1880.	1889.	1890.	1891.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Red hematite	31. 51	62. 38	65. 65	63. 92
Brown hematite	26. 95	17. 38	15. 96	18. 90
Magnetite	29. 97	17. 26	16. 03	15. 88
Carbonate	11. 57	2. 98	2. 36	1. 30

The following graphic representations show the amounts of the different kinds of iron ore produced in the various States in the census years 1880 and 1889 and the calendar years 1890 and 1891. Only those States which mined over 100,000 tons of ore are shown individually, the balance being grouped under the head of "Other States."

The red hematite class of iron-ores is indicated by solid cross section lines, the brown hematite by dotted cross-section lines, the magnetite by black blocks and the space devoted to carbonate ore is dotted.

The States are placed in the order of their precedence, *i. e.*, the one producing the largest amount of iron ore is at the bottom of the column, and the one holding second position immediately above it, etc. All of the columns are drawn to the same scale, and the same tonnage in one year occupies an equal space in any of the other years.

The census year 1880 is the first authentic record which gives the outputs of the different kinds of ore. In that year about one-ninth of the total amount produced was carbonate ore. The red hematite, magnetite, and brown hematite mines produced nearly equal quantities there being a divergence of but 4½ per cent. between those furthest removed, viz., the red hematite and brown hematite, the magnetite coming between the two. In 1889 the grand total for the country was more than double the 1880 output. The proportion of red hematite increased until over 62 per cent. of the ore won was of this character, the brown hematite and magnetite following in the order named, there being only a difference of a fraction of a per cent. between the proportions of these last two. The carbonate ore brought up the rear with about 3 per cent. of the total.

The increased demand for iron ores again advanced the total for the United States in 1890 over 10 per cent. above what it was in the previous year. Nearly two-thirds of the total for 1890 was red hematite, the production of magnetite and brown hematite again being nearly equal, each amounting to about one-sixth of the output for the United States; but the 1889 order of precedence is reversed, more magnetite than brown hematite being mined in 1890. The carbonate ore continued the smallest factor, with but slightly over 2 per cent. of the country's total.

The year 1891 shows a decline in the output of the United States, the quantity being considerably below 1890, but greater than the total of 1889.

The red hematite still furnishes by far the largest proportion of the iron ore output of the United States, but the percentage of this class has slightly fallen off, as has also that of the magnetite and carbonate, while the proportion of brown hematite has increased, it now ranking next to the red hematite.

In the year 1880, Pennsylvania headed the list of iron-ore producers, the brown hematite mines being the largest contributors, followed by the magnetite, red hematite, and carbonate, in the order named. Michigan was a close second, the greater portion of the ore mined being red hematite, although considerable brown hematite and a smaller amount of magnetite were won. New York owed her third rank to her magnetite mines, but both red and brown hematite mines were exploited to a considerable extent. The whole of New Jersey's product, with the exception of a few thousand tons of brown hematite, was magnetic ore. Ohio's ores were all of the carbonate variety, and Missouri's, with the exception of a small amount of brown hematite, supplied red hematite. Alabama's mines produced principally red and brown hematite, although a small amount of carbonate ore was reported as obtained in that year. The bulk of Virginia's product was brown hematite, the remainder being red hematite and magnetite. Maryland mined all of the four classes of ore in 1880, but the amounts of magnetite and red hematite were insignificant; the carbonate and brown hematite mines contributing nearly the entire amount. The remaining States produced brown hematite, red hematite, and carbonate ore, the latter representing the smallest percentage of the total.

In 1889 Michigan was first, having outranked Pennsylvania, owing to the increased output of the older ranges, Marquette and Menominee, and the contribution from the Gogebic range, which was first opened in 1884; the percentage of red hematite having increased over that of 1880, while both the brown hematite and carbonate ores showed decreased proportions. Alabama also passed Pennsylvania, having risen from seventh place in 1880 to second place as an iron-ore producer in 1889; this was due to the development of her red hematite mines, but the total amount of brown hematite ore was more than three times the product in 1880, although the proportion of the total for the State was much less, and no carbonate was reported as being won. Pennsylvania, as noted above, occupied third rank instead of first, as in 1880, producing all four kinds of ore, the magnetic mines being the largest contributors, taking the place of the brown hematite mines, which had fallen to second position, followed by the red hematite and the carbonate ores. New York's production of magnetite was greater, but the percentage of the total for the State was about the same as in 1880; the proportion of red hematite mined was larger and that of brown hematite smaller; in addition this State also contributed some carbonate ore from operations near the Hudson river. Minnesota appeared for the first time in these representations as an iron-ore producer, taking fifth place in 1889, owing to the large output of the red hematite mines, which were opened in 1884. This was the only class of ore produced there. Wisconsin had also taken rank as a large producing State, the major portion of the output being red hematite, although considerable quantities of brown hematite were mined. This advance in Wisconsin is due to the increased output of mines on the Menominee range, and the opening of new mines on the Gogebic range. Virginia largely augmented her brown hematite product, both in quantity and proportion, while the amount and proportion of red hematite and magnetite were diminished in 1889. Tennessee also showed a decided advance in production, taking eighth place, about two-thirds of her total being red hematite, and one-third brown hematite. New Jersey occupied ninth place, the whole of her output being magnetite ore. Practically all of Missouri's iron-ore output was red hematite, but a small amount of brown hematite being won. All of Ohio's iron ore was taken from the carbonate mines, but the amount was smaller than in 1880. Georgia's 1889 output was chiefly brown hematite, although some red hematite was won, and for the first time the State appears as a large producer, owing to the active exploration of her brown hematite mines. Colorado's brown hematites contributed the major portion of her output, but some magnetite and red hematite mines were operated. Colorado also enters the list of States producing over 100,000 tons, while Maryland drops out. Of the total for the remaining States in 1889 the larger portion was brown hematite, followed by carbonate, magnetite, and red hematite in the order named.

In 1890 Michigan continued first, having increased her total output, the proportions of the different varieties of ore remaining about the same as in 1889; and this is also true of Alabama. Pennsylvania's total decreased, and her percentage of magnetite ores increased at the expense of the brown hematite, which showed a falling off, the red hematite and carbonate ore remaining about as before. The proportions of the different characters of ore in New York, Wisconsin, Minnesota, Virginia, Tennessee, Ohio, and the other States show few changes in percentage. In New Jersey a small amount of red hematite was produced, and the quantity of red hematite in Georgia and Colorado and of brown hematite in Missouri were increased. Colorado, however, reported no magnetite mined in 1890.

In 1891 Michigan's brown hematite percentage increased slightly, while that of red hematite and magnetite decreased. The proportions of the different classes of ore in Alabama, Pennsylvania, Minnesota, Virginia, Wisconsin, Missouri, and Ohio remained practically the same as in 1890. New York produced more brown hematite and less carbonate than in 1890. Tennessee's percentage of red hematite ore was increased, the brown hematite mines showing a falling off. While New Jersey's output was nearly all magnetic ore, small amounts of brown and red hematite were also mined. Georgia mined less ore of the red hematite variety than in the previous year, and, in addition to the red and brown hematite, Colorado reported some magnetic ore. In the other States the proportion of red and brown hematite increased, while the amount of carbonate ore showed a decided decline.

IRON ORE PRODUCTION, BY STATES, IN 1891.

In the following data concerning the iron-ore outputs of various States the same order of precedence has been followed as in the table, *i. e.*, the States are arranged in the order which their iron-ore product bears to the total for the United States.

MICHIGAN.

Michigan continues to be a larger producer of iron ore than any other State, although its output decreased from 7,141,656 long tons in 1890 to 6,127,001 long tons in 1891, a decline of 1,014,655 long tons, or 14.21 per cent. Of the 1891 product, which represented 41.99 per cent of the total for the entire country, 5,445,371 long tons were red hematite; this was 88.87 per cent. of the total for the State and 58.38 per cent. of the amount of this class of ore mined in the entire country; 7.47 per cent. of Michigan's product (457,507 long tons) was brown hematite, representing 16.59 per cent. of the country's total of this class of ore. The remainder, 3.66 per cent. or 224,123 tons, was magnetic ore, being 9.67 per cent. of the total output of this class of ore. Michigan holds first rank among the States as a producer of red hematite; third place among those mining brown hematite, and fourth place in the output of magnetite. Of the total iron-ore output of Michigan for 1891, 4,834,802 tons, or 78.91 per cent., was obtained from nineteen mining operations, each of which produced over 100,000 tons in that year. Of these nineteen mines five produced over 300,000 tons, four between 300,000 and 200,000 tons, and ten between 200,000 and 100,000 tons. The mines of this State which have in any of the past five years exceeded a product of 100,000 tons per annum are as follows:

List of the larger Michigan mines.—Marquette range: Buffalo mine, Champion mine, Cleveland mine, Cliff's shaft and Salisbury mines, Jackson mine, Lake Angeline mine, Lake Superior mine, Queen mine, Republic mine, Winthrop mine, Volunteer mine.

Menominee range: Chapin mine, Dunn mine, Iron River mine, Ludington mine, Penn Iron Mining Company (Norway, Vulcan, Cyclops, etc.).

Gogebic range: Ashland mine, Aurora mine, Colby mine, Mount Hope mine, Norrie and East Norrie mines, Pabst mine.

Some of the above represent several mine openings under one management.

From the statistics furnished the U. S. Geological Survey, supplemented by those published by the State mining reports, the following information concerning the date of opening and total output of some of the more important Michigan mines was obtained.

Total production to date (1891) of the larger iron-ore mines of Michigan.

Name of mine.	When opened.	Range.	Iron ore produced to and including 1891.
			Long tons.
Lake Superior	1858	Marquette	5,319,056
Cleveland	1849	....do	4,763,900
Republic	1872	....do	3,737,096
Chapin	1880	Menominee	3,722,803
Jackson	1856	Marquette	3,183,958
Penn Iron Mining Company	1877	Menominee	3,076,950
Norrie	1885	Gogebic	2,719,470
Champion	1867	Marquette	2,717,471
Iron Cliffs Company	1864	....do	2,506,619
Lake Angeline	1864	....do	2,030,457
Ashland	1885	Gogebic	1,397,658
Colby	1885	....do	1,312,286
Winthrop & Mitchell	1870	Marquette	1,211,826
New York	1864	....do	1,052,298
Aurora	1885	Gogebic	1,049,157
Ludington	1880	Menominee	1,031,303
Iron River	1882	....do	902,734
Volunteer	1870	Marquette	805,647
Buffalo	1886	....do	701,858

Of the above the Lake Superior, Cleveland, Jackson, Iron Cliffs, Lake Angeline, New York, and Buffalo are grouped within 5 miles of each other, and the Norrie, Ashland, and Aurora are contiguous operations, as are also the Chapin and Ludington.

Occurrence.—Mr. Charles D. Lawton, ex-commissioner of mineral statistics for Michigan, in his annual reports on the mines of the State, presented memoranda concerning the iron-ore mines, from which the following abstracts have been taken, to briefly indicate the occurrence of iron ores in this interesting district.

The rocks of the iron district of Michigan are designated geologically as either Laurentian or Huronian, the latter being the ore-bearing series. The Laurentian rocks are granitic, passing into gneiss and mica-schists, the latter being formed from the decomposition of the granite. They are feldspathic, siliceous, micaceous, or they are coarse or fine, according to the predominating elements that enter into their composition, or whether the rocks of which they were made up were ground into mud or gravel. The forces recognized as chiefly instrumental in the rock-building of this region are igneous, aqueous, chemical, and mechanical.

These agencies destroyed the Laurentian, and with the materials thus derived built up the schists, jaspilites, quartzites, greenstones, etc., which form the Huronian or iron-bearing series of this State. In a general way the rocks which are associated with the ore in the Marquette range are jasper, quartzite, chloritic schist, siliceous schist; or flag, ferruginous schists, argillaceous slates, greenstone, etc., and with these occur intercalated the beds of the different varieties of iron ore. The rocks were subjected to pressure and became folded, forming ridges and synclinals, which were doubled and contracted by lateral pressure. The ore is found in pockets or lenses, or as one of the beds in formation. In the Marquette hard-ore district the hanging wall is invariably quartzite, being frequently separated from the ore by "soap rock." The largest mines on the range, such as the Lake Superior, Cleveland, Pittsburg, Lake Angeline, etc., find their ore in the folds of the formation, the quartzite overlying the ore. The rocks at Ishpeming form a succession of troughs having their axes east and west, and the mines are found in these troughs. At the Republic mine there has been a kinking and faulting of the formation caused by mechanical forces making sharp minor folds, so that the ore is found in a succession of lenses lying across the formation, forming as many independent pits. As the pits are sunk, however, the lenses converge and may possibly form a basin of ore.

In the Menominee range there is a greater regularity than in the Marquette range as to the position of the rocks. The rock in which the ore occurs at Iron Mountain and Vulcan is a soft, friable, black argillite that crumbles and disintegrates on exposure. Further west, at Crystal Falls, the jaspery ferruginous schists in which the ore is found are firm and make a good roof for the mine.

The Gogebic range lies partly in Michigan and partly in Wisconsin, crossing the river Montreal, which forms the boundary between the two States; the larger mines, however, are found in the State of Michigan. The ore formation is the most regular in the whole iron region of the State; here the rocks of the iron and copper series come together and run parallel with each other, the traps becoming like the greenstone of the Marquette range. The general trend is east and west, slightly southwesterly, the ore occurring in the jaspery ferruginous schists lying on or not far from a broad belt of fragmental quartzite, which is one of the most marked features of the ore formation, this belt acting as a guide in the matter of explorations. In this range the quartzite, which was the hanging wall in the Marquette range, becomes the foot wall, the hanging wall being one of the variety of schists or iron slates belonging with the ore. The foot wall occasionally becomes decomposed, but is generally hard and firm. In nearly all the mines the ore is cut by dikes, and this in the early history of the range, especially at the Colby mine, was so prominent that it was generally considered as indicating two distinct veins of ore.

To illustrate the important position which the State of Michigan holds, a comparison may be made of the output of the Bilbao district in Spain and the product of the Michigan mines since the opening of the Gogebic range (the first shipment of importance being made in 1885). The Michigan figures include the output of the mines on the Marquette range, most of those on the Menominee range and the larger mines on the Gogebic range.

Comparison of the iron ore product of Michigan with Bilbao, Spain.

Years.	Bilbao district.	Mines in Michigan.
	Metric tons.	*Long tons.*
1885	3,311,419	2,205,190
1886	3,185,228	3,179,511
1887	4,198,696	3,934,339
1888	3,631,593	4,113,803
1889	3,901,511	5,856,169
1890	4,326,933	7,141,656
1891	....	6,127,001

ALABAMA.

Alabama with a total of 1,986,830 long tons still continues as the second State in order of iron-ore production, its percentage of the total output being 13.62, an increase of 89,015 tons, or 4.69 per cent. over the 1890 output of 1,897,815 long tons. The larger portion of the State's product, 1,524,783 tons, or 76.74 per cent., was red hematite, in which class it occupied second place with 16.35 per cent. of the total, and the balance, 462,047 long tons, or 23.26 per cent., was brown hematite, in which class it occupied second place with 16.76 per cent. of the country's product.

The red hematites of Alabama follow a general southwest and northeast direction, entering the northeastern corner of the State, proceeding southwest until the northern central portion of the State is reached, where in the vicinity of Birmingham they turn, forming as it were a fold, and it is in this section of the State that the largest mines are found. The brown hematites trend in the same general direction as the red hematites, but are found to the southeast, entering the State in Cherokee county from Georgia, passing through Calhoun, Talladega, Shelby, and Bibb counties, then making a curve to the northward, and at Russellville in Franklin county large quantities are mined. There is also some brown hematite mined in Jefferson county, and from an area of 2 acres at the Tannehill mine 115,563 tons of ore have been taken out and 25,000 tons are estimated as still remaining ready for extraction. It is probable, owing to the improvement in quality of metal produced, which follows the mixture of red and brown hematites, that the demand for the latter class of ore will increase.

No statistics are obtainable which show the production of iron ore in Alabama for a series of years, but the development of this industry may be closely approximated by estimating the production of iron ore from the amounts of pig iron made, for although there are interchanges of ore between Alabama and adjoining States, it may be considered as producing about as much ore as is used in the State.

The following table has been prepared giving the estimated amounts of iron ore mined in Alabama from 1880 to 1891, inclusive, those marked "*" being taken from the reports of the U. S. Geological Survey; those marked "†" are taken from the census:

Production of Alabama iron-ore mines.

Years.	Production.	Years.	Production.
	Long tons.		*Long tons.*
1880†	171,139	1886	650,000
1881	220,000	1887	675,000
1882	250,000	1888	1,000,000
1883	385,000	1889†	1,570,319
1884	420,000	1890*	1,897,815
1885	505,000	1891*	1,986,830

Actual returns were only obtained for the years 1880, 1889, 1890, and 1891, but the estimates for other years are based on the most reliable data, and the table may be considered as an evidence of the influence of the rapid local development of the pig-iron industry. There were six mining companies in Alabama, each of which produced over 100,000 tons in 1891, and together they contributed the larger portion of the total output for the State. Some of these companies operated several mines.

PENNSYLVANIA.

Pennsylvania produced all four kinds of ore in the year 1891, the amounts and the percentages which each kind bears to the total being as follows:

Iron-ores produced in Pennsylvania in 1891.

	Long tons.	Per cent. of total.
Magnetite	727,299	57.13
Brown hematite	363,894	28.59
Red hematite	162,683	12.78
Carbonate	19,052	1.50

The total product, 1,272,928 long tons, 8.72 per cent. of the iron-ore output of the United States in 1891, gave the State third place. This exhibits a decline of 88,694 long tons, or 6.51 per cent., from the 1890 output of 1,361,622 long tons.

Of magnetite 727,299 long tons were mined, being 38,019 long tons, or 4.97 per cent., less than the 1890 product of 765,318 long tons; but Pennsylvania still holds second position in this class of ore, and is credited with 31.39 per cent. of the country's total. The 363,894 tons of brown hematite won from its mines gives the State fourth place in that class, with 13.20 per cent. of the total credited to it, the figures being 51,885 tons, or 12.48 per cent., less than in 1890, when 415,779 tons were mined. Although standing sixth as a producer of red hematite, with 1.74 per cent. of the total, the amount credited to the State was 162,683 long tons against 143,745 tons produced in 1890, an increase of 13.17 per cent., or 18,938 tons. Pennsylvania mined 19,052 tons of carbonate ore in 1891, ranking fourth in that class, with 10.07 per cent. of the total, a decline of 17,728 tons, or 48.20 per cent., from the 1890 output of 36,780 long tons.

In Pennsylvania, the brown hematites are seemingly divided into two series starting in the northern section of the State, and running southwest in nearly parallel lines, the magnetites occurring between the two belts. In the western portion of the State is found the carbonate formation, and between the carbonate and brown hematite belts are the red hematite ores. Although well supplied with these ores as to quantity, the quality and cost of winning them is such that they are displaced to large extent by the Lake Superior ores which find their principal market in the western part of Pennsylvania. A large portion of the foreign ores and some of those of New York, New Jersey, and Maryland are drawn upon to help out the local supplies. There are numerous idle mines equipped for operations, and others abandoned by reason of leanness or limited extent, excess of phosphorus, or expense of exploitation in Pennsylvania, and although many of these mines can produce ore of a quality equal to that used elsewhere in the United

States, the low rates for transporting ores of more satisfactory composition has discouraged for the present the exploitation of local mines.

The Cornwall Ore Hills which contribute the bulk of the magnetite obtained from Pennsylvania, have up to date supplied 11,508,990 tons of ore. Although this deposit has been wrought since 1740, the demand for large quantities of ore has been within the past ten years, in which time 5,791,258 tons of ore have been obtained from the operations of Cornwall. The maximum yearly output was in 1889, when 769,020 long tons were won. None of the other Pennsylvania iron-ore mines produced over 100,000 tons in 1891.

NEW YORK.

New York is the only State other than Pennsylvania which produced in 1891 all the four classes of iron ore, but it shows a decided falling off in its output from 1,253,393 long tons in 1890 to 1,017,216 tons in 1891, a decline of 236,177 long tons, or 18.84 per cent. The major portion of the output of New York in 1891, viz., 782,729 long tons, or 76.95 per cent. of its total, was magnetic ore, the State taking first place in that class of ore, with 33.78 per cent. of the total for the United States. The red hematite produced amounted to 153,723 tons, being 21.58 per cent., or 42,312 tons less than the 1890 output of 196,035 long tons. The brown hematites show an advance of 22,184 long tons, or 71.64 per cent. from the 1890 product of 30,968 tons, reaching 53,152 long tons in 1891, and its percentage (1.93) of that class of ore gave the State ninth place. The carbonates, however, show a falling off of 53,707 tons, or 66.04 per cent., being but 27,612 tons in 1891, as against 81,319 tons in 1890. New York, however, occupied second position in this class of ore, with 14.60 per cent. of the total for the United States.

While New York produces all of the different kinds of iron ore, the magnetites predominate, and deposits of this class of ore are wrought in the northeast corner of the State, on the western shore of lake Champlain, and southward along the lake; also on the western flank of the Adirondack mountains, and in the southeastern portion of the State. The brown hematites mined in the eastern section of New York are chiefly embraced in the noted Salisbury region of New York, Connecticut, and Massachusetts, which has long been famous for the iron produced from its ores. The red hematites are found in several groups of mines in the central and northern central portions of the State. The only carbonate ore which is mined is obtained in Columbia county near the Hudson river, 100 miles above New York, and an extensive plant of roasting kilns and shipping facilities is connected with the carbonate mines. The largest producers of iron ore are the magnetite mines in the lake Champlain district; the operations of Witherbees, Sherman & Co., the Port Henry Iron Ore Company, and the Chateaugay Ore and Iron Company each exceeding 100,000 long tons per annum. This region has within the past fourteen years contributed over 8,500,000 tons of ore, a larger amount than had been mined there in all the previous years.

MINNESOTA.

Minnesota, as a producer, advanced from sixth place in 1890 to fifth place in 1891, with an output of 945,105 long tons of iron ore, all of the red hematite variety, in which class the State occupied third place with a percentage of 10.13 of the national total. During the latter part of the year 1891 there was considerable excitement and speculation concerning new exploitations upon what is recognized as the Mesaba iron range. Owing to absence of transportation facilities no ore was shipped from this range during the year, but it is probable that in the future it may be an important factor in the iron-ore industry of the State. Prof. H. V. Winchell, assistant State geologist, says of this range: "It is too early and developments have not progressed far enough to grade the Mesaba ores closely, as all of the test pits have been sunk for but short distances and do not represent the entire ore body. The ore is not clean-looking nor uniform in color and texture, being yellow, red, purple, and brown. In some places the ore is hard, then powdery, and again granular; but analyses show that the composition is more uniform than would be supposed. Bessemer ore will probably be obtained from some of the mines, while in others the phosphorus is high. One peculiar feature is the intimate mixture of limonite, hematite, and magnetite. In some of the pits the ore lies in alternating layers or sheets of these various ores. Limonite is present to such an extent that it furnishes from 2 to 7 per cent. of moisture to a sample. The chief impurity is silica, with the usual traces of lime, magnesia, alumina, and manganese; sulphur and titanium are reported absent. The first test pits which were put down were unusually successful in finding large bodies of ore which varied in thickness from 1 foot to 80 feet. These deposits conform generally to the dip of the inclosing rocks, which is from 12 degrees to 40 degrees to the south or southwest." He inclines to the theory that the ore is therefore in beds, and not in veins or lodes. The active explorations exhibit favorable indications for a width of several hundred feet and a longitude of several miles. The ore is found below a surface covering of glacial drift or a capping of but a few feet of rock, the ore being soft and hard in alternate strata.

The Mesaba iron range lies north of Duluth and between that city and the Vermilion iron range. The course of the partially explored portion of the Mesaba range is from 50 to 75 miles from Lake Superior, running generally west or southwest. The existence of iron ore has been known for several years, and exploratory work has been pursued at intervals along the Mesaba range, but the discoveries reported during the season of 1891 were of such character as to excite widespread interest. As a consequence, mining companies were rapidly formed, locations secured, and considerable work done in exposing the ore bodies, which have proven sufficiently inviting to command attention from railroads and encourage lively competition to secure the ore traffic from the new range. As in the development of the Gogebic range, speculation has been rife, and it is stated that the total capitalization of the mines on the Mesaba range, some of which only exist on paper, is $75,000,000.

The reported leases of properties on this new range are based upon a minimum output insuring an annual production exceeding 500,000 tons of iron ore, which will swell the totals for the State as soon as shipping facilities are completed, and this, together with the ease of mining and the large proportion of the deposit which is claimed to be of Bessemer grade, is looked forward to as materially affecting the prices commanded by, and the quantities to be shipped from, other iron-ore mines in the Lake Superior region. The existence of large bodies of ore which are of excellent quality, but below the grade generally recognized as sufficiently high in iron to withstand long transportation charges, is also expected to encourage the production of pig iron by blast furnaces located near the head of Lake Superior.

All of the iron ore in Minnesota has, up to the present, been obtained from three operations, viz., the Minnesota Iron Company, the Chandler, and the Pioneer mines. The Minnesota Iron Ore Company, which commenced operations in 1884, has supplied to date over 3,000,000 tons, and the Chandler mine has since 1888 sent forward more than 1,000,000 long tons of iron ore.

VIRGINIA.

Virginia stands sixth as an iron-ore-producing State, with an output of 658,916 long tons, or 4.52 per cent. of the total for the United States, an increase over the 1890 output of 115,333 long tons, or 21.24 per cent. Practically all of this ore, viz., 99.15 per cent., was of the brown hematite variety, the amount being 653,342 long tons, an increase of 130,434 long tons or 24.94 per cent. over the 1890 output, Virginia thus taking first rank of all the States as a producer of this class of ore, with 23.69 per cent. of the country's total. The amount of red hematite and magnetite mined was small, the combined total being less than 1 per cent. of the iron-ore output of the State. But both classes showed a marked decline, the first mentioned of 12,938 long tons, or 79.81 per cent. from the 1890 output of 16,212 tons, and the latter of 2,163 long tons, or 48.47 per cent., from 4,463 long tons won in 1890.

The brown hematite deposits, which extend in a general northeast and southwest line through the State, along the Shenandoah valley and the Cripple creek, form the chief base of supplies for Virginia blast furnaces, although some ores are brought in from North Carolina, and possibly from Tennessee. While the local ores are not high in iron they are easily smelted, and make good foundry iron, but are unsuited for the manufacture of Bessemer pig, owing to their chemical composition. The small amount of red hematite is found in the vicinity of the James river and the magnetite in Pittsylvania county.

Within the last two years the increased demand for iron ores has caused the mining of large amounts of brown hematite ores locally known as "gossan" ores, which are found in the southwestern portion of the State, running in a northeastward direction from Floyd through Carroll county and into Grayson county. These ores are formed by the oxidation of "mundic," a term used to include both the pyrite and pyrrhotite. Mr. Moxham states that this cap or "iron hat" is from 12 to 40 feet wide at the surface, and 40 to 75 feet at the bottom at its junction with the "mundic," from 40 to 175 feet below the surface according to the height of the hills it traverses; the higher the hills the greater being the depth of the gossan ores, while the "mundic" as a rule remains in place. It has little or no cover, and its exposures vary in character. At some points large bodies of gossan ore extending over many acres present themselves. The ore is generally used as a mixture with the hard brown ores, and to its red-short tendency is credited the additional strength of the iron produced.

Mr. Moxham gives the following analyses of the "gossan" ore in its natural condition, and also some of the "mundic" or undecomposed sulphuret.

Analyses of "gossan" and "mundic" ores.

	Gossan.	Mundic.
Iron	41.28	53.15
Silica	9.74	2.99
Sulphur	1.13	34.06
Copper	0.293	0.866
Phosphorus	0.064	No trace.
Manganese	0.306	0.306

Other analyses show larger percentages of silica.

The blast-furnace industry of Virginia is apparently in advance of the present iron-ore developments, and the general activity of the smelting plants will demand either the discovery and exploitation of other deposits of iron ore, or a partial dependence upon the ores from adjacent States.

WISCONSIN.

Wisconsin shows a considerable falling off from the 1890 output of 948,965 long tons, that for 1891 being but 589,481 long tons, 359,484 tons, or 37.88 per cent. below that of 1890, and causing the State to drop from fifth to seventh position in rank as a producer of iron ores. The red hematites, of which class 527,705 long tons or 89.52 per cent. of the State's total were produced, gave it fourth rank with 5.66 per cent. of the total red hematite output of the nation. Of the total for the State, 61,776 tons, or 10.48 per cent., were taken from the brown hematite mines, in which class Wisconsin occupied eighth place, with 2.24 per cent. of the total for the United States.

The principal iron mines of the State are found on the Gogebic iron range, and in the vicinity of Florence on the Menominee range, general descriptions of these ranges being found under the paragraphs devoted to Michigan. Some red hematite is also mined in the eastern central portion of the State, and brown hematite in the western central section. The possible advance in the manufacture of steel by the basic method promises in the future a liberal supply of red hematite ore, locally termed "flaxseed" ore, which abounds about 50 miles northwest of Milwaukee; the special adaptability of this ore for the process named, its convenience to existing blast furnaces, and the low cost of mining combining to offer inducements for its use notwithstanding its comparatively low percentage of iron. It is also probable that the extensive deposits of brown hematite within convenient reach of the Mississippi river may encourage the development of industries to produce pig iron for foundry use.

While most of the larger mines on the Menominee and Gogebic ranges are in Michigan, some of the mines on these ranges located in Wisconsin have produced large quantities of iron ore, the date of opening and the total production of several of these being given below:

Date of opening and total production of the larger iron-ore mines in Wisconsin.

Names of mines.	When opened.	Iron ore produced to and including 1891.
		Long tons.
Florence	1880	978,094
Commonwealth	1881	865,995
Germania	1885	325,020
Cary	1886	280,780
Section 33	1885	238,909

TENNESSEE.

Tennessee produced 396,883 long tons of red hematite iron ore in 1891 as against 278,076 tons won in 1890, an advance of 118,807 long tons, or 42.72 per cent., and also 147,040 long tons of brown hematite ore, while in 1890, 187,619 long tons of this class were mined in the State, the balance in favor of 1890 being 40,579 long tons, or 21.63 per cent. A comparison between the total outputs of the State shows that in 1891 543,923 long tons were produced, while in 1890 465,695 tons were mined, a difference of 78,228 long tons, or 16.80 per cent. The State occupied eighth position, with 3.73 per cent. of the total iron ore for the country.

The red hematites are found in the eastern portion of the State, running in a general southwest and northeast direction along the valley of the Tennessee river, and there is also a series of brown hematite beds following the same trend, while in the central and western portion of the state, in the valleys of both the Tennessee and Cumberland rivers, are belts of brown hematite, continuing southward into Alabama.

NEW JERSEY.

New Jersey stands ninth as a producer of iron ore, with an output of 525,612 tons in 1891, or 3.60 per cent. of the total for the entire country. This is an increase of 29,804 long tons, or 6.01 per cent. over the 1890 product of 495,808 long tons. Of this amount the magnetite represented 98.54 per cent., and the red and brown hematite 0.73 per cent. each. The magnetite shows a gain of 28,114 tons, or 5.74 per cent., and the brown hematite increased 3,840 tons, or 100 per cent. respectively over the figures of 1890. The red hematite, however, declined from 6,000 long tons in 1890 to 3,850 tons in 1891, a loss of 35.83 per cent., or 2,150 tons.

The magnetites which start in the northern central portion of the State, entering it from New York, run in a south-southwest direction, crossing the Delaware river above Easton into Pennsylvania. The brown and red hematite is found in the vicinity of Butzville, where it occurs as an intimate mixture of magnetite, red hematite, and limonite. Two of the older mines in the State, the Dickerson and Teabo, have ceased operations. The former has been operated since the year 1713, when it was taken up as a mining tract by John Reading, but during the year 1891 the ore in the vein became leaner, and it was finally decided to close the mine, following the example of other New Jersey mines, which, while they contain considerable ore, are either too lean in iron, or the cost of mining is so high that they can not command a profitable market.

Concentration by magnetism is looked to as a possible means of resuming operations at some of the New Jersey mines. There are now three installations working at different points, and others are projected.

OTHER STATES.

Of the remaining iron-ore producing States, only four—Georgia, Colorado, Missouri, and Ohio—contributed over 100,000 tons each in 1891, and they occupied tenth, eleventh, twelfth, and thirteenth positions respectively, each with decreased totals from 1890. It is probable, however, that with an increased demand for ore, all of these States could materially increase their outputs. Of Georgia's product, 82.04 per cent. was brown hematite, and the balance red hematite. Of Colorado's iron ores 89.46 per cent. was brown hematite; of the remainder, 4.28 per cent. was magnetite, and 6.26 per cent. red hematite. A large amount of this iron ore was used as a flux in silver-smelting. Of Missouri's total 6.95 per cent. was brown hematite, and the balance red hematite.

The State of Missouri continues to show a decline, due to the practical closing of one of the large iron-ore mines, and the restricted output in others. It is, however, probable that with an increased demand for iron ores these mines would show renewed activity, as the deposits are not exhausted. The most important iron-ore producer in the State of Missouri is the Iron Mountain, which was first operated in 1847, and has up to date contributed 3,349,086 long tons.

The output of the Ohio mines (all of which are of the carbonate variety or its derivatives), again shows a decline, due to the disfavor which furnace managers exhibit to using this class of ore, because of its leanness and the necessity of preliminary roasting, and to the practicability of obtaining Lake Superior ores. Kentucky, Texas, Massachusetts, New Mexico, Maryland, Connecticut, Oregon, North Carolina, Montana, Utah, West Virginia, and Idaho follow in the order named.

Texas' advance is due to the starting up of new blast-furnace plants, the mining having been principally in the brown hematite deposits in the eastern part of the State. As, however, railroads have reached the southern central portion of the State where richer ores are found, it is probable that Texas will in the future augment her output and improve the average grade of her iron ores.

There has been little change in the outputs of Massachusetts, Connecticut, and Maryland, the product of these States, with the exception of some carbonate ore won in Maryland, being brown hematite. Most of these ores are used locally, but there was a heavy importation of foreign ores to supply the large steel works at Baltimore, which depends chiefly on imported ore.

The amount of ore mined in North Carolina remains practically the same as in 1890, its entire product being reported as magnetite, all obtained from the Cranberry district in the western part of the State.

Maine did not produce any ore in 1891, and as the only blast furnace in the State has suspended operations it is not probable that her mines will be worked in the near future.

IRON ORES USED IN SILVER SMELTING.

In addition to iron ores in Colorado, Oregon, and other Western States and Territories, which are mined and smelted for iron-making, there is a considerable amount of brown hematite which occurs as oxide of iron and is found while mining for silver ore. This is used as a flux at silver-smelters, and it is difficult to obtain exact data owing to the fact that while some of the ore may be rich enough in silver to make it valuable on that account, it may at any time become lean, and can only be used as flux. The smelters pay for this ore in various ways. One is to pay a certain price per ton for ore containing a minimum excess of iron, etc., over silica, with a sliding scale of increase per unit of iron or manganese above that minimum. Another way is to give an agreed price for the silver, based upon New York quotations, make a fixed charge for smelting, and credit so much per ton per unit of iron and manganese excess. Smelters do not usually buy pure iron ore if they can get ore containing some silver.

Iron ore for flux is now obtained principally from roasted auriferous pyrites, the latter being furnished raw in large quantities by dressing works. Some of the famous mines have yielded enormous quantities of ferruginous silver ores, sometimes of so low a grade that but for the value of the gangue to help out the silver alone could not have paid.

The market for this ore is rather uncertain, as sometimes the smelters obtain silver ores basic enough to make special additions of iron ore unnecessary.

The record of iron-ore mining during the year 1891 emphasizes the relative positions occupied by various States, districts, and individual mines, as influenced by the quality of the ores, the equipment for mining and handling, and the facilities for marketing the outputs. The impetus given by the extraordinary production of pig iron in 1890 caused an unprecedented output from the iron-ore mines, and the reduced demand which followed speedily affected this industry; consequently, a restriction of output resulted, and except where the ore was consumed close to its point of production, the reports received show that the diminished consumption was confined principally to the leaner ores.

TRANSPORTATION OF IRON ORES.

Much of the iron ores won in the Lake Superior region, a considerable portion of those obtained in the State of New York, and also some ores from other States have to be transported long distances to reach points of consumption, and reshipment is necessary where the transportations are made by both rail and water. An essential of such rehandling and transporting is that it should be done in the least possible time and at small expense in order to enable the ores to compete with others, which, although not so rich, are found nearer the blast furnaces. As the principal cost of rehandling is for labor, large amounts of money have been expended by different railroad companies for docks and cars built specially for the purpose, so as to bring this item to the lowest point practicable, and also make it possible to handle quantities of material which would have been impossible if done by manual labor. It is now no unusual thing for ore to be taken from the mine in "skips," automatically dumped into specially constructed railroad cars or into ore bins from which it can be discharged into cars, then hauled in these cars to ore docks, where the drop bottoms of the car are opened and the ore falls into pockets, from which it is run into the hold of the vessel, and in this whole process the only labor necessary is to open the doors of the bins or the bottoms of the railroad cars. When the material is deposited in the pockets in the ore docks, the spouts of the pockets are lowered into the holds of vessels, the doors leading to the spouts are opened, and the ore slides into the vessel's hold, being assisted, if necessary, by poking with long poles.

The ore shipping docks on Lakes Superior and Michigan (the largest in the country, if not in the world), in connection with the ore receiving docks at the lower lake ports (fitted with bridge tramway plants), the railroad cars, and in some cases vessels specially constructed for this purpose, have aided materially in reducing the cost of transporting iron ore to points of consumption. The furnace manager by means of advanced methods, cheaper or richer iron ores, improved facilities, and larger output, has lessened the cost of pig iron, which in turn has lowered the price of manufactured iron and steel, which has been one of the most important, if not the most important, factor in bringing this country up to its present degree of prosperity.

To indicate the capital and skill utilized for ore-handling appliances, it is well to enumerate the shipping docks owned by the different railroads at the principal ports in the Lake Superior region from which the ore is sent and those elsewhere at which it is received, and to present a general description of the shipping and also of the receiving docks. In addition to the shipping docks erected to handle iron ores from the Lake Superior region, there are others of less magnitude on Lake Champlain, on the Mississippi river, and elsewhere, but the proportions of the docks on Lakes Superior and Michigan and the quantities of ore handled by them are much greater than the others, and the same holds true concerning the ore-receiving docks at lower lake ports.

The following data are offered to emphasize the provision made for handling and transporting iron ores mined in the Lake Superior region, because in no part of the world is this equaled, and because from this region was obtained 52 per cent. of all the iron ore mined in the United States in 1891.

Marquette, Michigan, is the port from which the first Lake Superior iron ore was sent, and up to the close of the year 1891 there have been loaded into vessels 17,616,880 tons at this port. The Lake Superior iron ores were at first only obtained from the Marquette range in Michigan, and until 1865 all of this ore was shipped from Marquette. In 1891, however, this port ranked third, with a total shipment of 1,056,027 long tons, all of which came from mines in the Marquette range.

In 1865 Escanaba, Michigan, claimed a share of the shipments from the Marquette range, this port and Marquette keeping company until 1879, when Escanaba took a liberal lead, chiefly by reason of the development of the Menominee range, commencing in 1877, and this lead has been continually maintained. In 1891, 3,058,590 long tons, or nearly one-half of the lake shipments, were sent from this port. Of this amount the mines on the Marquette range contributed 1,154,645 long tons, the Menominee range 1,480,248 tons, and the Gogebic range the balance, 423,697 long tons. Since 1865 there has been handled at the Escanaba docks a total of 29,963,257 tons.

In 1873 the shipping dock at L'Anse, Michigan, was erected to handle the ore from the western section of the Marquette range, receiving its first consignment in that year. It continued handling ore until 1885, since which time no shipments have been made from it. This was never an important shipping port, as the largest amount handled in one year was 88,962 tons, in 1876, the total reaching 744,697 tons.

In 1882 Saint Ignace, Michigan, entered the list of shipping ports, reaching its maximum of 107,399 long tons in 1888, since which time it has declined in importance, and in 1891 a portion of the dock was removed. It has handled a total of 610,315 tons.

The nearly simultaneous development of the Gogebic iron range in Michigan and Wisconsin and of the Vermilion iron range in Minnesota caused the erection of shipping docks for the former at Ashland, Wisconsin, and for the latter at Two Harbors, Minnesota, both ports making their first shipment in 1884. Ashland, however, soon outstripped its rival and in 1891 ranked second as a shipping port, with 1,261,658 long tons as its output. Since the docks were erected at Ashland in 1884, 7,760,025 tons of ore have been shipped. Two Harbors, while not increasing as rapidly as its rival, has shown a marked advance each year, and if the mines recently developed on the Mesaba range prove as productive as those on the Vermilion range it may in the future show largely increased shipments. In 1891 Two Harbors, Minnesota, ranked fourth, 890,299 long tons being shipped, and the total from 1884 to the close of 1891 was 4,030,899 long tons. Receiving docks are also projected at Duluth, Minnesota, to accommodate the anticipated increased shipments from the Minnesota mines.

Gladstone, Michigan, made its first shipment of ore in 1889, and serves as an additional and competing shipping point for the mines of the Menominee range. In 1891, 177,866 long tons were shipped. It has handled a total of 342,804 long tons to the close of 1891.

SHIPPING DOCKS.

The ore shipping docks consist of a wooden structure, built on piles and reached by a long or short approach, depending upon the nature of the ground and the depth of the water. Owing to the interference with the operation of mines, railroads, and vessels, which would result in the destruction of one of the large ore-shipping docks, the project of constructing them of iron has been considered. The top of the dock is from 38 feet to 51 feet 10 inches above the ordinary water level and wide enough to accommodate from two to five lines of railroad tracks. In the latest construction the gauge between tracks is the same as between the two rails forming one track, thus making the entire top of the dock practically an opening into the various pockets. The ore docks have from 50 to 300 pockets, holding from 80 to 170 tons of ore each. The pockets are sheathed with plate iron and slope downward toward the water side of the dock. At the bottom of each pocket is a door which is controlled from the top of the dock. When it is desired to load a vessel, plate-iron chutes, usually semicircular in form, are lowered into the hatches of the boat, the doors which connect these chutes to the respective pockets are raised, and the ore discharges itself into the hold of the vessel. This occupies but a very short time, if a sufficient number of bins can be discharged at once, and a few instances of quick dispatch may be mentioned. At the docks of the Chicago and Northwestern railway, at Escanaba, the steamer *Massachusetts* was loaded with 1,659 long tons of iron ore in 45 minutes; the *Maryland*, with 3,027 long tons in 3 hours; the *Maryland*, with 3,132 long tons in 4 hours; the *Cambria*, with 2,379 long tons in 2 hours; the *Kaliyuga*, with 1,927 long tons in 2 hours; the *Manchester*, with 2,502 long tons in 2 hours; and the *Manhattan*, with 1,850 long tons in 45 minutes. In this last case just one hour elapsed between the arrival of the boat at the dock and its departure. The record for most rapid loading is that of 980 tons, which were run into the steamer *Frontenac* in 4¾ minutes. The maximum quantity handled at the docks of this company into vessels in 24 hours was 42,320 long tons.

At the docks of the Duluth, South Shore and Atlantic Railway, at Marquette, over 20,000 long tons of ore are often handled per day, and frequently 2,000 long tons of hard ore have been loaded into a boat in one hour and one-half.

The following table shows the location, principal dimensions, capacity, etc., of the iron-ore-shipping docks erected on Lakes Superior and Michigan to handle the ores from the Lake Superior region:

Dimensions of shipping docks for Lake Superior iron ores.

Location.	Height of dock.		Length of dock.	Number of pockets.	Total capacity.	Number of railroad tracks.	Cost.
	Ft.	*in.*	*Feet.*		*Long tons.*		
Marquette, Mich., No. 1	45		1,800	270	30,000	4	Not given.
No. 3	44		1,600	300	25,000	3	
No. 4	47	6	1,400	200	30,000	4	
St. Ignace, Mich	42		400	50	7,000	3	
L'Anse, Mich	38		1,000	100	8,000	....	
Escanaba, Mich., No. 1	46		1,104	184	23,000	2	$1,122,000
No. 2	39		1,082	192	19,300	2	
No. 3	39		1,212	202	20,000	2	
No. 4	46		1,500	250	33,200	2	
No. 5	51	10	1,392	232	40,600	2	
Gladstone, Mich	47		....	120	16,000	5	Not given.
Two Harbors, Minn., No. 1	47		1,056	162	55,000	2	$1,000,000
No. 2	46		1,056	141		2	
No. 4	51	6	528	84		4	
Ashland, Wis., No. 1	40		1,404	234	23,000	4	$483,000
No. 2	45		1,404	234	27,000	3	
Ashland, Wis	46		1,404	234	28,250	3	$256,000

The aggregate length of the seventeen ore-shipping docks, independent of approaches, is 19,342 feet, or say 3⅝ miles. They contain 3,189 pockets, have a total capacity of 385,350 long tons, and cost, approximately, $4,500,000.

The Duluth, South Shore and Atlantic railway own the three iron-ore docks at Marquette, and also had a fourth dock, No. 2, which has been rebuilt for use as a pig-iron and lumber dock. This company is also the proprietor of the docks at Saint Ignace and L'Anse. The five docks at Escanaba are owned by the Chicago and Northwestern railway; that at Gladstone is operated conjointly by the Minneapolis, Saint Paul and Sault Ste. Marie and the Milwaukee and Northern railways. The three docks at Two Harbors belong to the Duluth and Iron Range railway, while two docks at Ashland are owned by the Milwaukee, Lake Shore and Western, and one dock at the same place by the Wisconsin Central railway.

Most of these companies also have large numbers of cars built especially for the iron ore trade, and the following table gives the number, the capacity, and the total value of such cars owned by some of the companies:

Special car equipment for handling Lake Superior iron ores.

Names of railroad companies.	Number of cars.	Capacity of car.	Cost of cars.
		Tons.	
Chicago and Northwestern	2,400	20	$1,656,600
Do	3,300	7 to 10	
Duluth, South Shore and Atlantic	3,200	8	Not given.
Do	600	20	Do.
Duluth and Iron Range	900	25	$506,250
Milwaukee, Lake Shore and Western	150	30	$400,000
Do	800	22½	
Wisconsin Central	780	25	$388,800
Do	100	20	
Minneapolis, Saint Paul and Sault Ste. Marie and the Milwaukee and Northern	296	25	Not given.

This gives a total of 12,526 cars built for use in transporting iron ore with an aggregate capacity of 187,550 tons of iron ore, their total cost being estimated at $3,600,000.

According to the *Iron Trade Review* there are 6 iron-ore mining companies in the Lake Superior region owning fleets of vessels, and the table below gives the number of such vessels and their size and aggregate tonnage. The companies run these vessels in order to prevent extreme fluctuations in rates and insure steadiness to the ore freight schedule. It is doubtful if the high freight rates of former years, as detailed in "Mineral Resources of the United States, 1889 and 1890," will be repeated.

Special iron-ore vessels on the Great Lakes.

Owners.	No. of vessels.	Capacity of vessels.	Total capacity.
		Tons.	*Tons.*
Minnesota Iron Company	8	2,300 to 3,000	19,800
Menominee Transit Company	6	2,900	17,400
Lake Superior Iron Company	6	2,300 to 2,500	14,400
Cleveland Cliffs Company	4	1,800 to 3,000	9,800
Republic Iron Company	5	1,200 to 2,500	9,200
Cleveland Rolling Mill Company	4	2,000 to 2,700	9,150

This makes a total of 33 vessels, mostly steamships, with an aggregate tonnage of 80,750, especially devoted to the transportation of iron ore, and maintained by the iron-ore producers.

RECEIVING DOCKS.

The bulk of the lake shipments of iron ore are taken to the lower lake ports—Cleveland, Fairport, Ashtabula, Toledo, Sandusky, Huron and Lorain, Ohio; Erie, Pennsylvania, and Buffalo, New York, for distribution to the various blast furnaces in Pennsylvania, Ohio, West Virginia, New York, etc. The remaining portion going direct to furnaces situated near to or on the Great Lakes, such as Milwaukee, Wisconsin; Chicago, Illinois; Detroit, Michigan; Tonawanda, New York, and to individual furnaces at various points in Michigan and Wisconsin. Most of the furnaces on the lakes or their estuaries have special appliances for handling iron ore, but it is at the first-mentioned ports on lake Erie that the larger receiving docks are located, Cleveland having 4; Buffalo, 3; Ashtabula and Fairport 2 each, and the remaining ports, 1 each.

Two of the receiving docks at Cleveland are each half a mile in length and have a storage width of 350 feet; one at Fairport has a water front of 1 mile and a width for storage purposes of from 180 to 350 feet. As the ore is stored in piles from 25 to 50 feet in height, the capacity of each of these docks is from 1,000,000 to 1,500,000 long tons, and the average storage capacity of the receiving docks is 300 to 500 tons per foot of water front. During the shipping season, from May to October, the ore is brought to these ports, unloaded, a portion being handled directly to railroad cars and the balance stocked, being shipped to the blast furnaces during the winter months. Mr. A. E. Brown, of Cleveland, Ohio, states that the ore from the Lake Superior region occupies from 10 to 16 cubic feet per long ton, the average approximating 14 cubic feet. When piled in large quantities on the dock, however, it occupies less space, generally from 10 to 13 cubic feet per ton, but if loosely placed the average is greater, being about 13.625 cubic feet per ton for the Marquette ores, and 15.2 cubic feet for those from the Gogebic range.

Five general types of machinery are employed for moving the iron ores from the holds of the vessels to the ore docks.

(1) Swing-boom derricks, operated either with engines placed on them,

or driven by wire rope from steam engines at a distance, the mast being either stationary or carried on trolleys. The iron buckets are lowered into the holds of vessels where the navvies shovel the ore into them, steam machinery raising the buckets and swinging the boom to the point where the ore is to be deposited.

(2) A similar arrangement of swing-boom derricks which discharge the ore into hoppers from which it is fed automatically into tram cars carrying the ore from the dock to stock piles located at a considerable distance from the water.

(3) An A frame which lifts with the buckets and discharges them into tram cars, that run to the stock pile or dump the ore into pockets and thence into railroad cars.

(4) Aprons which project over the holds of vessels. The buckets traveling up the incline of this apparatus are dumped into tram cars, which run by gravity, discharge, and return automatically.

(5) Booms or aprons upon which the buckets are carried, and continue their journey either over cables or on trussed bridges, the buckets dumping automatically at the point desired, and returning to the hold without detaching from the machinery.

As a companion to the figures showing the capacity of the ore-shipping docks, the following statement made up from an editorial which appeared in the Iron Trade Review, of Cleveland, Ohio, will give an idea as to the magnitude of the trade carried on at the receiving docks. The table given below shows the long tons of iron ore in stock on the docks of the lower lake ports for a series of years at the close of and at the resumption of navigation each season, the difference between these being winter shipments by rail to furnaces. In this table the close of navigation is considered as being fixed on December 1, and the opening of navigation as May 1 of the year following.

Stocks of Lake Superior iron ores at Lake Erie ports for ten years.

Years.	Stock on hand at close of navigation, December 1.	Stock on hand at opening of navigation, May 1.	Shipments.
	Long tons.	*Long tons.*	*Long tons.*
1883	1,692,689	524,749	1,303,950
1884	1,841,877	388,739	1,285,220
1885	1,463,969	556,657	1,090,648
1886	966,472	373,321	817,168
1887	1,558,865	149,304	855,145
1888	1,848,555	703,720	1,289,802
1889	2,607,106	558,753	1,670,878
1890	3,893,487	936,228	1,231,264
1891	3,508,489	2,662,223	1,971,301
1892	....	(a)1,537,188	

a The stock on hand May 1, 1892, was published prior to the revision of this report, and it and the winter shipments are therefore included as an item of interest.

From the above table it will be seen that the largest stock on hand at lake ports in the past nine years was on December 1, 1890, when 3,893,487 long tons were on the docks, a constant increase since the year 1886, when 966,472 tons were on hand, this being the only one of the years under consideration in which the stocks on hand at the close of navigation was under 1,000,000 tons. As a consequence the largest stock of ore at the opening of navigation was that on May 1, 1891, when the heavy stocks of the previous year had been reduced to but 2,662,223 tons, and the lowest amount on the docks was in May, 1887, when the minimum stock of the previous December had been depleted until but 149,304 tons were on hand. The shipments, of course, fluctuated according to the demand for ore, being largest between December 1, 1891, and May 1, 1892, when 1,971,301 tons of stocked were forwarded to blast furnaces, and the minimum shipment was in 1886–'87, when but 817,168 long tons were taken from the docks.

The distribution of this stock, both at the close and opening of navigation, for the seasons of December 1, 1890, to May 1, 1891, and from December 1, 1891, to May 1, 1892, show that the bulk of business was at the ports of Cleveland, Ashtabula, and Fairport, in the order named.

Distribution of stocks of Lake Superior iron ores at Lake Erie ports, 1890 and 1891.

Ports.	Close of navigation.		Opening of navigation.	
	Dec. 1, 1890.	Dec. 1, 1891.	May 1, 1891.	May 1, 1892.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Toledo	110,740	122,515	27,000	62,960
Sandusky	115,000	122,000	70,000	85,500
Huron	1,200	14,910	1,200	5,000
Lorain	210,237	250,812	158,749	115,919
Cleveland	1,209,467	1,114,762	908,566	452,664
Fairport	721,080	597,617	465,612	255,422
Ashtabula	1,151,317	903,957	789,433	361,806
Erie	248,714	252,916	199,663	131,437
Buffalo	125,732	129,000	42,000	66,480
Total	3,893,487	3,508,489	2,662,223	1,537,188

FOREIGN IRON ORES IMPORTED.

The foreign iron ores brought into this country have since 1879 been an important factor to the eastern pig-iron trade. Some of the larger American iron companies now own mines in Cuba, and Spain has for a number of years been the largest contributor to the influx of foreign ores. Although the number of tons imported in the year 1891 was but 912,864 tons, as against 1,246,830 tons in 1890, the ore was apparently of a higher grade, as the import value of the foreign ore per ton increased from $2.29 in 1890 to $2.69 in 1891 in the face of a depressed market.

The following table shows the pig iron made in the United States and the iron ore imported in each year from 1879 to 1891, inclusive, as well as the relations which the amounts of ores bear to the quantities of pig iron made in the country for each year. The largest amount of iron ore imported was in 1890, viz., 1,246,830 long tons; the smallest importation, viz., 284,141 tons, was in 1879; but previous to 1879 the amounts were smaller. The average amount of foreign iron ore imported per ton of pig iron made was, however, the largest in 1881, being 0.189 ton, and smallest, 0.086 ton, in 1885; in 1891 it was 0.110 ton.

As the average yield of iron ores mined in the United States was determined by the Eleventh Census to be 51.27 per cent., the average consumption of domestic iron ore per ton of pig iron produced may be assumed as 1.95 tons; therefore, if proper allowance be made for the foreign iron ores, mill cinder, etc., in 1891, 5¾ per cent. of the ore mixtures fed to American blast furnaces was composed of foreign ores. This differs from the figures in the third column of the table, which indicate simply the relation which the tons of imported iron ore bore to the total domestic iron ore produced in the four years for which actual figures of the latter are obtainable.

Relation of imported iron ores to domestic pig iron for thirteen years.

Years.	Pig iron made.	Iron ore imported.	Percentage which imported iron ore bears to total iron ore production by weight.	Average amount of ore imported per ton of iron produced.
	Long tons.	*Long tons.*		*Long tons.*
1879	2,741,853	284,141	5.51 (1879–1880)	0.104
1880	3,835,191	493,408		0.129
1881	4,144,254	782,887	....	0.189
1882	4,623,323	589,655	....	0.128
1883	4,595,510	490,875	....	0.107
1884	4,097,868	487,820	....	0.109
1885	4,004,526	390,786	....	0.086
1886	5,683,329	1,039,433	....	0.183
1887	6,417,418	1,194,301	....	0.183
1888	6,489,738	587,470	....	0.091
1889	7,603,642	853,573	5.88	0.112
1890	9,202,703	1,246,830	7.67	0.135
1891	8,279,870	912,864	6.17	0.110

Maj. S. G. Brock, Chief of the Bureau of Statistics of the Treasury Department, supplied the following tables giving the amounts and values of the iron ores imported into the United States, and the country from which the iron ore is invoiced. Some of the iron ores on which high valuations are placed contain other ingredients than iron which add to their value, and are used for purposes other than that of pig-iron manufacture. Most, if not all, of the iron ore from Cuba and Spain is hematite, and the same holds true of the other countries, except Canada, which supplies magnetite principally.

Quantity and value of iron ores imported into the United States in the fiscal year 1891.

Countries.	Quantity.	Value.
	Long tons.	
Spain	323,771	$716,920
Cuba	257,189	720,508
Italy	154,073	544,914
French possessions in Africa and Occanica	96,961	193,606
England	39,451	119,052
Greece	24,412	34,589
Portugal	9,940	22,130
Turkey in Europe	3,850	92,571
Quebec, Ontario, Manitoba, etc	2,126	4,008
British Columbia	588	2,189
Venezuela	300	600
Turkey in Asia	158	2,075
Nova Scotia, New Brunswick, etc	35	270
France	9	3,084
Brazil	1	5
Total imports	912,864	(*a*)2,456,521

a The difference in the total value between this table and that of the United States Custom-House Department is due to the fact that in several of the ports of entry a value was given, but the amount of iron ore was not furnished by the Department, and these were therefore omitted in our total valuations.

If the imports are arranged according to the customs districts it will be found that nearly the entire amount was entered at Atlantic ports, the two ports of Baltimore and Philadelphia receiving 870,219 long tons, or over 95 per cent. of the total importations.

Distribution by customs districts of foreign iron ores imported in 1891.

Districts.	Quantity.	Value.
	Long tons.	
Baltimore, Md	453,373	$1,219,015
Philadelphia, Pa	416,846	1,098,992
New York, N. Y	25,817	89,975
Perth Amboy, N. J	14,089	42,087
Total Atlantic ports	910,125	2,450,069
Oswegatchie, N. Y	1,958	3,591
Buffalo Creek, N. Y	114	342
Detroit, Mich	44	75
Chicago, Ill	35	276
Total lake ports	2,151	4,284
Puget Sound, Wash	588	2,189
Total imports	912,864	(*a*)2,456,542

a The difference in the total value between this table and that published by the United States custom-house department is due to the fact that in several of the ports of entry a value was given, but the amount of iron ore imported was not furnished by the Department, and these were therefore omitted in the total valuations.

The foreign iron ores imported into this country pay a specific duty of 75 cents per long ton. This has the effect of encouraging the shipment of rich ores only; for the ocean freight rates and the duty (being by the ton, independent of the grade of the ore) bear a smaller relation to the selling price of the rich than of the lean ores. Another fact which tends to encourage the selection of superior ores for shipment is brought out by a decision of the United States Supreme Court confirming a ruling of a lower court in which the point involved was whether duty should be assessed on an importation of iron ore according to the number of pounds reported by the United States weigher, as weighed at the side of the vessel when the cargo was discharged, or on the weight when the moisture contained in it was dried out. The collector assessed duty according to weight at the vessel's side and the court held that to be the correct method.

THE LAKE SUPERIOR AND BILBAO DISTRICTS COMPARED.

The two mining districts which produce iron ore in the greatest quantities are the Lake Superior region of the United States and the Bilbao district of Spain, and a comparison of the outputs of these two important mining centers is of special interest.

Prior to 1860, it is estimated that 203,676 long tons were taken from the Marquette mines, the only one of the four ranges comprising the Lake Superior district which was producing ore at that time. The output of Bilbao (Spain) mines previous to 1860 is not known. The figures for the output of the Lake Superior district (embracing the four ranges) for subsequent years are taken from Michigan Mineral Resources and the U. S. Geological Survey, and those for the Bilbao district obtained from a report of the chief mining engineer of the province. They are compared in the following table:

Comparison of the iron-ore product of the Lake Superior region with the Bilbao, Spain, district.

Years.	Bilbao district.	Lake Superior district.	Year.	Bilbao district.	Lake Superior district.
	Metric tons.	*Long tons.*		*Metric tons.*	*Long tons.*
1860	69,816	114,401	1879	1,262,671	1,420,745
1861	54,869	49,909	1880	2,683,627	1,962,477
1862	70,460	124,169	1881	2,620,626	2,323,640
1863	70,720	203,055	1882	3,855,000	2,932,953
1864	120,470	247,059	1883	3,627,752	2,580,223
1865	102,360	193,758	1884	3,216,321	2,321,882
1866	89,912	296,713	1885	3,311,419	2,485,855
1867	136,075	565,504	1886	3,185,228	3,634,201
1868	154,120	510,522	1887	4,198,696	4,728,695
1869	164,800	639,097	1888	3,631,593	5,006,896
1870	250,337	859,507	1889	3,901,511	7,519,614
1871	403,142	813,984	1890	4,326,933	8,944,031
1872	402,000	948,553			
1873	365,340	1,195,234	Total 1860 to 1890	45,099,253	57,549,800
1874	(a) 10,821	899,934			
1875	(a) 34,296	881,166	Yearly average 31 years	1,454,815	1,856,445
1876	432,418	993,311	1891	Unknown.	7,621,465
1877	1,040,264	1,025,129			
1878	1,305,656	1,127,583			

a Carlist war.

The extent to which iron-ore mining has been prosecuted, as measured by the depths reached in various workings, is seldom appreciated. Concerning the Lake Superior iron-ore mines, Mr. Richard A. Parker, M. E., of Marquette, who is thoroughly familiar with the region, states that "on the Menominee range, the Hamilton Ore Company operated a vertical shaft 1,325 feet deep, and has a winze 115 feet deeper. The Ludington mine, near by, has a depth of 1,150 feet vertically. In the Marquette range the Champion mine is 1,260 feet deep on an angle of 67 degrees from the horizontal, equivalent to 1,160 feet vertically. There are seventeen active mines over 500 feet deep on the Marquette range, and two that are idle exceed that depth; seven mines on the Menominee range, and nine mines upon the Gogebic range have depths of 500 feet or more, making a total of thirty-three on these three ranges, adding one in the Vermilion range of Minnesota, gives thirty-four deep mines active in the iron-ore district of Lake Superior."

The graphic representation shows the output of the more prominent sources of the iron-ore supply for the blast furnaces of the United States. In some of these districts, owing to the destruction of the records by fire, they can not be traced back for twenty years and in others no statistics have been kept, but it is interesting to note the advance of some sections and the decline in others.

The figures of production will be found in the accompanying table. Those of the Marquette range, up to and including 1877, were taken from the Michigan Mineral Statistics, from 1878 to and including 1888, the data for the Marquette, Menominee, and Gogebic ranges were obtained from a table compiled by Mr. W. J. Stevens. The figures for the remaining years and for the other districts were obtained from the reports of the U. S. Geological Survey. No reliable statistics for the output of the Alabama mines can be obtained, except for the last three years, but, as before stated, the estimates were carefully made.

The first range which was opened in the Lake Superior district was the Marquette, and it is to-day the largest contributor to the country's iron-ore supply. It reached a total of 1,000,000 tons in 1873, suffered a decline for three years, and since then has shown an almost constant increase, reaching its maximum in 1890, when 2,863,848 long tons were mined.

The Menominee range, from its first shipment in 1877, increased its output until 1,000,000 tons was reached in 1882. In 1883 its product was slightly less, and in the three years following, owing to a depression in the iron trade, its output was under 1,000,000 tons, but since 1887 it has been increasing, reaching the maximum in 1890, when 2,274,192 long tons were produced, but it fell off in 1891.

The Gogebic and Vermilion ranges were developed in the same year, viz., 1884, but the former soon outstripped its rival, reaching an output of over 1,000,000 tons in 1887, and in 1890, 2,914,081 long tons were mined. Its 1891 product was 870,000 tons less than that of 1890. The Vermilion range has shown a constant growth each year and reached its maximum in 1891, when 945,105 tons were produced.

The New Jersey mines have advanced and declined according to the demand for ores and the keenness of competition with other districts and with imported ores. Its maximum output was in the year 1882, when 932,762 long tons were mined. Since 1886 the production has remained comparatively uniform, its average being in the neighborhood of 500,000 long tons annually.

While the ore of the Cornwall Ore Hills, in Pennsylvania, is lower in its percentage of iron than the Lake Superior or Lake Champlain ores, it is of Bessemer quality, and is cheaply mined. The enormous increase in the Bessemer steel industry and the nearness of the mines to points of consumption has encouraged a large demand for this ore, the amount mined increasing from 98,925 tons in 1875 to 769,020 tons in 1889. In 1890 and 1891 smaller amounts were won.

In the earlier history of the Lake Champlain region of New York most of its iron ores were used to supply the needs of the blast furnaces, forges, and bloomaries which abounded in that district, but, although the number of these plants has decreased, the average output of the district has increased, owing to the demand for high-grade ores from blast-furnace plants in New York and other States, and it is therefore but natural that its largest output was in the same year as the maximum pig-iron product, viz., 1890, when 821,994 tons of iron ore were mined.

The major portion of Missouri's output of iron ore came from Iron Mountain and Pilot Knob, and the partial exhaustion of the latter deposit, in connection with the abandonment of some of the smaller mines, has led to a gradual decline. Of the years for which figures could be obtained, 1887 gives the maximum output, viz, 427,785 long tons, while the smallest product was in 1891 (106,749 tons).

The demand for iron ores carrying a high percentage of iron and below the Bessemer limit in phosphorus has attracted considerable foreign ore. This is, however, consumed on the Atlantic and Pacific coasts, very little, if any, being used west of Pennsylvania, with the exception of the small amount imported on the Pacific coast, which is used at small furnaces near the port of entry. Until the year 1879 the amount was below 100,000 tons, but in that year over a quarter of a million tons were imported and of late years it has exerted a considerable influence in the eastern markets. The largest imports were in 1890, when 1,246,830 tons were brought from various foreign countries. This year, however, the shipments were about 25 per cent. less.

All of Ohio's iron ores are found in the Coal Measures and are either carbonate or altered carbonate. The output has fallen from 377,465 long tons in 1887 to 104,487 tons in 1891, owing to the facilities for supplying local blast furnaces with the richer Lake Superior ores.

Nearly all of the Alabama ores are used in local blast furnaces, and as the number and output of these furnaces increased the iron-ore output also showed a corresponding advance, rising from 171,139 long tons in 1880 to 1,000,000 tons in 1888, and in the year 1891 to a still further advance to 1,986,830 long tons.

Outputs of prominent sources of iron-ore supply for twenty years.

Years.	Marquette range.	Menominee range.	Gogebic range.	Vermilion range.	New Jersey.	Cornwall, Pa.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1872	948,553				600,000	193,317
1873	1,195,234				665,000	166,782
1874	899,934				525,000	112,429
1875	881,166				390,000	98,925
1876	993,311				285,000	137,902
1877	1,014,754	10,375			315,000	171,589
1878	1,033,082	78,028			409,674	179,299
1879	1,130,019	245,672			488,028	268,488
1880	1,384,010	524,735			745,000	231,173
1881	1,579,834	726,671			737,052	249,050
1882	1,829,394	1,136,018			932,762	309,681
1883	1,305,364	1,047,863			521,416	363,144
1884	1,559,912	895,634	1,022	62,122	393,710	412,320
1885	1,430,862	690,435	119,590	227,075	330,000	508,864
1886	1,627,383	880,006	756,237	307,948	500,501	688,054
1887	1,851,717	1,199,343	1,285,265	394,910	547,889	667,210
1888	1,918,672	1,191,097	1,433,689	511,953	447,738	722,917
1889	2,631,026	1,876,157	2,147,923	864,508	415,510	769,020
1890	2,863,848	2,274,192	2,914,081	891,910	495,808	686,302
1891	2,778,482	1,856,124	2,041,754	945,105	525,612	663,746

Years.	Lake Champlain, N. Y.	Missouri.	Ohio.	Alabama.	Importations.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1872	350,000	Unknown	Unknown	Unknown	27,000
1873	420,000	do	do	do	62,000
1874	250,000	do	do	do	69,000
1875	300,000	do	do	do	83,000
1876	290,000	do	do	do	26,000
1877	365,000	do	do	do	42,000
1878	380,000	do	do	do	29,765
1879	480,000	do	do	171,139 (1879–1880)	284,141
1880	700,000	do	do		493,408
1881	637,000	do	do	220,000	782,887
1882	725,000	do	do	250,000	589,655
1883	540,000	do	do	385,000	490,875
1884	530,000	233,225	do	420,000	487,820
1885	420,000	169,162	do	505,000	390,786
1886	588,829	379,776	344,484	650.000	1,039,433
1887	768,852	427,785	377,465	675,000	1,194,301
1888	669,553	217,931	253,352	1,000,000	587,470
1889	779,900	265,718	254,294	1,570,319	853,573
1890	821.994	181,690	169,088	1,897,815	1,246,830
1891	554,865	106,749	104,487	1,986,830	912,864

IRON-ORE CONCENTRATION.

Strictly speaking, the concentration of iron ores would refer to any process or method by which the percentage of iron in the ore is improved by the removal of gangue materials. If it were taken in this broad sense it would include washing of brown hematite ores to remove the ochre and clay and the system of hand sorting or cobbing employed at some of the red hematite mines of the Lake Superior region.

The term "concentrates", however, is more generally applied to ore which has been comminuted by means of crushing machinery and then passed through water-jigs or magnetic separators to remove materials which lower the grade of the ore.

In jigging, the crushed ore is agitated, water being introduced which removes the lighter material, while the heavier iron ore sinks and is conveyed from the jig as it is separated.

The largest plant of this description (*i. e.* of jigs) is that at Lyon Mountain, New York, where the Chateaugay Ore and Iron Company treats the lean magnetite taken from the mines. The next in importance is that erected at Iron Mountain, Missouri, for the separation of the leaner red hematites. A large plant was also erected at Negaunee, Michigan, for the same purpose, but it proved unprofitable and was abandoned.

Magnetic separators have been in use since 1852, but it is only within late years that this system has attracted much attention. Although the forms of magnetic separators vary, they may be classed under three general heads.

(1) Altering the trajectory of falling material by introducing the attraction of a magnet, to draw the magnetic portion away from the nonmagnetic.

(2) Feeding the ore to a revolving drum or drums, in which is a magnet core, the shells of the drum being either of alternate magnetic and nonmagnetic strips or entirely of magnetic or nonmagnetic material. In some of these drums the magnet core is wound so as to exert a constant polarity, in others a series of magnets of alternate polarity compose the core, and in some, opposite drums are of opposite polarity. When two drums are used, they are placed so as to revolve toward each other, the ore passing between them, or they are arranged tandem, the drums revolving in the same direction, but sometimes at different speeds and with different degrees of magnetic force, so that the ore fed from one drum to the other receives successive treatment. Machines are also arranged with more than two drums.

(3) Belt machines in which the ore is fed to a belt or series of belts passing under or over magnets or magnetic drums, the machines working sometimes in water and sometimes dry. In some of the machines the polarity is maintained continuously by means of pole pieces; in others the material is constantly submitted to magnets of alternate

polarity, the belts being placed so as to run either vertically, horizontally, or on an incline, according as the conditions require.

Of these different classes there are now in actual operation the following: six of class 1, twenty-nine of class 2, and twenty-seven of class 3. These are used either at the mines to enrich the ore, at steel works and rolling mills to remove the magnetic particles from slag and dirt, to separate iron ore from pottery clay or from emery—and in one instance iron ore occurring as a hematite with zinc ore is treated in a roasting furnace after being comminuted, and, becoming magnetic, can be separated.

The principle magnetic separator plants are those of Messrs. Witherbees, Sherman & Co., at Mineville, New York, who constructed the first large plant operated entirely with magnetic separators, and made a number of experiments with various machines. There are also large magnetic separating plants at the Croton mines, at Clover Hill, and at the Tilly Foster mine near Brewster, New York; at the Magnetic Iron Ore Company's works at Little River, New York, and another at the Ogden mine, New Jersey. In addition to the extensive plant which Mr. Edison has at the Ogden mine, he also put up plants at Humboldt, Michigan, and Bechtelsville, Pennsylvania, both of which were destroyed by fire. In addition to those plants mentioned there are smaller ones at Michigamme, Michigan, two in New Jersey, two in Pennsylva, nia, and one each in Virginia and North Carolina.

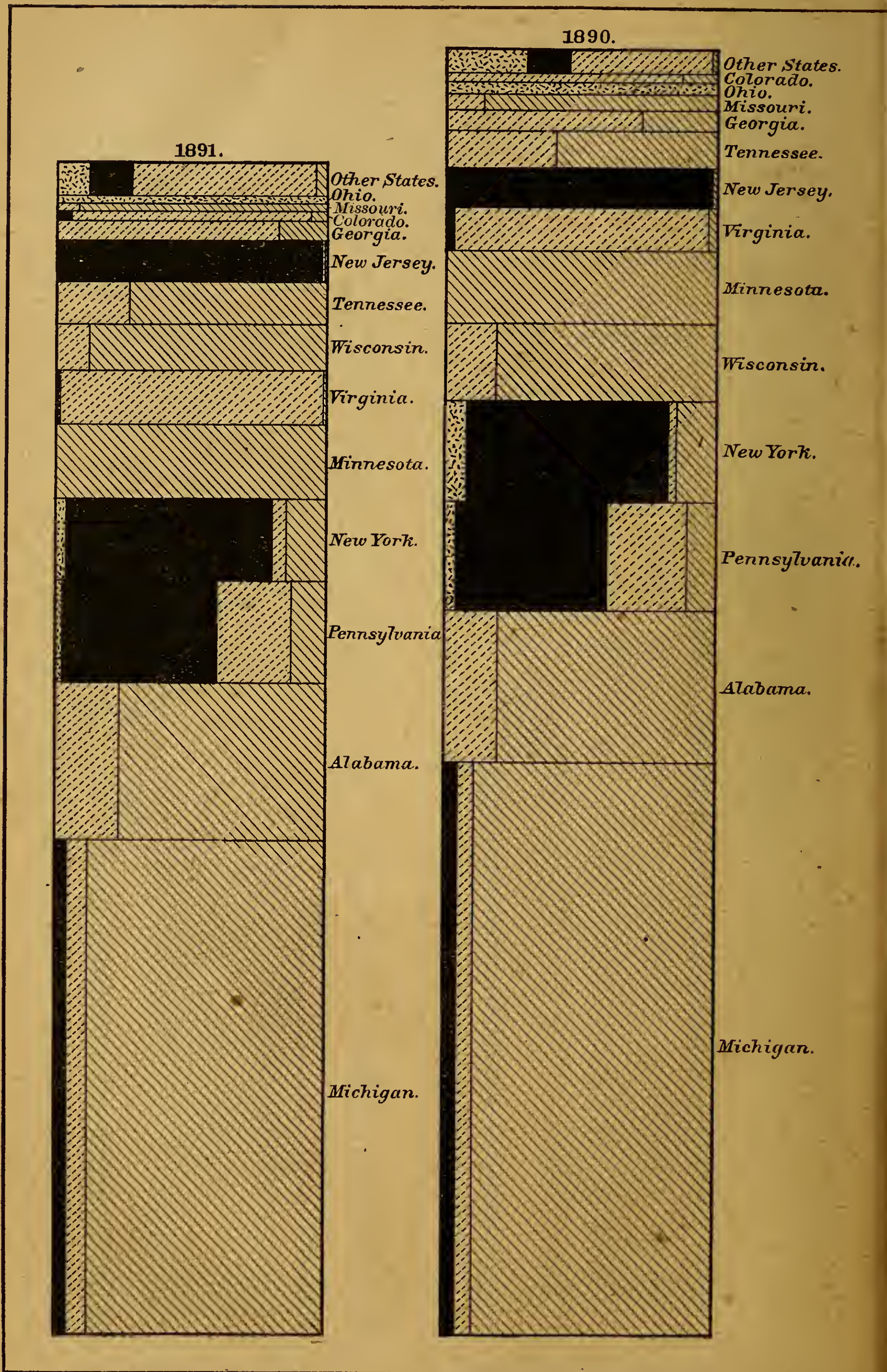
Along the Rhode Island shore the iron sands are treated by passing them over magnetic separators, and a small quantity of concentrated iron ore is thus produced and sold.

There is apparently a wide field for magnetic separation, especially in the States of New York, New Jersey, Pennsylvania, Virginia, North Carolina, and Michigan, where there are large deposits of lean magnetic ores. At first there was considerable prejudice against the use of concentrated ore by some of the blast furnace managers, but this has been largely overcome by practice, which has proven that properly concentrated ore contributes to the good working of the furnace, and in the future this class of ore may be used largely in place of some of the higher-priced ore brought to eastern blast furnaces. This class of ore has also been used in most of the direct processes, and any development of these processes will encourage a corresponding demand for concentrates.

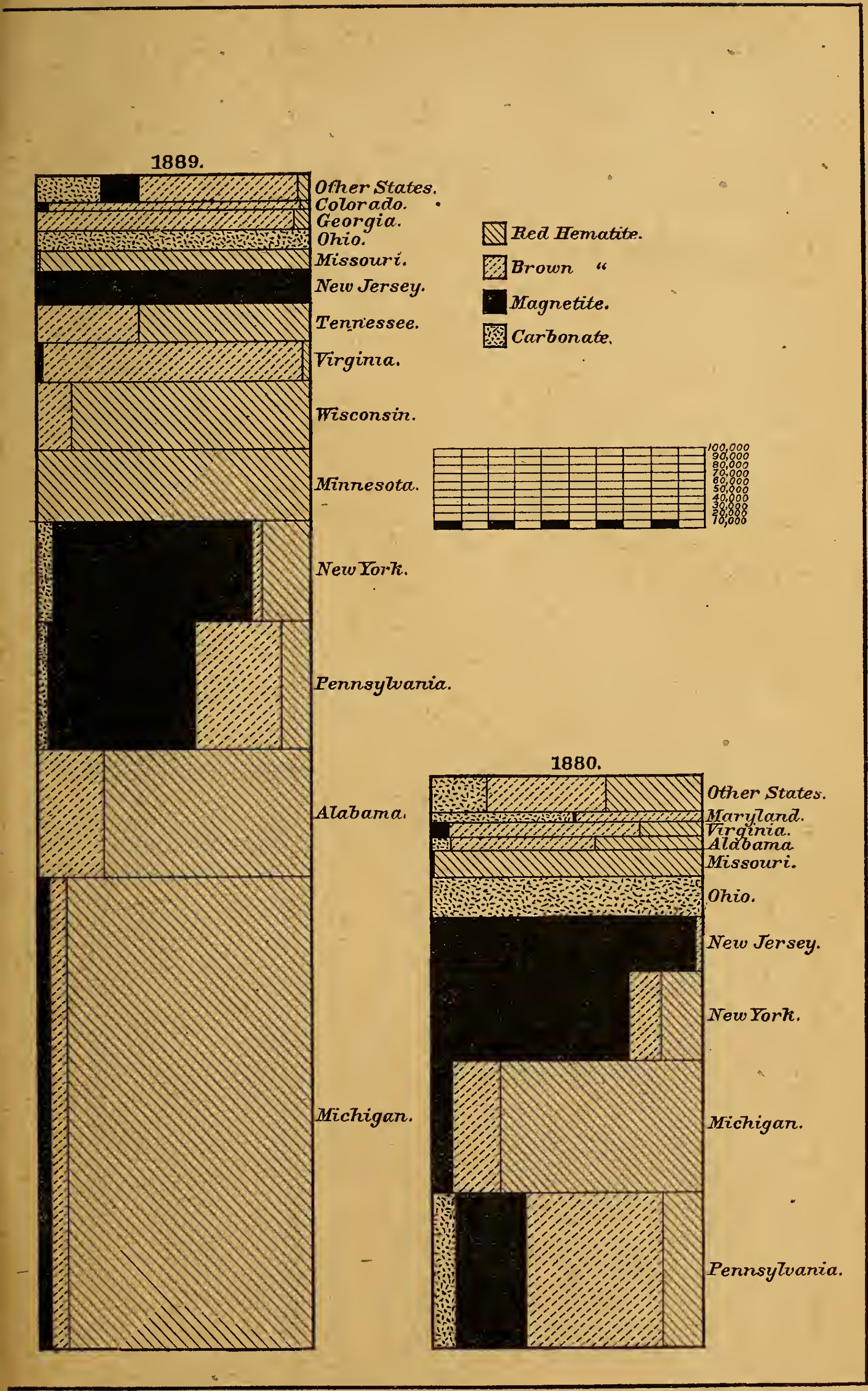
During the year 1891 there were produced 16,802 long tons of hand-picked or cobbed ore, 98,546 long tons of magnetically separated ore, and 110,777 long tons of jigged ore.

FOREIGN AND DOMESTIC IRON MINES COMPARED.

The Colliery Guardian has published an interesting article upon the working of iron mines in different countries, from which are taken the following figures, showing comparisons between the United States and some of the other iron-ore producing countries.



RELATIVE PRODUCTION OF VARIOUS KINDS OF IRON ORES,
Quantities are repre



BY STATES, IN THE YEARS 1880, 1889, 1890 AND 1891.
sented by areas.

The table gives the number of employés engaged in mining iron ore, the total production and the average output per employé in the countries named, the production being recorded in even thousands of tons. It is understood that all of these estimates are based on the 1889 outputs:

Iron ore mining in different countries.

Countries.	Number of employés.	Production.	Average output per employé.
		Tons.	*Tons.*
Germany and Luxemburg	37,762	(*a*)11,002,000	291
United States	37,707	(*b*)14,518,000	385
Spain	13,682	(*a*)4,167,000	305
France	5,474	(*a*)3,070,000	561
Austria	4,961	(*a*)1,115,000	225
Algeria	1,841	(*a*)352,000	191

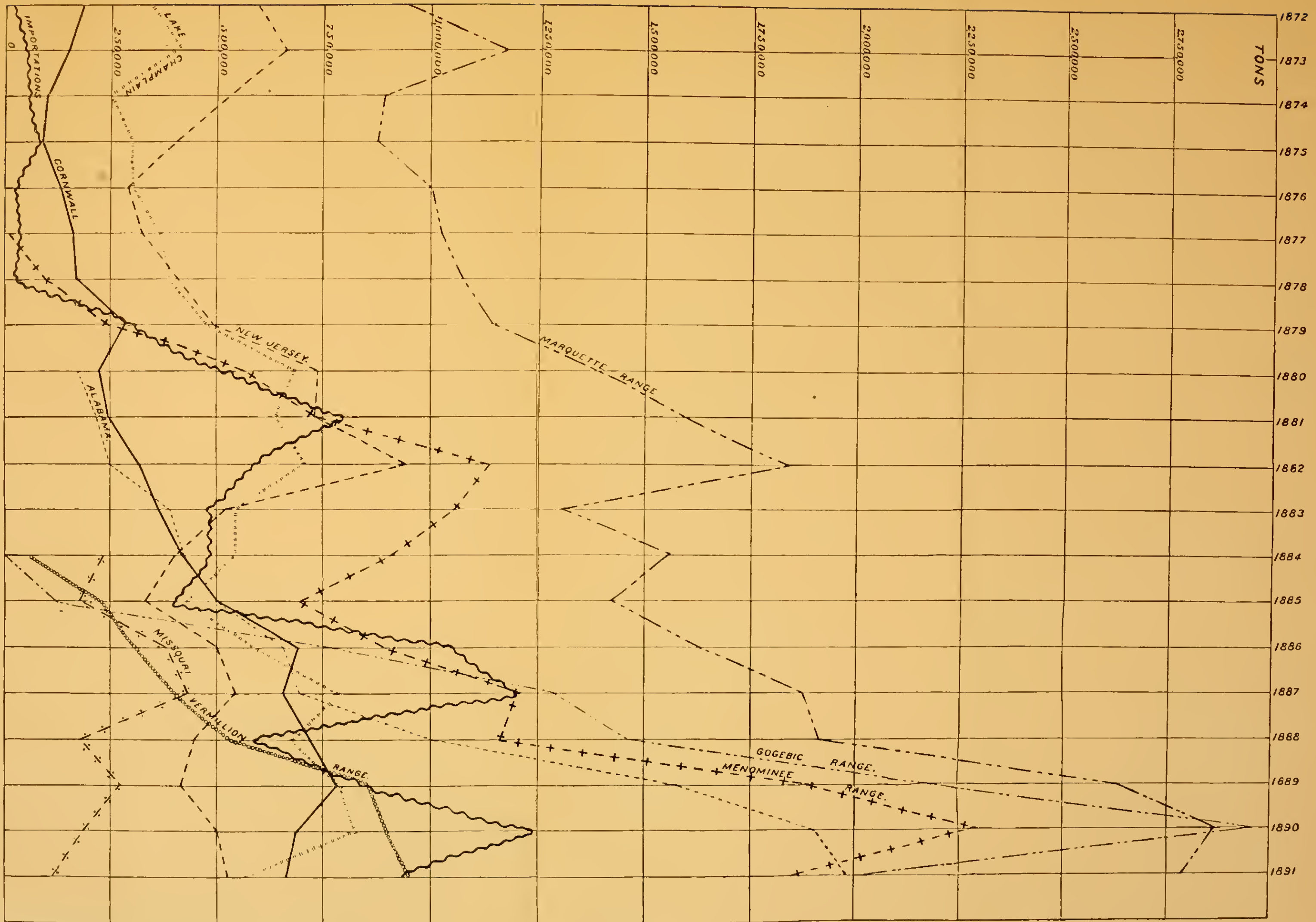
The number of producing mines, the production, and the average output per mine in different countries and districts are also given as follows:

Production of iron ore in various countries.

Countries.	Number of mines.	Production.	Average output per mine.
		Tons.	*Tons.*
Germany and Luxemburg	675	(*a*)11,002,000	16,299
United States	592	(*b*)14,518,000	24,524
Michigan (United States)	73	(*b*)5,856,000	80,221
Cleveland district (England)	38	(*b*)5,650,000	148,684

a Metric tons. *b* Long tons.

OUTPUT OF PROMINENT SOURCES OF IRON-ORE SUPPLY FOR TWENTY YEARS.



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TWENTY YEARS OF PROGRESS IN THE MANUFACTURE OF IRON AND STEEL IN THE UNITED STATES.

By James M. Swank,

General Manager of the American Iron and Steel Association.

In the present paper will be presented a summary of the progress made by the United States in the development of its iron and steel industries in the twenty years extending from 1872 to 1891. The changes of these twenty years in the processes of iron and steel manufacture in our country, in the uses to which these products have been applied, in the quantities which have been produced, and in the prices at which they have been sold, have been in the main important, remarkable, phenomenal, and marvelous. In no other period of the world's history and in no other country could they have been possible. The statistical and other details which will be cited are chiefly derived from the records of the American Iron and Steel Association.

TWENTY YEARS OF IRON ORE DEVELOPMENT.

The production of iron ore in the United States in the census year 1870 was 3,031,891 long tons; in the census year 1880 it was 7,120,362 tons; in the calendar year 1889 it was 14,518,041 tons; in the calendar year 1890 it was 16,036,043 tons; and in the calendar year 1891 it was 14,591,178 tons. The production of 1870 was very much less than one-fifth the production of 1890. Statistics of the production of iron ore in 1872, just twenty years ago, are not in existence. The statistics above given for 1889 were gathered by Mr. John Birkinbine for the Census Office, and for 1890 and 1891 they were gathered by the same gentleman for the division of mining statistics of the United States Geological Survey.

The United States is a larger producer of iron ore than any other country, having in late years passed Great Britain, its only rival as an iron-ore producer, as it has also passed her as a producer of pig iron and steel. This prominence as an iron-ore producer is not, as might at first sight be supposed, a natural sequence of the fact that the United States is the largest producer of pig iron in the world, as many countries which produce pig iron in large quantities are large importers of iron ore. It may also be said that Spain and Italy annually export much more iron ore than they consume, while Algeria and Cuba are also large exporters of iron ore, but consume none. The United States is itself an importer of iron ore in considerable quantities, but not in as large quantities as either Germany or France, and to a very much less degree than Great Britain.

Comparative production of iron ore.—As has already been stated, the production of iron ore in the United States in 1889 was 14,518,041 tons; in 1890 it was 16,036,043 tons; and in 1891 it was 14,591,178 tons. The production of iron ore by Great Britain in 1889 amounted to 14,546,105 tons; in 1890 it was 13,780,767 tons; and in 1891 it was 12,777,689 tons. These figures for Great Britain show a steady decline in production since 1889. Both Germany and France annually produce much less iron ore than either the United States or Great Britain. In 1890 Germany and Luxemburg produced 11,409,625 tons, and in 1887 France produced 2,579,465 tons. Although producing much less pig iron than France, Spain is a much larger producer of iron ore, its production in 1890 amounting to 5,788,743 tons.

Comparative imports of iron ore.—Of all iron-making countries Great Britain is the largest importer of iron ore. Her imports in recent years have been as follows: 3,765,788 tons in 1887, 3,562,071 tons in 1888, 4,031,265 tons in 1889, 4,471,790 tons in 1890, and 3,180,543 tons in 1891. Great Britain also imports annually several hundred thousand tons of "purple ore," which are used in her blast furnaces. The imports of iron ore into Germany and Luxemburg amounted to 1,036,217 tons in 1887, 1,163,373 tons in 1888, 1,234,789 tons in 1889, 1,522,501 tons in 1890, and 1,408,025 tons in 1891. The imports of iron ore into France amounted to 1,154,405 tons in 1887, 1,310,695 tons in 1888, 1,545,363 tons in 1889, 1,610,244 tons in 1890, and 1,437,527 tons in 1891. The imports into the United States in the five years mentioned have been less than the imports into any one of the other countries named above in the same time, and in the last thirteen years, from 1879 to 1891, inclusive, they have averaged a little over 719,500 tons annually. The years of largest importations were 1886, 1887, and 1890, when we imported 1,039,433 tons, 1,194,301 tons, and 1,246,830 tons respectively. In no year prior to 1879 did the imports amount to 100,000 tons.

From the statistics which have been presented it plainly appears that no other leading ironmaking country is so independent of foreign sources of iron-ore supply as the United States. To this statement it may be added that new iron-ore fields in our country are constantly being discovered and developed, so that our supply of iron ore for the future promises to be practically inexhaustible. It is, however, true that there is a scarcity of Bessemer iron ores on the Atlantic coast and of all iron ores on the Pacific coast. The three interior States of Michigan, Wisconsin, and Minnesota now annually produce more than one-half of our total production of iron ore. Our imports of iron ore are chiefly to supply the wants of blast furnaces on the Atlantic coast, and particularly of those furnaces which produce Bessemer pig iron.

Leading iron-ore districts in the United States.—Of all the iron-ore producing districts of the United States, those embraced in the Lake Superior region are not only the most important, but they have been the most recently developed. In 1872, twenty years ago, the total shipments of iron ore from the region mentioned, including shipments to local furnaces, aggregated only 900,901 tons; but in 1890, the year of largest production, the shipments aggregated 9,012,379 tons, or ten times as much as in 1872. In the twenty years from 1872 to 1891 the shipments of iron ore from the Lake Superior region aggregated 59,617,497 tons, while the shipments in all preceding years aggregated only 4,593,818 tons.

The first experimental shipment of iron ore from the Marquette district of the Lake Superior region, the first to be developed, occurred in 1850, but shipments from this district for commercial purposes did not begin until 1853. The next Lake Superior iron-ore district to be developed was the Menominee district, from which the first shipments were made in 1877, aggregating 10,405 tons. In 1884 the first shipments were made from the Vermilion district, aggregating 62,124 tons. Next followed the development of the Gogebic district, from which the first shipments were also made in 1884, aggregating 1,022 tons. In 1892 the development of the promising Mesaba iron-ore district in the Lake Superior region was also undertaken, and the first shipments were made late in that year.

The rapidity with which the Menominee, Gogebic, and Vermilion districts have been developed is seen in the statistics of their shipments of iron ore in 1890. In that year the Menominee district shipped 2,289,017 tons; the Gogebic district, 2,845,171 tons, and the Vermilion district, 880,264 tons. The Marquette district shipped in the same year 2,997,927 tons. The grand total for the year was 9,012,379 tons, or over 56 per cent. of the total production of iron ore in the United States in that year.

The next most productive iron-ore district in the United States is the Cornwall district in Pennsylvania, and this district has also made extraordinary strides in development during the past twenty years, although the first ore was taken from its mines in the first half of the last century. In 1872 the production of iron ore by the Cornwall mines was 193,317 tons, but in 1889 the shipments from these mines, when the maximum was attained, amounted to 769,020 tons. From the beginning of their development in 1740 to the close of 1891 the Cornwall iron-ore mines have produced 11,514,995 tons of iron ore, of which 7,600,221 tons were produced in the twenty years from 1872 to 1891.

Changes in the use of domestic iron ores.—The introduction of the Bessemer process into the United States called for the use of domestic iron ores of different character from those which had previously been in general use. Ores low in phosphorus were absolutely necessary for the manufacture of Bessemer pig iron. It is just twenty-five years since

Bessemer steel rails were first made in our country in commercial quantities, and for many years afterwards the search for ores of suitable quality for the production of Bessemer pig iron was industriously prosecuted, and many failures occurred in using domestic pig iron that was unsuited for conversion into steel. Large quantities of Bessemer pig iron were for many years imported because of the difficulty in obtaining domestic pig iron of equally good quality or because it was made at such remote distances from points of consumption that it could not compete in price with its foreign rival. More thorough knowledge of the character of the Lake Superior iron-ore deposits, cheaper rates of transportation for the ores of that region, the more general use of Connellsville coke, and lastly the ease with which foreign Bessemer ores could be imported were influences which between 1870 and 1880 gradually rendered our Bessemer-steel manufacturers independent of foreign Bessemer pig-iron makers, and since 1880 we have imported very little pig iron of this quality. We do, however, as we have always done, import a part of our supply of spiegeleisen and ferro-manganese, although if compelled to rely upon our own manganese resources we could certainly make all the spiegeleisen and ferro-manganese that we need.

By the development of our Bessemer industry and also of our open-hearth industry, we have not only created a demand for iron ores which had not previously been much sought after, but we have also, by the substitution of steel for iron, as well as by the growing economic necessity of using the purest ores for all purposes, displaced ores of inferior quality and richness which were once in general use. This has been the case most conspicuously in the great ironmaking and steel-making State of Pennsylvania, which at one time within the memory of the present generation relied almost entirely on its own sources of iron-ore supply, but now largely neglects its own ores and imports from sister States and from foreign countries fully three-fourths of all the ores that it consumes. In the census year 1870 it produced 978,113 tons of iron ore, or over 32 per cent. of the total production of the country in that year; in the census year 1880 it produced 1,951,495 tons, or over 27 per cent. of the total production; in 1889 it produced 1,560,234 tons, or less than 11 per cent. of the total production. Beginning with 1889 the Southern State of Alabama has annually produced more iron ore than Pennsylvania, although Pennsylvania has since annually produced more than five times as much pig iron as Alabama.

Twenty years ago Lake Champlain iron ores were very popular for fettling in puddling furnaces as far west as Pittsburg, but their use for this purpose is now chiefly confined to eastern rolling mills. It was in 1872 that Lake Champlain ores were first used for fettling at Pittsburg. From June to December of that year 20,580 tons of these ores were received in that city. Lake Superior and Missouri ores soon superseded Lake Champlain ores at Pittsburg for the purpose mentioned. Twenty years ago it was also supposed that the iron made in the forges of the Lake Champlain district would be largely used in the production of crucible steel, and many tons were annually used for this purpose at Pittsburg and elsewhere, but the presence of phosphorus beyond the prescribed limits in some of the Champlain ores and the high cost of producing Champlain iron in charcoal forges, have combined to reduce the demand by crucible-steel manufacturers for the iron of this district. Some of the recently developed Champlain ores, are, however, very low in phosphorus.

The iron ores of Missouri received at one time a great deal of attention from our iron and steel manufacturers, but in late years they have been overshadowed by the richer and more easily mined ores of other localities, and their production has declined. Some of the iron-ore mines of the State have also been practically exhausted. The best known mines are located at Iron Mountain and Pilot Knob. The former have been operated since 1845 and the latter since 1847. Iron Mountain alone has produced over 3,000,000 tons of ore, and Pilot Knob has produced over 1,000,000 tons. In 1872 there were mined and shipped from Iron Mountain alone 269,480 tons. A large part of the production of Iron Mountain and Pilot Knob has been taken to points on the Ohio river, but in recent years shipments have been mainly to nearer localities and have been inconsiderable in quantity. The receipts of Missouri iron ore at Saint Louis in 1873, chiefly for shipment to other localities, amounted to 349,357 tons. Of the total receipts in that year 113,327 tons were shipped by river and 63,717 tons by rail. In those days Pittsburg was the principal purchaser of Missouri ores, her furnaces and rolling mills taking 35,440 tons in 1871, 68,420 in 1872, and 113,069 tons in 1873. The production of iron ore by all the mines of Missouri in the census year 1870 amounted to 159,680 tons; in the census year 1880, to 344,819 tons; and, in the calendar year 1889, to 265,718 tons. The production has since declined.

Shipments of Southern iron ores to Northern markets.—In late years shipments of Southern pig iron to Northern and Western markets have constituted a leading feature of the home iron trade, but twenty years ago these shipments were almost unknown, and Southern men were looking to the North for a market for their iron ores. This was in 1872, 1873, and 1874, in which years considerable quantities of iron ore from Tennessee, Alabama, and Georgia were shipped to furnaces in Indiana and on the Ohio river. The trade began in 1872, reached its culmination in 1873, and came to an end in 1874. In 1873 Mr. George H. Hull, of Louisville, shipped northward about 25,000 tons of Alabama brown hematite iron ore, mined on the Selma, Rome and Dalton railroad, and about the same number of tons of red fossiliferous iron ore, mined near Birmingham. A considerable part of these ores was shipped to Brazil, Knightsville, Terre Haute, and Harmony, in Indiana, and to Mingo Junction and Steubenville, in Ohio. These ores when delivered cost from $7.75 to $9.25 per ton, and two tons were required to make one ton of pig iron.

TWENTY YEARS OF PIG-IRON PRODUCTION.

The total production of pig iron in the United States in 1872 was 2,548,713 long tons, and the total production in 1890, the year of largest production, was 9,202,703 long tons, an increase in annual production in nineteen years of 6,653,990 tons. In 1891, owing to a world-wide financial reaction originating in England at the close of 1890, the production fell to 8,279,870 tons. The production of pig iron in Great Britain and in the United States from 1872 to 1891 is compared in the following table:

Production of pig iron in Great Britain and in the United States during twenty years.

Years.	Great Britain.	United States.	Years.	Great Britain.	United States.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
1872	6,741,929	2,548,713	1882	8,586,680	4,623,323
1873	6,566,451	2,560,963	1883	8,529,300	4,595,510
1874	5,991,408	2,401,262	1884	7,811,727	4,097,868
1875	6,365,462	2,023,733	1885	7,415,469	4,044,526
1876	6,555,997	1,868,961	1886	7,009,754	5,683,329
1877	6,608,664	2,066,594	1887	7,559,518	6,417,148
1878	6,381,051	2,301,215	1888	7,998,969	6,489,738
1879	5,995,337	2,741,853	1889	8,322,824	7,603,642
1880	7,749,233	3,835,191	1890	7,904,214	9,202,703
1881	8,144,449	4,144,254	1891	7,406,064	8,279,870

This table shows not only the wonderful growth of the pig-iron industry of the United States in the last twenty years, but also its rapid growth in that period as compared with the slower growth of the pig-iron industry of our great industrial and commercial rival, Great Britain, which reached its maximum of production in 1882, but remained the world's largest producer of pig iron until 1890, when its place was taken by the United States. The years 1873 to 1879 were years of financial depression in this country, during which our pig-iron industry made no progress, but really retrograded in some years, but the pig-iron industry of Great Britain also retrograded during the same period.

Production of pig iron by sections.—In accompanying tables is presented a comparative statement of the production of pig iron in the last twenty years by the Eastern, Western, and Southern States, each group regarded as a geographical division, omitting only the trifling production of Minnesota by one furnace and the production of the few Rocky Mountain and Pacific Coast furnaces. These tables show that the East, the West, and the South have all made giant strides in building up their pig-iron industry during the period mentioned. The figures given are in short tons. They exhibit some curious as well as interesting results.

New England made a smaller quantity of pig iron in 1891 than in 1872, her product being 41,770 tons in 1872 and 34,497 tons in 1891. New York made more pig iron in 1882 than she has made since or had previously made, namely, 416,156 tons. New Jersey made almost exactly the same quantity of pig iron in 1872 that she made in 1891, namely, 103,858 tons in 1872 and 103,589 tons in 1891. Her highest production was in 1890, when she made 177,788 tons. Pennsylvania increased her production from 1,401,497 tons in 1872 to a maximum of 4,945,169 tons in 1890.

The pig-iron industry of the six Western States of Ohio, Indiana, Illinois, Michigan, Wisconsin, and Missouri has had an unequal development since 1872. The production of Ohio increased from 399,743 tons in that year to a maximum of 1,389,170 tons in 1890; that of Illinois increased from 78,627 tons in 1872 to a maximum of 785,239 tons in 1890, or almost exactly tenfold; that of Michigan increased from 100,222 tons in 1872 to a maximum of 258,461 tons in 1890; and that of Wisconsin increased from 65,036 tons in 1872 to a maximum of 246,237 tons in 1890. Upon the other hand, Indiana, which had a promising pig-iron industry in 1872, having built eight furnaces since 1867 to use its block coal, now makes far less pig iron than it did then, its production having steadily fallen from 39,221 tons in 1872 to 8,657 tons in 1891. The pig-iron industry of Missouri, also promising at one time, has made no progress in the last twenty years, its production being 101,158 tons in 1872 and reaching a maximum of 138,643 tons in 1887, since which year it has declined to figures greatly below those of 1872. The aggregate production of the six Western States mentioned was 784,007 tons in 1872 and 2,796,055 tons in 1890, the year of greatest production.

The nine Southern States of Alabama, Tennessee, Virginia, West Virginia, Kentucky, Georgia, Maryland, North Carolina, and Texas have, as a whole, shown a much more rapid growth in the production of pig iron in the last twenty years than any other section of the country. All the States mentioned, except Kentucky, have greatly increased their production during this period. The production of Kentucky, commencing with 67,396 tons in 1872, attained a maximum of 69,889 tons in 1873, and amounted to 50,225 tons in 1891. In the twenty years referred to Tennessee has increased her production from 42,454 tons in 1872 to 326,747 tons in 1891; Virginia from 21,445 tons in 1872 to 330,727 tons in 1891; and Maryland from 63,031 tons in 1872 to a maximum of 165,559 tons in 1890. West Virginia Georgia, and Texas have all made good progress since 1872 in building up their pig-iron industry, while North Carolina has made but little progress. But of all the Southern States which produce pig iron, Alabama has made the greatest progress. No other State has ever made such progress in the manufacture of pig iron as has been made by this State since 1872. In that year it produced only 12,512 tons of pig iron, all made with charcoal, while in 1890 it produced 914,940 tons, nearly all of which was made with coke. The aggregate production of the nine Southern States mentioned was 232,271 tons in 1872 and 1,953,459 tons in 1890.

During the twenty years from 1872 to 1891 Vermont and Utah Territory dropped out of the list of pig-iron producing States and Territories. Minnesota made its first pig iron in 1880, and California and Washington Territory made their first pig iron in 1881. The first pig iron made in Colorado by the Colorado Coal and Iron Company was made in the same year. If we may except the extraordinary growth in the pig-iron industry of Alabama, the habitat or home of the pig-iron industry of the whole country has not greatly changed during the last twenty years.

Production of pig iron by fuels.—In 1872 the total production of pig iron in this country was distributed among the different fuels used as follows, in short tons: Anthracite and mixed anthracite and coke, 1,407,058 tons; bituminous coal and coke, 946,913 tons; charcoal, 500,587 tons. In 1890 the figures were as follows: Anthracite and mixed anthracite and coke, 2,448,781 tons; bituminous coal and coke, 7,154,725 tons; charcoal, 703,522 tons. In 1872 but little coke was mixed with anthracite, the production of pig iron with mixed anthracite and coke being only 37,246 tons, but in 1890 only 279,184 tons were produced with anthracite alone. During the twenty years under consideration, therefore, bituminous coal, almost entirely in the form of coke, has become the leading fuel used in this country in the manufacture of pig iron. In the total production of 10,307,028 short tons of pig iron in 1890 only 982,706 tons were made without the use of bituminous fuel, or less than one-tenth of the whole. Michigan now annually produces more than one-third of our charcoal pig iron, Wisconsin, Alabama, and Tennessee being the next most productive States. All the pig iron made in New England has for many years been made with charcoal alone.

Production of pig iron in the United States, by sections, from 1872 to 1891.

States.	1872.	1873.	1874.	1875.	1876.	1877.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
New England	41,770	51,993	47,620	36,581	18,752	19,517
New York	291,155	296,818	326,721	266,431	181,620	230,442
New Jersey	103,858	102,341	90,150	64,069	25,349	52,909
Pennsylvania	1,401,497	1,389,573	1,213,133	960,884	1,009,613	1,153,356
Total	1,838,280	1,840,725	1,677,624	1,327,965	1,235,334	1,456,224
Ohio	399,743	406,029	425,001	415,893	403,277	400,398
Indiana	39,221	32,486	13,732	22,081	14,547	15,460
Illinois	78,627	55,796	37,946	49,762	54,168	61,358
Michigan	100,222	123,506	136,662	114,805	95,177	82,216
Wisconsin	65,036	74,148	50,792	62,139	51,261	22,205
Missouri	101,158	85,552	75,817	59,717	68,223	73,565
Total	784,007	777,517	739,950	724,397	686,653	655,202
Alabama	12,512	22,283	32,863	25,108	24,732	41,241
Tennessee	42,454	43,134	48,770	28,311	24,585	25,940
Virginia	21,445	26,475	29,451	29,985	13,046	12,434
West Virginia	20,796	23,056	30,134	25,277	41,165	34,905
Kentucky	67,396	69,889	61,227	48,339	34,686	47,607
Georgia	2,945	7,501	9,786	16,508	10,518	13,223
Maryland	63,031	55,986	54,556	38,741	19,876	26,959
Texas	619	280	1,012	....	426	525
North Carolina	1,073	1,432	1,340	800	400	325
Total	232,271	250,036	269,139	213,069	169,432	203,159

Production of pig iron in the United States, by sections, from 1872 to 1891—Continued.

States.	1878.	1879.	1880.	1881.	1882.	1883.	1884.
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*
New England	19, 081	24, 028	46, 978	53, 997	39, 987	35, 136	19, 076
New York	247, 698	239, 056	395, 361	359, 519	416, 156	331, 964	239, 486
New Jersey	70, 958	96, 908	170, 049	171, 672	176, 805	138, 773	82, 935
Pennsylvania	1, 342, 633	1, 607, 763	2, 083, 121	2, 190, 786	2, 449, 256	2, 638, 891	2, 385, 402
Total	1, 680, 370	1, 967, 755	2, 695, 509	2, 775, 974	3, 082, 204	3, 144, 764	2, 726, 899
Ohio	420, 991	447, 751	674, 207	710, 546	698, 900	679, 643	567, 113
Indiana	....	11, 303	12, 500	7, 300	10, 000	9, 950	2, 568
Illinois	78, 455	78, 143	150, 556	251, 781	360, 407	237, 657	327, 568
Michigan	70, 853	101, 539	154, 424	187, 043	210, 195	173, 185	172, 834
Wisconsin	49, 887	89, 522	96, 842	102, 029	85, 859	51, 893	52, 815
Missouri	47, 499	84, 637	105, 555	109, 799	113, 644	103, 296	60, 043
Total	667, 685	812, 895	1, 194, 084	1, 368, 498	1, 479, 005	1, 255, 624	1, 182, 941
Alabama	41, 482	49, 841	77, 190	98, 081	112, 765	172, 465	189, 664
Tennessee	28, 347	41, 475	70, 873	87, 406	137, 602	133, 963	134, 597
Virginia	16, 928	18, 873	29, 934	83, 711	87, 731	152, 907	157, 483
West Virginia	50, 667	70, 801	70, 338	66, 409	73, 220	88, 398	55, 231
Kentucky	50, 182	48, 725	57, 708	45, 973	66, 522	54, 629	45, 052
Georgia	16, 363	20, 373	27, 321	37, 404	42, 440	45, 364	42, 655
Maryland	24, 027	37, 237	61, 437	48, 756	54, 524	49, 153	27, 342
Texas	....	400	2, 500	3, 000	1, 321	2, 381	5, 140
North Carolina	....	....	....	800	1, 150	....	435
Total	227, 996	287, 725	397, 301	471, 540	577, 275	699, 260	657, 599

States	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*
New England	18, 809	32, 574	37, 252	40, 466	37, 094	29, 283	34, 497
New York	160, 157	233, 618	296, 572	257, 180	297, 247	369, 381	352, 925
New Jersey	73, 667	157, 886	172, 554	101, 882	125, 693	177, 788	103, 589
Pennsylvania	2, 445, 496	3, 293, 289	3, 684, 618	3, 589, 186	4, 181, 242	4, 945, 169	4, 426, 673
Total	2, 698, 129	3, 717, 367	4, 190, 996	3, 988, 714	4, 641, 276	5, 521, 621	4, 917, 684
Ohio	553, 963	908, 094	975, 539	1, 103, 818	1, 215, 572	1, 389, 170	1, 159, 215
Indiana	6, 634	16, 660	13, 211	15, 260	9, 839	16, 398	8, 657
Illinois	327, 977	501, 795	565, 453	579, 307	601, 035	785, 239	749, 506
Michigan	143, 121	190, 734	213, 543	213, 251	214, 356	258, 461	238, 722
Wisconsin	24, 632	65, 933	133, 508	116, 037	158, 634	246, 237	220, 819
Missouri	51, 408	74, 523	138, 643	91, 783	86, 190	100, 550	32, 736
Total	1, 107, 735	1, 757, 739	2, 039, 897	2, 119, 456	2, 285, 626	2, 796, 055	2, 409, 655
Alabama	227, 438	283, 859	292, 762	449, 492	791, 425	914, 940	891, 154
Tennessee	161, 199	199, 166	250, 344	267, 931	294, 655	299, 741	326, 747
Virginia	163, 782	156, 250	175, 715	197, 396	251, 356	327, 912	330, 727
West Virginia	69, 007	98, 618	82, 311	95, 259	117, 900	144, 970	96, 637
Kentucky	37, 553	54, 844	41, 907	56, 790	42, 518	53, 604	50, 225
Georgia	32, 924	46, 490	40, 947	39, 397	27, 559	32, 687	55, 841
Maryland	17, 299	30, 502	37, 427	17, 606	33, 847	165, 559	138, 206
Texas	1, 843	3, 250	4, 383	6, 587	4, 544	10, 865	20, 902
North Carolina	1, 790	2, 200	3, 640	2, 400	2, 898	3, 181	3, 603
Total	712, 835	875, 179	929, 436	1, 132, 858	1, 566, 702	1, 953, 459	1, 914, 042

Production of Bessemer pig iron.—Statistics of the production of Bessemer pig iron in the United States prior to 1887 have not been preserved. In that year the production was 3,220,517 short tons, the total production of pig iron being 7,187,206 tons. In 1890 the production of Bessemer pig iron was 4,583,424 tons, the total production of pig iron for the year being 10,307,028 net tons. These figures show how greatly our pig-iron industry has been benefited by the building up of our Bessemer steel industry.

Production of spiegeleisen.—The following table gives in short tons the production of spiegeleisen and ferro-manganese in the United States in the twenty years from 1872 to 1891. This production is included in that of pig iron already given.

Production of spiegeleisen and ferro-manganese since 1872.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1872	4,561	1879	13,931	1886	47,982
1873	4,402	1880	19,603	1887	47,598
1874	4,558	1881	21,086	1888	54,769
1875	7,832	1882	21,963	1889	85,823
1876	6,616	1883	24,574	1890	149,162
1877	8,845	1884	33,893	1891	143,098
1878	10,674	1885	34,671		

In the first three years mentioned in the above table all the spiegeleisen produced in this country was made by the New Jersey Zinc Company, of Newark, New Jersey, from zinc residuum. In August, 1875, the Bethlehem Iron Company commenced the manufacture of spiegeleisen, and soon afterwards the Cambria Iron Company also began its manufacture—Bethlehem importing manganiferous iron ores from Palomares, and Cambria from Carthagena. In 1876 W. P. Ward, of Cartersville, Georgia, made 100 net tons of ferro-manganese. We need not give further attention to the early stages of the manufacture of spiegeleisen and ferro-manganese in this country. Both foreign and domestic ores are used in their production.

Causes of the rapid growth of our pig-iron industry.—The great progress that has been made in the development of the pig-iron industry of this country during the past twenty years has been due to many causes, among which is prominent, of course, the increased use of iron and steel in all forms. Most notable has been the great extension of our railroad system, which has rapidly stimulated the development of our steel rail industry, which, in turn, has created a large demand for Bessemer pig iron. There has also been a notably large increase in the demand for structural iron and steel and for cast-iron pipe, this demand supplying a market for large quantities of pig iron. In the production of cast-iron pipe alone in 1890 there were used 591,258 net tons of pig iron. Another leading cause of the rapid growth of our pig-iron industry has been the cheapening of the cost of production of pig iron through the more general use of good ores and good coke, the steady improvement in blast-furnace machinery, and the equally steady improvement in the skill of blast-furnace engineers. Still another leading cause has been the maintenance during these twenty years of protective duties on pig iron and on other iron and steel products, through which the supply of the home market with all these products has been left chiefly in the hands of the home producers.

TWENTY YEARS OF PROGRESS IN THE MANUFACTURE OF STEEL.

Total production of steel in the United States.—The following table gives the production of all kinds of steel in the United States from 1860 to 1891, in long tons. The figures for 1860 are for the census year, but for all the other years they are for calendar years. They embrace Bessemer, open-hearth, and crucible steel; also blister and other kinds of steel:

Production of steel in the United States since 1860.

Years.	Long tons.	Years.	Long tons.	Years.	Long tons.
1860	11, 838	1872	142, 954	1882	1, 736, 692
1863	8, 075	1873	198, 796	1883	1, 673, 535
1864	9, 258	1874	215, 727	1884	1, 550, 879
1865	13, 627	1875	389, 799	1885	1, 711, 920
1866	16, 940	1876	533, 191	1886	2, 562, 503
1867	19, 643	1877	569, 618	1887	3, 339, 071
1868	26, 786	1878	731, 977	1888	2, 899, 440
1869	31, 250	1879	935, 273	1889	3, 385, 732
1870	68, 750	1880	1, 247, 335	1890	4, 277, 071
1871	73, 214	1881	1, 588, 314	1891	3, 904, 240

Bessemer steel appears for the first time in 1867 in the totals above given, in which year 2,679 tons of ingots were produced. Open-hearth steel appears for the first time in 1869, in which year 893 tons of ingots were produced. Prior to the introduction of the Bessemer and open-hearth processes into the United States our production of steel, all of which was crucible and blister steel, was, as our table shows, only nominal. With the introduction of these two new methods our steel industry may almost be said to have had its beginning.

As will be noticed, it was just twenty years ago, in 1872, when our production of steel began to make a respectable showing in our industrial statistics, the production of that year being almost double that of the preceding year. Yet how insignificant was the production of 142,954 tons in 1872 compared with that of 4,277,071 tons in 1890. In the intervening years our steel industry had become the first in the world.

Production of each kind of steel in the United States.—The following table gives in short tons of 2,000 pounds the production of each kind of steel in the United States in the twenty years from 1872 to 1891:

Production of each kind of steel in the United States since 1872.

Years.	Bessemer steel.	Open-hearth steel.	Crucible steel.	Other steel.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1872	120, 108	3, 000	29, 260	7, 740	160, 108
1873	170, 652	3, 500	34, 786	13, 714	222, 652
1874	191, 933	7, 000	36, 328	6, 353	241, 614
1875	375, 517	9, 050	39, 401	12, 607	436, 575
1876	525, 996	21, 490	39, 382	10, 306	597, 174
1877	560, 587	25, 031	40, 430	11, 924	637, 972
1878	732, 226	36, 126	42, 906	8, 556	819, 814
1879	928, 972	56, 290	56, 780	5, 464	1, 047, 506
1880	1, 203, 173	112, 953	72, 424	8, 465	1, 397, 015
1881	1. 539, 157	146, 946	89, 762	3, 047	1, 778, 912
1882	1, 696, 450	160, 542	85, 089	3, 014	1, 945, 095
1883	1, 654, 627	133, 679	80, 455	5, 598	1, 874, 359
1884	1, 540, 595	131, 617	59, 662	5, 111	1, 736, 985
1885	1, 701, 762	149, 381	64, 511	1, 696	1, 917, 350
1886	2, 541, 493	245, 250	80, 609	2, 651	2, 870, 003
1887	3, 288, 357	360, 717	84, 421	6, 265	3, 739, 760
1888	2, 812, 500	352, 036	78, 713	4, 124	3, 247, 373
1889	3, 281, 829	419, 488	84, 969	5, 734	3, 792, 020
1890	4, 131, 535	574, 820	79, 716	4, 248	4, 790, 319
1891	3, 637, 107	649, 323	81, 297	5, 022	4, 372, 749

The production of crucible steel in this country has been stationary for many years, the greatly increased demand for steel for tools, agricultural implements, carriage and other springs, etc., in the last decade having been supplied by the cheaper products of the Bessemer and open-hearth processes. Our annual production of miscellaneous steel is of trifling importance.

Production of steel by the United States and Great Britain.—The following table gives the production of Bessemer, open-hearth, crucible, and all other kinds of steel by the United States and Great Britain rom 1878 to 1891, in long tons:

Production of steel in the United States and Great Britain since 1878.

Years.	United States.	Great Britain.	Years.	United States.	Great Britain.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
1878	731, 977	1, 063, 027	1885	1, 711, 920	1, 968, 045
1879	935, 273	1, 089, 511	1886	2, 562, 503	2, 344, 670
1880	1, 247, 335	1, 375, 382	1887	3, 339, 071	3, 150, 507
1881	1, 588, 314	1, 859, 719	1888	2, 899, 440	3, 405, 536
1882	1, 736, 692	2, 189, 649	1889	3, 385, 732	3, 669, 960
1883	1, 673, 535	2, 088, 880	1890	4, 277, 071	3, 679, 043
1884	1, 550, 879	1, 854, 926	1891	3, 904, 240	3, 256, 543

It will be observed that a very active rivalry in the production of steel has existed between the United States and Great Britain since 1879. In 1886 and 1887 our total production for the first time exceeded that of our rival, but in 1888 and 1889 we fell to the second place. In 1890 and 1891 we again took the first place.

In late years the prominence of Great Britain as a steel-producer has been largely due to the growth of her open-hearth steel industry. In the production of Bessemer steel alone she was long ago surpassed by the United States. The following table shows in long tons the production of Bessemer-steel ingots and Bessemer-steel rails in the United States and in Great Britain from 1877 to 1891.

Production of Bessemer-steel ingots and rails in the United States and Great Britain since 1877.

Years.	United States.		Great Britain.	
	Ingots.	Rails.	Ingots.	Rails.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
1877	500, 524	385, 865	750, 000	508, 400
1878	653, 773	491, 427	807, 527	622, 390
1879	829, 439	610, 682	834, 511	520, 231
1880	1, 074, 262	852, 196	1, 044, 382	732, 910
1881	1, 374, 247	1, 187, 770	1, 441, 719	1, 023, 740
1882	1, 514, 687	1, 284, 067	1, 673, 649	1, 235, 785
1883	1, 477, 345	1, 148, 709	1, 553, 380	1, 097, 174
1884	1, 375, 531	996, 983	1, 299, 676	784, 968
1885	1, 519, 430	959, 471	1, 304, 127	706, 583
1886	2, 269, 190	1, 574, 705	1, 570, 520	730, 343
1887	2, 936, 033	2, 101, 904	2, 089, 403	1, 021, 847
1888	2, 511, 161	1, 386, 277	2, 032, 794	979, 083
1889	2, 930, 204	1, 510, 057	2, 140, 791	943, 048
1890	3, 688, 871	1, 867, 837	2, 014, 843	1, 019, 606
1891	3, 247, 417	1, 293, 053	1, 642, 005	662, 676

It will be seen from this table that the United States passed Great Britain in the production of Bessemer-steel ingots in 1880, but fell to the second place in each of the next three years. In 1884 the United States again took the first place, which it has since steadily retained. In 1891 our production of Bessemer-steel ingots was almost double that of Great Britain. In the production of Bessemer-steel rails the United States passed Great Britain in 1879, and it has since steadily kept the first place. In 1886 and 1887 our production of Bessemer-steel rails was a little more than double that of Great Britain.

Great Britain is the largest producer of open-hearth steel in the world, and in this branch of the steel industry the United States is still a long distance behind its great rival. The following table gives in long tons the production of open-hearth steel in the United States and Great Britain from 1878 to 1891:

Production of open-hearth steel in the United States and Great Britain since 1878.

Years.	United States.	Great Britain.	Years.	United States.	Great Britain.
	Long tons.	*Long tons.*		*Long tons.*	*Long tons.*
1878	32, 255	175, 500	1885	133, 376	583, 918
1879	50, 259	175, 000	1886	218, 973	694, 150
1880	100, 851	251, 000	1887	322, 069	981, 104
1881	131, 202	338, 000	1888	314, 318	1, 292, 742
1882	143, 341	436, 000	1889	374, 543	1, 429, 169
1883	119, 356	455, 500	1890	513, 232	1, 564, 200
1884	117, 515	475, 250	1891	579, 753	1, 514, 538

It will be noticed that in 1891 the production of open-hearth steel by Great Britain very nearly equaled that of Bessemer steel, and that, bad as the year was for Bessemer steel, the open-hearth industry nearly held its own as compared with 1890. Apparently it will be many years before the United States equals Great Britain in the production of open-hearth steel. Great Britain's production of crucible and miscellaneous steel has for many years been about 100,000 tons annually.

Summary.—In preceding pages we have shown the marvelous growth of the pig-iron industry of the United States in the last twenty years, but the above tables show that our steel industry has had a yet more remarkable growth. It has also grown much more rapidly than that of Great Britain. It seems almost incredible that as late as 1860 this country should have produced only 11,838 tons of all kinds of steel; yet these are the official Government statistics. Our magnificent steel industry is virtually, therefore, the creation of the present generation.

TWENTY YEARS OF ROLLING-MILL DEVELOPMENT.

Since the practical abandonment of the manufacture of hammered bar iron in this country, about 1844, and the beginning of our manufacture of iron rails in that year, the development of our rolling-mill industry has kept steady pace with the growth of our pig-iron industry, and latterly with the growth of our steel industry. Our manufacturers have not only met all the country's wants for rolled iron and steel, but they have met these wants promptly and with a skill that has been nowhere surpassed.

Our earliest rolling-mill statistics are for the year 1856, in which we produced a total of 557,850 short tons of rolled iron, including nail plate and railroad bars. Of this total New England rolled 78,989 tons; the old Middle States, 366,542 tons; the Southern States, 70,601 tons; and the Western States, 41,718 tons. Of the whole quantity rolled 159,662 short tons were railroad bars. The quantity of cut nails produced was 1,824,749 kegs of 100 pounds, representing 91,237 short tons of nail plate. The steel rolled in 1856 could not have exceeded a thousand tons.

From 1856 to 1872 the production of all kinds of rolled iron in this country increased rapidly, owing chiefly to the increased demand for iron rails. In 1872 the total production of rolled iron amounted to 1,847,922 short tons. In 1873 the total production was 1,837,430 tons. The production of iron rails amounted to 905,930 short tons in 1872 and to 761,062 tons in 1873. In addition to the rolled iron produced in these two years there were also rolled 94,070 tons of Bessemer steel rails in 1872 and 129,015 tons in 1873, making the total production of rolled iron and steel, if we except a few thousand tons of other rolled steel which are not a matter of exact record, 1,941,992 tons in 1872 and 1,966,445 tons in 1873. Nearly all the Bessemer steel that was produced in these two years was rolled into rails. The total production of steel other than Bessemer was 40,000 net tons in 1872 and 52,000 tons in 1873, not all of which was rolled. It is entirely safe to assume that the total quantity of iron and steel in all forms that was rolled in this country in 1872 and 1873 did not exceed 2,000,000 net tons in either year.

Production of all rolled iron and steel by States.—The following table gives the production of all rolled iron and steel in each of the States in 1873, with the exceptions already noted, in short tons. Full details of the statistics for 1872 were not preserved.

Production of rolled iron and steel in 1873, by States.

States.	Short tons.	States.	Short tons.
Maine	21, 210	Alabama	500
New Hampshire	300	West Virginia	51, 796
Vermont	6, 088	Kentucky	37, 955
Massachusetts	118, 669	Tennessee	16, 561
Rhode Island	11, 662	Ohio	272, 066
Connecticut	11, 409	Indiana	36, 006
New York	154, 782	Illinois	143, 017
New Jersey	77, 688	Michigan	8, 542
Pennsylvania	835, 584	Wisconsin	39, 495
Delaware	11, 617	Missouri	22, 621
Maryland	58, 025	California	7, 420
Virginia	12, 808		
Georgia	10, 624	Total	1, 966, 445

During the twenty years from 1872 to 1891 our rolling-mill industry has more than trebled its production, the aggregate production of all our rolling mills in 1890, the year of largest production, being 6,745,620 short tons. No other country has in any year produced nearly so large a quantity of rolled iron and steel. The following table gives in short tons the production of rolled iron and steel in each of the States in 1890 and 1891:

Production of rolled iron and steel in 1890 and 1891, by States.

States.	1890.	1891.	States.	1890.	1891.
	Short tons.	*Short tons.*		*Short tons.*	*Short tons.*
Maine	10, 588	8, 083	Alabama	42, 691	34, 022
New Hampshire	6, 300	5, 550	Ohio	839, 592	877, 604
Massachusetts	147, 379	156, 989	Indiana	103, 137	125, 584
Rhode Island	14, 618	14, 787	Illinois	838, 129	661, 166
Connecticut	29, 121	31, 846	Michigan	37, 186	33, 526
New York	132, 378	132, 554	Wisconsin	74, 695	75, 821
New Jersey	113, 975	112, 729	Minnesota	2, 565	5, 000
Pennsylvania	3, 951, 390	3, 406, 205	Missouri	26, 040	27, 016
Delaware	51, 659	40, 820	Iowa	....	3, 100
Maryland	16, 132	37, 618	Colorado	37, 012	14, 714
Virginia	57, 396	32, 754	Wyoming	10, 287	4, 000
West Virginia	93, 461	88, 712	California	45, 236	43, 576
Kentucky	41, 086	50, 641			
Tennessee	22, 067	10, 336			
Georgia	1, 500	3, 125	Total	6, 745, 620	6, 037, 878

There are a few small rolling mills in Texas, but they did not roll any iron or steel in 1890 or 1891. The table shows that Alabama and some other Southern States which make large quantities of pig iron are producers of very small quantities of rolled iron and steel, some of these States rolling smaller quantities now than in 1873.

The following table gives in net tons the production of all rolled iron and steel products in the United States in 1888, 1889, and 1890, separately classified:

Production of all rolled iron and steel products in 1888, 1889, and 1890.

Articles.	1888.		1889.		1890.	
	Iron.	Steel.	Iron.	Steel.	Iron.	Steel.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Rails	14, 252	1, 557, 892	10, 258	1, 694, 610	15, 548	2, 095, 996
Cut nails	108, 505	216, 174	88, 904	201, 634	90, 307	191, 740
Plates and sheets	469, 312	213, 694	471, 193	331, 283	505, 642	401, 537
Wire rods	14, 571	298, 770	14, 460	393, 053	19, 798	492, 153
Other rolled products	1, 805, 014	473, 247	2, 001, 570	658, 394	2, 189, 082	743, 817
Total	2, 411, 654	2, 759, 777	2, 586, 385	3, 278, 974	2, 820, 377	3, 925, 243

In these three years our production of rolled steel exceeded that of iron in a constantly increasing proportion. Of the total production in the last year mentioned in the table 42 per cent. was iron and 58 per cent. was steel. But our production of rolled steel was also greater than that of iron in the years immediately preceding 1888. This was certainly the case in 1886 and 1887. Exact statistics of all forms of rolled steel for these two years are wanting, but enough is known to justify the assertion that we rolled more steel in both these years than iron. In 1885 the two products were very close together, and for the first time, the difference being very slight either way.

TWENTY YEARS OF CHANGES IN THE MANUFACTURE OF IRON AND STEEL RAILS.

In the preceding tables of rolled iron and steel produced from 1872 to 1891 we have included our production of both iron and steel rails, as has already been explained.

Production of iron rails.—The history of our iron-rail industry from the earliest period for which statistics are available to 1891 is told in short tons in the following table of yearly production:

Production of iron rails since 1849.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1849	24, 318	1860	205, 038	1871	737, 483	1882	227, 874
1850	44, 083	1861	189, 818	1872	905, 930	1883	64, 954
1851	50, 603	1862	213, 912	1873	761, 062	1884	25, 560
1852	62, 478	1863	275, 768	1874	584, 469	1885	14, 815
1853	87, 864	1864	335, 369	1875	501, 649	1886	23, 679
1854	108, 016	1865	356, 292	1876	467, 168	1887	23, 062
1855	138, 674	1866	430, 778	1877	332, 540	1888	14, 252
1856	180, 018	1867	459, 558	1878	322, 890	1889	10, 258
1857	161, 918	1868	499, 489	1879	420, 160	1890	15, 548
1858	163, 712	1869	583, 936	1880	493, 762	1891	9, 229
1859	195, 454	1870	586, 000	1881	488, 581		

Since the beginning of 1883 the manufacture of iron rails has been almost entirely superseded by the manufacture of steel rails. Such iron rails as have since been made have been chiefly street rails and light rails for mines, logging camps, and similar uses.

It will be seen from the table that the largest annual production of iron rails was in 1872 and the smallest in 1891. At the beginning of this period of twenty years our iron-rail industry had attained the highest point of productiveness in its history, and at its close it was practically an extinct industry. In the same period our steel-rail industry grew from a stage that was experimental to be one of the world's industrial wonders.

Production of steel rails.—We now turn to the statistics of our production of Bessemer steel rails from 1867 to 1891, exactly twenty-five years, which we give in the following table in short tons:

Production of Bessemer-steel rails since 1867.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1867	2,550	1876	412,461	1885	1,074,607
1868	7,225	1877	432,169	1886	1,763,667
1869	9,650	1878	550,398	1887	2,354,132
1870	34,000	1879	683,964	1888	1,552,631
1871	38,250	1880	954,460	1889	1,691,264
1872	94,070	1881	1,330,302	1890	2,091,978
1873	129,015	1882	1,438,155	1891	1,448,219
1874	144,944	1883	1,286,554		
1875	290,863	1884	1,116,621		

The largest annual production of Bessemer steel rails was in 1887, and the next largest annual production was in 1890. Since 1887 the building of new railroads in this country has declined.

In addition to our production of Bessemer steel rails we annually make a small quantity of open-hearth steel rails, California producing the most of them. The following table gives in short tons our production of open-hearth steel rails from 1878 to 1891:

Production of open-hearth steel-rails since 1878.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1878	9,397	1883	9,186	1888	5,261
1879	9,149	1884	2,670	1889	3,346
1880	13,615	1885	4,793	1890	4,018
1881	25,217	1886	5,255	1891	6,589
1882	22,765	1887	19,203		

Street rails.—The rapid extension of street railroads in late years has called for a constantly increasing supply of street rails. Nearly all of the street rails that have been made in late years have been made of Bessemer steel. In 1887 the quantity of street rails rolled was 57,362 short tons; in 1888 it was 50,345 tons; in 1889 it was 78,534 tons; in 1890 it was at least 110,353 tons, and in 1891 it was at least 91,058 tons, with the probability that a few thousand tons additional were made in each of these two years which were classified by the manufacturers in their reports as having been made of standard sections for steam railroads. The following table gives in short tons the ascertained production of street rails from 1874 to 1891:

Production of street rails since 1874.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1874	6,739	1880	16,894	1886	48,009
1875	16,340	1881	21,554	1887	57,362
1876	13,086	1882	22,286	1888	50,345
1877	7,015	1883	19,440	1889	78,534
1878	9,229	1884	31,357	1890	110,353
1879	8,646	1885	35,990	1891	91,058

In Poor's Manual of American Street Railways for 1892 the number of miles of street railroads in the United States in 1891 is stated to have been 9,662, and the number in Canada is said to have been 213.

Mileage of iron and steel rails.—Poor's Manual of the Railroads of the United States for 1892 gives the number of miles of steam railroad track in the United States from 1880 to the end of 1891 which had been laid with steel rails and iron rails as follows:

Miles of steel and iron rails in use each year since 1880.

Years.	Steel rails.	Iron rails.	Total.	Percentage of steel rails.
	Miles.	*Miles.*	*Miles.*	
1880	33,680	81,967	115,647	29.1
1881	49,063	81,473	130,536	37.5
1882	66,691	74,269	140,960	47.3
1883	78,491	70,692	149,183	52.7
1884	90,243	66,254	156,497	57.6
1885	98,102	62,495	160,597	61.0
1886	105,724	62,324	168,048	62.9
1887	125,459	59,588	185,047	67.7
1888	138,516	52,981	191,497	72.3
1889	151,723	50,513	202,236	75.0
1890	167,606	40,697	208,303	80.4
1891	174,931	39,756	214,687	81.5

In the above figures all tracks of steam railroads are included, and also the tracks of elevated railroads. In the period covered by the table the mileage of iron rails had decreased over 50 per cent., while that of steel rails had increased over 400 per cent.

An important change in the equipment of American railroads which has taken place during the last twenty years is the general substitution of rails of heavier weight for those that were in use at the beginning of this period. Twenty years ago the rail section that was most in use weighed 56 pounds to the yard, and rails weighing 60 pounds and upwards were not so frequently called for as rails weighing 50 pounds, and even 45 and 40 pounds. In time heavier rails largely displaced the 56-pound rails. In very recent years rails weighing 80 pounds and 85 pounds have been frequently used. The standard section of the Pennsylvania Railroad is now an 85-pound rail. Rails weighing 90 pounds have also recently been made for a New England railroad, and experiments are now being made with a 100-pound rail for the Pennsylvania Railroad. The average weight per yard of all the rails produced by the Illinois Steel Company during the last four years which weighed 50 pounds and upwards has been as follows: 1889 (from May 1), 63.75 pounds; 1890, 66.80 pounds; 1891, 66.95 pounds; 1892 (to October 1), 68.10 pounds.

It may be mentioned as a historical fact worthy of preservation that the Pennsylvania Railroad Company ordered in 1858 a large quantity of iron rails weighing 83 pounds to the yard, to be laid down on the mountain division of its main line. The experiment was not, however, regarded as so signally successful from an economical standpoint as to justify a continuance of the use of rails of this weight.

Narrow-gauge railroads.—Another change which has taken place in the equipment of American railroads in the past twenty years is the virtual abandonment of the narrow-gauge, for which so much was claimed at the beginning of this period. There are now very few miles of narrow-gauge railroad in the United States which are devoted to general traffic. At the close of 1874 there were 1,758 miles, of which 619 miles were built in that year. In the same year 260 miles of narrow-gauge railroad were built in Canada. On May 1, 1878, there were 3,082 miles of narrow gauge railroad in 32 States and Territories of the United States, and the whole number of narrow-gauge railroads was 133. In the whole of 1878 there were built in the United States 990 miles of narrow-gauge railroads, bringing the total mileage in this country up to over 4,000 miles. Mining roads are not included in this total. After 1878 the popularity of narrow-gauge railroads in this country and in Canada rapidly declined, and the tracks of nearly all these roads were changed to the standard gauge. The Toronto and Nipissing Railway in Canada, which laid its first rail in 1869, was the first narrow-gauge railroad in America. The first in the United States was the Denver and Rio Grande Railroad, which laid its first rail in 1871.

TWENTY YEARS OF PROGRESS IN THE MANUFACTURE OF NAILS.

Cut nails.—The production of iron and steel cut nails in the United States, not including wire nails, which will be noticed hereafter, has been as follows from 1856 to 1891, in kegs of 100 pounds:

Production of iron and steel cut rails since 1856.

Years.	Kegs.	Years.	Kegs.	Years.	Kegs.
1856	1,824,749	1878	4,396,130	1885	6,696,815
1872	4,065,322	1879	5,011,021	1886	8,160,973
1873	4,024,704	1880	5,370,512	1887	6,908,870
1874	4,912,180	1881	5,794,206	1888	6,493,591
1875	4,726,881	1882	6,147,097	1889	5,810,758
1876	4,157,814	1883	7,762,737	1890	5,640,946
1877	4,828,918	1884	7,581,379	1891	5,002,176

Down to 1883 all the cut nails manufactured in this country in commercial quantities were made of iron, but in that year cut nails were made of Bessemer steel and others were made of combined iron and steel. In 1884 the production of steel cut nails, including 500 kegs of combined iron and steel nails, was 393,482 kegs, or 5 per cent. of the total production. The maximum production of all cut nails down to the present time was reached in 1886, with 8,160,973 kegs, and the maximum production of steel cut nails alone was reached in 1888, with 4,323,484 kegs. In 1889 and 1890 over two-thirds of the total production of cut nails were made of steel, and in 1891 about three-fourths of the total production were made of the same material.

Wire nails.—The first wire nails manufactured in this country were made at New York in 1851 or 1852 by William Hassall from iron or brass wire. They were of small sizes, escutcheon and upholsterers' nails being specialties. The wire nail as a substitute for the cut nail did not, however, come into notice in this country until a few years ago, in 1883 or 1884. The American Wire Nail Company, whose works are now located at Anderson, Indiana, was the first company to give the wire nail a start in American markets as a competitor of the cut nail. The origin of this company dates back as far as 1871, when a few German residents of Covington, Kentucky, contributed to a fund for importing three German wire-nail machines. In 1886 the production of wire nails was estimated to have amounted to 600,000 kegs of 100 pounds, made by 27 wire-nail works; in 1887 the production was estimated to have been 1,250,000 kegs, made by 47 works; in 1888 it was estimated to have been 1,500,000 kegs; in 1889 it was estimated to have been 2,435,000 kegs. The actual production in 1890 was 3,135,911 kegs, made by 47 works, nearly all the nails being made of steel. In 1891 the production was 4,114,385 kegs.

Total production.—The total production of cut and wire nails in the United States during the last six years has been as follows:

Production of cut and wire nails since 1886.

Kegs of 100 pounds.	1886.	1887.	1888.	1889.	1890.	1891.
Cut nails	8,160,973	6,908,870	6,493,591	5,810,758	5,640,946	5,002,176
Wire nails	600,000	1,250,000	1,500,000	2,435,000	3,135,911	4,114,385
Grand total	8,760,973	8,158,870	7,993,591	8,245,758	8,776,857	9,116,561

The production of wire nails promises to overtake that of cut nails at a very early day. It exceeded the production of steel cut nails in 1891.

PROGRESS IN IRON AND STEEL BRIDGE-BUILDING.

We have already briefly referred to the large demand in this country during the last twenty years for iron and steel for structural purposes. These virtually new uses for iron and steel embrace rolled plates, angles, channels, beams, etc., for bridge-building and shipbuilding, and for warehouses, depots, public halls, and public buildings of all kinds, and for general engineering work. Rolled forms of iron and steel are also used in the construction of private dwellings. Much cast iron is also used for architectural and other structural purposes, but the quantity so used is small compared with the quantity of iron and steel, but chiefly steel, that is rolled for the same purposes.

Great progress has been made during the last twenty years in the substitution of iron and steel bridges for wooden bridges and in the erection of iron and steel bridges where bridges of any kind had not previously existed. Where stone arches or viaducts are not used it is now the rule for our railroad companies to use either iron or steel bridges. Many streams which are crossed by "country roads" are now spanned by these bridges, and in cities and large towns which have streams to be crossed, either within their borders or to connect one city or town with another, wooden bridges are no longer thought of.

It is worthy of mention that some of the world's industrial wonders, some of the greatest engineering achievements, are in the form of iron and steel bridges. In this country our most notable bridge is the Brooklyn suspension bridge, built of wire cables made of American steel, which was planned by John A. Roebling and completed under the direction of his son, W. A. Roebling. Since its completion over ten years ago, the still more celebrated steel cantilever railroad bridge over the Firth of Forth, in Scotland, has been undertaken and completed under the engineering direction of Sir John Fowler and Mr. Benjamin Baker. The recently constructed steel cantilever bridge over the Mississippi at Memphis, the steel-arched Washington bridge over the Harlem River at One hundred and eighty-first street, New York, the new steel cantilever bridge over the Hudson River at Poughkeepsie, and some other new steel bridges spanning the Mississippi, the Missouri, and other rivers are monuments of American engineering skill and of the skill of American steel manufacturers.

It must not be supposed, however, that this country had not made creditable and even remarkable progress in the building of iron and steel bridges twenty years ago. We had built many iron and a few steel bridges of large size and involving difficult engineering problems before 1872, but still larger iron and steel bridges and more difficult engineering feats were undertaken after that year, and there was also manifested thereafter a constantly increasing faith in the wisdom of building both iron and steel bridges. In the last few years the tendency has been almost entirely to use steel in bridge construction, whereas twenty years ago iron and not steel was the popular metal. The bridge over the Mississippi at St. Louis, which was undertaken in 1868 and formally opened to the public on July 4, 1874, is in many respects the most notable bridge in this country to-day next to the Brooklyn bridge. The arches between its piers are composed of four series of steel tubes.

We are not aware of the existence of any statistical records which will show the quantity of iron and steel that annually enters into the construction of American bridges. It is a constantly increasing quantity. Our railroad system alone will always maintain an active demand for iron and steel bridges.

TWENTY YEARS OF IRON AND STEEL SHIPBUILDING.

The following table gives the number and gross tonnage of all iron and steel vessels, except those for the Navy, which have been built in the United States in the fiscal years from 1872 to 1892. Nearly all were steam vessels. Since 1883 we have built many vessels of steel, and the tendency now is to use steel in constantly increasing quantities in the construction of both merchant and naval vessels. This table has been compiled from the reports of the Bureau of Navigation of the Treasury Department:

Number and total tonnage of iron and steel vessels constructed during fiscal years 1872 to 1892.

Years.	No.	Tons.	Years.	No.	Tons.	Years.	No.	Tons.
1872	20	12, 766	1879	24	22, 008	1886	26	14, 908
1873	26	26, 548	1880	31	25, 582	1887	29	34, 354
1874	23	33, 097	1881	42	28, 392	1888	43	36, 719
1875	20	21, 632	1882	43	40, 097	1889	48	53, 513
1876	25	21, 346	1883	35	39, 646	1890	63	80, 378
1877	7	5, 927	1884	34	35, 031	1891	76	105, 618
1878	32	26, 960	1885	48	44, 028	1892	55	51, 374

The increase in these twenty-one years has been from 20 vessels to 76 vessels, and from 12,766 tons to 105,618 tons. The whole number of iron and steel vessels built from 1872 to 1891 was 695, of which 16 were sailing vessels and 679 were steam vessels. The whole number built since 1872, including those built in 1892, was 750. Such shipbuilding records as are accessible go back only to 1867, when iron vessels aggregating about 2,000 tons were built, and to 1868, when five iron and steel ships were built, with an aggregate of 2,801 long tons. The building of the new American Navy has added greatly during the last few years to the number and tonnage of the iron and steel vessels above mentioned.

The first iron steamships to attract attention which were built in this country for transatlantic service were the four vessels of the American Steamship Company's line, the *Pennsylvania*, *Ohio*, *Indiana*, and *Illinois*, all built at Philadelphia in 1871, 1872, and 1873 by W. Cramp & Sons, and still running regularly between that port and European ports. Their tonnage capacity was originally 3,100 tons each. In 1874 John Roach & Son built at Chester, Pennsylvania, for the Pacific Mail Steamship Company, two iron steamships of large size and superior equipment, the *City of Peking* and the *City of Tokio*, which fully equaled in all respects the best British-built iron steamers. Their registered tonnage was 5,000 tons each. The whole of our magnificent fleet of steel vessels on the great lakes has been built within the last few years. With scarcely an exception wooden vessels were used on these lakes twenty years ago.

The new Navy.—The work of building a new American Navy of American steel has been wholly undertaken during the last twenty years; indeed, during the last twelve years. Our activity in this patriotic work must be added to the above achievements in iron and steel shipbuilding during the twenty years mentioned. A correspondent of a New York journal gives the following details of the first steps that were taken to establish the new Navy:

It is a matter of official record in Washington that the new Navy received its first start in 1881, when, under the direction of W. H. Hunt, the Secretary of the Navy, the first Naval Advisory Board was appointed to report upon the pressing needs of appropriate vessels required to replace the old wooden vessels. In November, 1881, the Board submitted a report, upon which was based the construction of the first lot of steel vessels. An act of Congress of August 5, 1882, authorized the construction of the steel cruisers *Atlanta, Boston, Chicago,* and *Dolphin,* the A, B, C, and D of the new Navy. The contracts to build them were awarded in July, 1883, and the first of the vessels, the *Dolphin,* was finished in November, 1884. The *Atlanta* was launched on October 9, 1884; the *Boston* on December 4, 1884, and the *Chicago* on December 5, 1885.

In his annual report, dated December 3, 1891, the Secretary of the Navy gives the cost of the new Navy as follows:

The cost of building the new ships of the Navy, excluding tugs, from beginning to final completion, covering operations from the fiscal year 1883–'84 to 1894–'95, aggregates during the twelve years a total of $69,993,382, or considerably less than $6,000,000 a year. The vessels included in this statement are 40 in number, with an aggregate tonnage of 155,820 tons.

The number of guns required to equip the main batteries of all the vessels authorized down to December, 1891, was 347, all to be of American manufacture and some to be of very large caliber.

Our present extensive iron and steel shipbuilding industry has been greatly aided by the readiness with which our iron and steel manufacturers have responded to the requirements of our shipbuilders, and by the cheapness with which all forms of iron and steel have been supplied to them. Even in the production of armor plate our manufacturers have within the last three years exceeded the best achievements of European skill.

EFFORTS TO ESTABLISH THE TIN-PLATE INDUSTRY.

The manufacture of tin plates in the United States, in which phrase we include terneplates, was undertaken in 1873 at Wellsville, Ohio, and at Leechburg, Pennsylvania. In 1875 it was also undertaken at Demmler, near Pittsburg. Owing, however, to the low duty which was imposed on foreign tin plates, domestic tin plates ceased in 1878 to be made at the three places mentioned, and no further attempts to establish the tin-plate industry in this country were made until about the time of the passage of the tariff act of October 1, 1890, in which the previously existing duty on tin plates was more than doubled. Since that date many works for the manufacture of tin plates have been established in the United States, while the building of many others has been commenced.

Statistics of production.—The United States Government has made provision for the collection of the statistics of our production of tin plates, and the task of collecting these statistics has been confided to Col. Ira Ayer, a special agent of the Treasury Department. The statistics which he has already collected and published cover the first five quarters which have elapsed since the new duty on tin plates went into effect, namely, on July 1, 1891. In the following table is given the production of tin plates and terne plates from July 1, 1891, to October 1, 1892:

Production of tin and terne plates since July 1, 1891.

Quarters.	Tin plates.	Terne plates.	Total.
	Pounds.	*Pounds.*	*Pounds.*
July 1, 1891, to Sept. 30, 1891	152,489	674,433	826,922
Sept. 30, 1891, to Dec. 31, 1891	215,911	1,193,910	1,409,821
Jan 1, 1892, to Mar. 31, 1892	1,099,656	2,109,569	3,209,225
Apr. 1, 1892, to June 30, 1892	3,071,534	5,129,217	8,200,751
July 1, 1892, to Sept. 30, 1892	3,611,367	7,341,358	10,952,725
Total	8,150,957	16,448,487	24,599,444

Colonel Ayer says that during the quarter ended September 30, 1892, thirty-two firms produced 10,952,725 pounds of tin and terne plates, against 826,922 pounds produced by five firms during the same quarter of 1891. The production of the fiscal year beginning with July 1, 1891, and ending with June 30, 1892, was 13,646,719 pounds. Of the total production for the quarter ending with September 30, 1892, 5,920,082 pounds, or more than 54 per cent., were made from American black plates; 3,611,367 pounds, or about one-third of the whole, were bright tin plates, of which 3,337,036 pounds, or more than 92 per cent., were of the lighter class of plates named in the new tariff, weighing less than 63 pounds per 100 square feet; 7,341,358 pounds were terne plates, of which more than 93 per cent. belonged to the lighter class named in the law. Compared with the first quarter after the new duty went into effect, the number of firms engaged in the manufacture of tin and terne plates in the quarter ending with September 30, 1892, was more than six times as many; the quantity of tin and terne plates made was more than thirteen times as large and the quantity of American black plates used in the manufacture was about eight times as large.

It will be seen that our new tin-plate industry has made remarkable progress since the new duty went into effect. What its future will be can be only a subject of conjecture at this time.

A BRANCH OF THE IRON INDUSTRY WHICH HAS DECLINED.

The production of blooms, billets, and bars direct from the ore in primitive Catalan forges in various States and in the improved Catalan forges in New York was an important if not a prominent branch of the iron trade of this country at the beginning of the period of twenty years under consideration. This branch of our iron industry has since greatly declined. The use of the primitive Catalan forge has indeed wholly ceased.

The earliest statistics which exist of the production of blooms and bars in forges direct from the ore are for the year 1856, in which year 32,069 net tons of these products were made in 204 forges, or bloomery forges, as they were generally called. Of the whole number of these active forges in the year mentioned 5 were in Vermont, 42 in New York, 48 in New Jersey, 36 in North Carolina, 2 in South Carolina, 4 in Georgia, 14 in Alabama, 50 in Tennessee, and 3 in Michigan. Nearly all of these forges and others which have since been built have been abandoned. In February, 1892, only 10 forges were left, 9 of which were in New York and 1 was in New Jersey.

In the following table we give in net tons the production of blooms, billets, and bars by the bloomery forges above mentioned from 1856 to 1891:

Production of blooms, billets, and bars from bloomery forges since 1856.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1856	32,069	1877	24,227	1882	48,354	1887	15,088
1873	32,863	1878	24,139	1883	35,237	1888	14,088
1874	36,450	1879	30,282	1884	29,789	1889	12,407
1875	24,416	1880	40,652	1885	19,887	1890	7,945
1876	20,784	1881	45,369	1886	15,878	1891	5,925

The production of wrought iron direct from the ore in forges is now confined to the Lake Champlain district of New York, where the total tonnage of 1891 was made.

The production of blooms by other forges from pig iron and scrap iron, which is another declining branch of our iron industry, is not included in the above table.

PRICES OF IRON AND STEEL FOR TWENTY YEARS.

In preceding tables we have given the production of leading articles of iron and steel in the twenty years from 1872 to 1891. The figures presented show a marvelous development of all the leading branches of these industries. We now present a table, compiled from the records of the American Iron and Steel Association, which shows the average annual prices of five leading iron and steel products during the twenty years mentioned. These prices are yearly averages of monthly quotations for No. 1 anthracite foundry pig iron, best refined bar iron, and iron rails, all per long ton, at Philadelphia; cut nails, per keg, wholesale, at Philadelphia; and steel rails, per long ton, at Pennsylvania mills.

Prices of iron and steel products from 1872 to 1891.

Years.	No. 1 anthracite foundry pig iron.	Best refined bar iron.	Iron rails.	Steel rails.	Cut nails, per keg.
1872	$48.88	$97.63	$85.13	$112.00	$5.46
1873	42.75	86.43	76.67	120.50	4.90
1874	30.25	67.95	58.75	94.25	3.99
1875	25.50	60.85	47.75	68.75	3.42
1876	22.25	52.08	41 25	59.25	2.98
1877	18.88	45.55	35.25	45.50	2.57
1878	17.63	44.24	33 75	42.25	2.31
1879	21.50	51.85	41.25	48.25	2.69
1880	28.50	60.38	49.25	67.50	3.68
1881	25.12	58.05	47.13	61.13	3.09
1882	25.75	61.41	45.50	48.50	3.47
1883	22.38	50.30	....	37.75	3.06
1884	19.88	44.05	....	30.75	2.39
1885	18.00	40.32	....	28.50	2.33
1886	18.71	43.12	....	34.50	2.27
1887	20.92	49.37	....	37.08	2.30
1888	18.88	44.99	....	29.83	2.03
1889	17.75	43.40	....	29.25	2.00
1890	18.40	45.92	....	31.75	2.00
1891	17.52	42.56	....	29.92	1.86

Quotations for iron rails after 1882 are not given, as the manufacture of standard sections of iron rails virtually came to an end at the close of that year. Such iron rails as have since been manufactured have been almost entirely of light sections.

THE UNITED STATES NOW THE FIRST OF ALL IRON AND STEEL MANUFACTURING COUNTRIES.

We can not better close this review of the progress of our country in the manufacture of iron and steel in the twenty years from 1872 to 1891 than by reproducing from the second edition of the History of the Manufacture of Iron in All Ages the following tables giving the production of iron ore, coal, pig iron, and steel in all countries in 1890 or in immediately preceding years. These tables were compiled late in 1891. Tons of 2,240 pounds are used in giving the production of the United States, Great Britain, Canada, and "other countries," and metric tons of 2,204 pounds are given for all the continental countries of Europe. It has not seemed to be necessary to reduce all tons in the table to a common standard.

World's production of iron ore, coal, pig iron, and steel.

Countries.	Iron ore.		Coal.		Pig iron.		Steel.	
	Years.	Tons.	Years.	Tons.	Years.	Tons.	Years.	Tons.
United States	1890	16,036,043	1889	141,229,513	1890	9,202,703	1890	4,277,071
Great Britain	1890	13,780,767	1890	181,614,288	1890	7,904,214	1890	3,679,043
Germany and Luxemburg	1890	11,409,625	1890	89,051,527	1890	4,637,239	1890	2,161,821
France	1887	2,579,465	1890	25,836,953	1890	1,970,160	1890	704,013
Belgium	1889	202,431	1890	20,343,495	1890	781,958	1890	239,266
Austria and Hungary	1890	2,200,000	1889	25,326,417	1890	925,308	1890	440,605
Russia (including Siberia)	1888	1,433,513	1889	6,228,000	1889	745,872	1889	263,719
Sweden	1890	941,241	1890	258,000	1890	456,102	1890	169,286
Spain	1888	4,500,000	1888	1,203,119	1888	232,000	1888	28,645
Italy	1889	173,489	1889	390,320	1889	13,473	1889	157,899
Canada	1890	68,313	1890	2,783,626	1890	19,439	1889	24,887
Other countries *a*	1890	2,000,000	1890	11,200,000	1890	80,000	1890	5,000
Total	......	55,324,887	......	515,465,258	......	26,968,468	......	12,151,255
Percentage of the United States	......	28.9	......	27.3	......	34.1	......	35.2

a Including Cuba.

The percentage of iron ore produced by the United States is seen by these tables to have been 28.9; of coal, 27.3; of pig iron, 34.1; and of steel, 35.2.

GOLD AND SILVER.

The statistics of the production of gold and silver are compiled by Hon. Edward O. Leech, Director of the Mint. They are accepted as authoritative in this report. The year 1889 is an exception to this. The production for that year was determined by the Census Office.

The combined product of gold and silver in 1891 reached $108,591,565 in value. This is the greatest value ever produced in the United States in a year and brings the total product since 1792 almost to $3,000,000,000. This point was passed in the second month of 1892. Both gold and silver increased in product in 1891; gold slightly, from $32,845,000 in 1890 to $33,175,000 in 1891, and silver considerably, from $70,485,714 in 1899 to $75,416,565 in 1891, both coining values. In all, the sum of the gold product in the United States from the earliest statistics exceed the coining value of the silver by nearly two to one. This is shown in the following table of the total product in the United States since 1792.

Product of gold and silver in the United States from 1792.

[The estimate for 1792–1873 is by Dr. R. W. Raymond, United States Mining Commissioner, and since by the Director of the Mint.]

Years.	Total.	Gold.	Silver.
April 2, 1792–July 31, 1834	$14, 000, 000	$14, 000, 000	(*a*)
July 31, 1834–Dec. 21, 1844	7, 750, 000	7, 500, 000	$250, 000
1845	1, 058, 327	1, 008, 327	50, 000
1846	1, 189, 357	1, 139, 357	50, 000
1847	939, 085	889, 085	50, 000
1848	10, 050, 000	10, 000, 000	50, 000
1849	40, 050, 000	40, 000, 000	50, 000
1850	50, 050, 000	50, 000, 000	50, 000
1851	55, 050, 000	55, 000, 000	50, 000
1852	60, 050, 000	60, 000, 000	50, 000
1853	65, 050, 000	65, 000, 000	50, 000
1854	60, 050, 000	60, 000, 000	50, 000
1855	55, 050, 000	55, 000, 000	50, 000
1856	55, 050, 000	55, 000, 000	50, 000
1857	55, 050, 000	55, 000, 000	50, 000
1858	50, 500, 000	50, 000, 000	500, 000
1859	50, 100, 000	50, 000, 000	100, 000
1860	46, 150, 000	46, 000, 000	150, 000
1861	45, 000, 000	43, 000, 000	2, 000, 000
1862	43, 700, 000	39, 200, 000	4, 500, 000
1863	48, 500, 000	40, 000, 000	8, 500, 000
1864	57, 100, 000	46, 100, 000	11, 000, 000
1865	64, 475, 000	53, 225, 000	11, 250, 000
1866	63, 500, 000	53, 500, 000	10, 000, 000
1867	65, 225, 000	51, 725, 000	13, 500, 000
1868	60, 000, 000	48, 000, 000	12, 000, 000
1869	61, 500, 000	49, 500, 000	12, 000, 000
1870	66, 000, 000	50, 000, 000	16, 000, 000
1871	66, 500, 000	43, 500, 000	23, 000, 000
1872	64, 750, 000	36, 000, 000	28, 750, 000
1873	71, 750, 000	36, 000, 000	35, 750, 000
1874	70, 800, 000	33, 500, 000	37, 300, 000
1875	65, 100, 000	33, 400, 000	31, 700, 000
1876	78, 700, 000	39, 900, 000	38, 800, 000

a Insignificant.

Product of gold and silver in the United States from 1792—Continued.

Years.	Total.	Gold.	Silver.
1877	$86,700,000	$46,900,000	$39,800,000
1878	96,400,000	51,200,000	45,200,000
1879	79,700,000	38,900,000	40,800,000
1880	75,200,000	36,000,000	39,200,000
1881	77,700,000	34,700,000	43,000,000
1882	79,300,000	32,500,000	46,800,000
1883	76,200,000	30,000,000	46,200,000
1884	79,600,000	30,800,000	48,800,000
1885	83,400,000	31,800,000	51,600,000
1886	86,000,000	35,000,000	51,000,000
1887	86,350,000	33,000,000	53,350,000
1888	92,370,000	35,175,000	59,195,000
1889 mint	97,446,000	32,800,000	64,646,000
1889 census	99,282,866	32,886,180	66,396,686
1890	103,330,714	32,845,000	70,485,714
1891	108,591,565	33,175,000	75,416,565
Total	2,978,075,048	1,904,881,769	1,073,193,279

In the tables below the product is distributed, as well as possible, to the States where it was produced.

Distribution of the gold and silver product in 1891, by States.

[Estimated by the Director of the Mint.]

States and Territories.	Gold.		Silver.		Total value.
	Fine ounces.	Value.	Fine ounces.	Coining value.	
Alaska	43,537	$900,000	8,000	$10,343	$910,343
Arizona	47,166	975,000	1,480,000	1,913,535	2,888,535
California	609,525	12,600,000	750,000	969,697	13,569,697
Colorado	222,525	4,600,000	21,160,000	27,358,384	31,958,384
Georgia	3,870	80,000	400	517	80,517
Idaho	81,270	1,680,000	4,035,000	5,216,970	6,896,970
Michigan	3,628	75,000	73,000	94,384	169,384
Montana	139,804	2,890,000	16,350,000	21,139,394	24,029,394
Nevada	99,169	2,050,000	3,520,000	4,551,111	6,601,111
New Mexico	43,779	905,000	1,325,000	1,713,131	2,618,131
North Carolina	4,595	95,000	5,000	6,465	101,465
Oregon	79,335	1,640,000	230,000	297,374	1,937,374
South Carolina	6,047	125,000	500	646	125,646
South Dakota	171,131	3,550,000	100,000	129,293	3,679,293
Texas	....	....	375,000	484,848	484,848
Utah	31,444	650,000	8,750,000	11,313,131	11,963,131
Washington	16,206	335,000	165,000	213,334	548,334
Other States *a*	1,209	25,000	3,100	4,008	29,008
Total	1,604,840	33,175,000	58,330,000	75,416,565	108,591,565

a Includes Alabama, Maryland, Tennessee, Vermont, Virginia, and Wyoming.

Approximate distribution in round numbers, by States and Territories, of the estimated total product of precious metals in the United States during the calendar years 1881 to 1891, inclusive.

States and Territories.	1881.			1882.		
	Gold.	Silver.	Total.	Gold.	Silver.	Total.
Alaska	$15,000	....	$15,000	$150,000	....	$150,000
Arizona	1,060,000	$7,300,000	8,360,000	1,065,000	$7,500,000	8,565,000
California	18,200,000	750,000	18,950,000	16,800,000	845,000	17,645,000
Colorado	3,300,000	17,160,000	20,460,000	3,360,000	16,500,000	19,860,000
Dakota	4,000,000	70,000	4,070,000	3,300,000	175,000	3,475,000
Georgia	125,000	....	125,000	250,000	....	250,000
Idaho	1,700,000	1,300,000	3,000,000	1,500,000	2,000,000	3,500,000
Maine	....	5,000	5,000	....	....	....
Montana	2,330,000	2,630,000	4,960,000	2,550,000	4,370,000	6,920,000
Nevada	2,250,000	7,060,000	9,310,000	2,000,000	6,750,000	8,750,000
New Mexico	185,000	275,000	460,000	150,000	1,800,000	1,950,000
North Carolina	115,000	....	115,000	190,000	25,000	215,000
Oregon	1,100,000	50,000	1,150,000	830,000	35,000	865,000
South Carolina	35,000	....	35,000	25,000	....	25,000
Tennessee	5,000	....	5,000	....	....	....
Utah	145,000	6,400,000	6,545,000	190,000	6,800,000	6,990,000
Virginia	10,000	....	10,000	15,000	....	15,000
Washington	120,000	....	120,000	120,000	....	120,000
Wyoming	5,000	....	5,000	5,000	....	5,000
Total	34,700,000	43,000,000	77,700,000	32,500,000	46,800,000	79,300,000
	1883.			1884.		
Alaska	$300,000	....	$300,000	$200,000	....	$200,000
Arizona	950,000	$5,200,000	6,150,000	930,000	$4,500,000	5,430,000
California	14,120,000	1,460,000	15,580,000	13,600,000	3,000,000	16,600,000
Colorado	4,100,000	17,370,000	21,470,000	4,250,000	16,000,000	20,250,000
Dakota	3,200,000	150,000	3,350,000	3,300,000	150,000	3,450,000
Georgia	199,000	1,000	200,000	137,000	....	137,000
Idaho	1,400,000	2,100,000	3,500,000	1,250,000	2,720,000	3,970,000
Montana	1,800,000	6,000,000	7,800,000	2,170,000	7,000,000	9,170,000
Nevada	2,520,000	5,430,000	7,950,000	3,500,000	5,600,000	9,100,000
New Mexico	280,000	2,845,000	3,125,000	300,000	3,000,000	3,300,000
North Carolina	167,000	3,000	170,000	157,000	3,500	160,500
Oregon	660,000	20,000	680,000	660,000	20,000	680,000
South Carolina	56,500	500	57,000	57,000	500	57,500
Utah	140,000	5,620,000	5,760,000	120,000	6,800,000	6,920,000
Virginia	6,000	....	6,000	2,000	....	2,000
Washington	80,000	500	80,500	85,000	1,000	86,000
Wyoming	4,000	....	4,000	6,000	....	6,000
Other	17,500	....	17,500	76,000	5,000	81,000
Total	30,000,000	46,200,000	76,200,000	30,800,000	48,800,000	79,600,000
	1885.			1886.		
Alaska	$300,000	$2,000	$302,000	$446,000	$2,000	$448,000
Arizona	880,000	3,800,000	4,180,000	1,110,000	3,400,000	4,510,000
California	12,700,000	3,500,000	15,200,000	14,725,000	1,400,000	16,125,000
Colorado	4,200,000	15,800,000	20,000,000	4,450,000	16,000,000	20,450,000
Dakota	3,200,000	100,000	3,300,000	2,700,000	425,000	3,125,000
Georgia	136,000	....	136,000	152,500	1,000	153,500
Idaho	1,800,000	3,500,000	5,300,000	1,800,000	3,600,000	5,400,000
Montana	3,300,000	10,060,000	13,360,000	4,425,000	12,400,000	16,825,000
Nevada	3,100,000	6,000,000	9,100,000	3,090,000	5,000,000	8,000,000
New Mexico	800,000	3,000,000	3,800,000	400,000	2,300,000	2,700,000
North Carolina	152,000	3,000	155,000	175,000	3,000	178,000
Oregon	800,000	10,000	810,000	990,000	5,000	995,000
South Carolina	43,000	....	43,000	37,500	500	38,000
Utah	180,000	6,750,000	6,930,000	216,000	6,500,000	6,716,000
Washington	120,000	70,000	190,000	147,000	80,000	227,000
Texas, Alabama, Tennessee, Virginia, Vermont, Michigan, and Wyoming	90,000	5,000	95,000	5,000	205,000	210,000
Total	31,801,000	51,600,000	83,401,000	34,869,000	51,321,500	86,190,500

Approximate distribution in round numbers, by States and Territories, of the estimated total product of precious metals in the United States, etc.—Continued.

States and Territories.	1887.			1888.		
	Gold.	Silver.	Total.	Gold.	Silver.	Total.
Alaska	$675,000	$300	$675,300	$850,000	$3,000	$853,000
Arizona	830,000	3,800,000	4,630,000	871,500	3,000,000	3,871,500
California	13,400,000	1,500,000	14,900,000	12,750,000	1,400,000	14,150,000
Colorado	4,000,000	15,000,000	19,000,000	3,758,000	19,000,000	22,758,000
Dakota	2,400,000	40,000	2,440,000	2,600,000	100,000	2,700,000
Georgia	110,000	500	110,500	104,000	500	104 500
Idaho	1,900,000	3,000,000	4,900,000	2,400,000	3,000,000	5,400,000
Michigan	35,000	26,000	61,000	42,000	84,000	126,000
Montana	5,230,000	15,500,000	20,730,000	4,200,000	17,000,000	21,200,000
Nevada	2,500,000	4,900,000	7,400,000	3,525,000	7,000,000	10,525,000
New Mexico	500,000	2,300,000	2,800,000	602,000	1,200,000	1,802,000
North Carolina	225,000	5,000	230,000	136,000	3,500	139,500
Oregon	900,000	10,000	910,000	825,000	15,000	840,000
South Carolina	50,000	500	50,500	39,000	200	39,200
Utah	220,000	7,000,000	7,220,000	290,000	7,000,000	7,290,000
Washington	150,000	100,000	250,000	145,000	100,000	245,000
Texas	....	250,000	250,000	....	300,000	300,000
Alabama, Tennessee, Virginia, Vermont, Michigan, and Wyoming	22,000	1,000	23,000	30,000	500	30,500
Total	33,147,000	53,433,300	86,580,300	33,167,500	59,206,700	92,374,200

States and Territories.	1889.			1890.		
	Gold.	Silver.	Total.	Gold.	Silver.	Total.
Alaska	$900,000	$10,343	$910,343	$762,500	$9,697	$772,197
Arizona	900,000	1,939,393	2,839,393	1,000,000	1,292,929	2,292,929
California	13,000,000	1,034,343	14,034,343	12,500,000	1,163,636	13,663,636
Colorado	4,000,000	20,686,868	24,186,868	4,150,000	24,307,070	28,457,070
Dakota	2,900,000	64,646	2,964,646	3,200,000	129,292	3,329,292
Georgia	107,000	465	107,465	100,000	517	100,517
Idaho	2,000,000	4,395,959	6,395,959	1,850,000	4,783,838	6,633,838
Michigan	10,000	77,575	147,575	90,000	71,111	161,111
Montana	3,500,000	19,393,939	22,893,939	3,390,000	20,363,636	23,663,636
Nevada	3,000,000	6,206,060	9,206,060	2,800,000	5,753,535	8,553,535
New Mexico	1,000,000	1,461,010	2,461,010	850,000	1,680,808	2,530,808
North Carolina	145,000	3,878	148,878	118,500	1,757	126,257
Oregon	1,200,000	38,787	1,238,787	1,100,000	96,969	1,196,969
South Carolina	45,000	232	45,232	100,000	517	100,517
Utah	500,000	9,050,505	9,550,505	680,000	10,343,434	11,023,434
Washington	175,000	103,434	278,434	204,000	90,505	294,505
Texas	....	300,000	300,000	....	387,878	387,878
Alabama, Tennessee, Virginia, Vermont, and Wyoming	25,000	1,293	26,293	40,000	2,585	42,585
Total	32,967,000	64,768,730	97,735,730	32,845,000	70,485,714	103,330,714

States and Territories.	1891.		
	Gold.	Silver.	Total.
Alaska	$900,000	$10,343	$910,343
Arizona	975,000	1,913,535	2,888,535
California	12,600,000	969,697	13,569,697
Colorado	4,600,000	27,358,384	31,958,384
South Dakota	3,550,000	129,293	3,679,293
Georgia	80,000	517	80,517
Idaho	1,680,000	5,216,970	6,896,970
Michigan	75,000	94,384	169,384
Montana	2,890,000	21,139,394	24,029,394
Nevada	2,050,000	4,551,111	6,601,111
New Mexico	905,000	1,713,131	2,618,131
North Carolina	95,000	6,465	101,465
Oregon	1,640,000	297,374	1,937,374
South Carolina	125,000	646	125,646
Utah	650,000	11,313,131	11,963,131
Washington	335,000	213,334	548,334
Texas	....	484,848	484,848
Alabama, Tennessee, Virginia, Vermont, and Wyoming	25,000	4,008	29,008
Total	33,175,000	75,416,565	108,591,565

Rank of the States and Territories in the production of gold and silver.

1886.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Colorado.	1	Colorado.
2	Colorado.	2	Montana.	2	Montana.
3	Montana.	3	Utah.	3	California.
4	Nevada.	4	Nevada.	4	Nevada.
5	Dakota.	5	Idaho.	5	Utah.
6	Idaho.	6	Arizona.	6	Idaho.
7	Arizona.	7	New Mexico.	7	Arizona.
8	Oregon.	8	California.	8	Dakota.
9	Alaska.	9	Dakota.	9	New Mexico.
10	New Mexico.	10	"Other."	10	Oregon.
11	Utah.	11	Washington.	11	Alaska.
12	North Carolina.	12	Oregon.	12	Washington.
13	Georgia.	13	North Carolina.	13	"Other."
14	Washington.	14	Alaska.	14	North Carolina.
15	South Carolina.	15	Georgia.	15	Georgia.
16	"Other."	16	South Carolina.	16	South Carolina.

1887.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Montana.	1	Montana.
2	Montana.	2	Colorado.	2	Colorado.
3	Colorado.	3	Utah.	3	California.
4	Nevada.	4	Nevada.	4	Nevada.
5	Dakota.	5	Arizona.	5	Utah.
6	Idaho.	6	Idaho.	6	Idaho.
7	Oregon.	7	New Mexico.	7	Arizona.
8	Arizona.	8	California.	8	New Mexico.
9	Alaska.	9	Texas.	9	Dakota.
10	New Mexico.	10	Washington.	10	Oregon.
11	North Carolina.	11	"Other."	11	Alaska.
12	Utah.	12	Dakota.	12	Washington.
13	Washington.	13	Michigan.	13	Texas.
14	Georgia.	14	Oregon.	14	North Carolina.
15	South Carolina.	15	North Carolina.	15	Georgia.
16	Michigan.	16	Georgia.	16	"Other."
17	"Other."	17	South Carolina.	17	South Carolina.
		18	Alaska.	18	Michigan.

1888.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Colorado.	1	Colorado.
2	Montana.	2	Montana.	2	Montana.
3	Colorado.	3	Nevada.	3	California.
4	Nevada.		Utah.	4	Nevada.
5	Dakota.	4	Arizona.	5	Utah.
6	Idaho.		Idaho.	6	Idaho.
7	Arizona.	5	California.	7	Arizona.
8	Alaska.	6	New Mexico.	8	Dakota.
9	Oregon.	7	Texas.	9	New Mexico.
10	New Mexico.	8	Dakota.	10	Alaska.
11	Utah.		Washington.	11	Oregon.
12	Washington.	9	Michigan.	12	Texas.
13	North Carolina.	10	Oregon.	13	Washington.
14	Georgia.	11	North Carolina.	14	North Carolina.
15	Michigan.	12	Alaska.	15	Michigan.
16	South Carolina.	13	Georgia.	16	Georgia.
17	"Other."		"Other."	17	South Carolina.
		14	South Carolina.	18	"Other."

Rank of the States and Territories in the production of gold and silver—Continued.

1889.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Colorado.	1	Colorado.
2	{Colorado.	2	Montana.	2	Montana.
	{Montana.	3	Utah.	3	California.
3	Nevada.	4	Nevada.	4	Utah.
4	Dakota.	5	Idaho.	5	Nevada.
5	Idaho.	6	Arizona.	6	Idaho.
6	Oregon.	7	New Mexico.	7	Dakota.
7	New Mexico.	8	California.	8	Arizona.
8	{Alaska.	9	Texas.	9	New Mexico.
	{Arizona.	10	Washington.	10	Oregon.
9	Utah.	11	Michigan.	11	Alaska.
10	Washington.	12	Dakota.	12	Texas.
11	North Carolina.	13	Oregon.	13	Washington.
12	Georgia.	14	Alaska.	14	North Carolina.
13	Michigan.	15	North Carolina.	15	Michigan.
14	South Carolina.	16	"Other."	16	Georgia.
15	"Other."	17	Georgia.	17	South Carolina.
		18	South Carolina.	18	"Other."

1890.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Colorado.	1	Colorado.
2	Colorado.	2	Montana.	2	Montana.
3	Montana.	3	Utah.	3	California.
4	Dakota.	4	Nevada.	4	Utah.
5	Nevada.	5	Idaho.	5	Nevada.
6	Idaho.	6	New Mexico.	6	Idaho.
7	Oregon.	7	Arizona.	7	Dakota.
8	Arizona.	8	California.	8	New Mexico.
9	New Mexico.	9	Texas.	9	Arizona.
10	Alaska.	10	Dakota.	10	Oregon.
11	Utah.	11	Oregon.	11	Alaska.
12	Washington.	12	Washington.	12	Texas.
13	North Carolina.	13	Michigan.	13	Washington.
14	{South Carolina.	14	Alaska.	14	Michigan.
	{Georgia.	15	North Carolina.	15	North Carolina.
15	Michigan.	16	"Other."	16	{Georgia.
16	"Other."	17	{Georgia.		{South Carolina.
			{South Carolina.	17	"Other."

1891.

Rank.	Gold.	Rank.	Silver.	Rank.	Total.
1	California.	1	Colorado.	1	Colorado.
2	Colorado.	2	Montana.	2	Montana.
3	South Dakota.	3	Utah.	3	California.
4	Montana.	4	Idaho.	4	Utah.
5	Nevada.	5	Nevada.	5	Idaho.
6	Idaho.	6	Arizona.	6	Nevada.
7	Oregon.	7	New Mexico.	7	South Dakota.
8	Arizona.	8	California.	8	Arizona.
9	New Mexico.	9	Texas.	9	New Mexico.
10	Alaska.	10	Oregon.	10	Oregon.
11	Utah.	11	Washington.	11	Alaska.
12	Washington.	12	South Dakota.	12	Washington.
13	South Carolina.	13	Michigan.	13	Texas.
14	North Carolina.	14	Alaska.	14	Michigan.
15	Georgia.	15	North Carolina.	15	South Carolina.
16	Michigan.	16	"Other."	16	North Carolina.
17	"Other."	17	South Carolina.	17	Georgia.
		18	Georgia.	18	"Other."

During 1891 the only surprise in gold and silver mining was the great development at Creede, Colorado. With this exception no especially important mining districts were developed.

A matter of great significance to the mining industry of California is the endeavor which is still continued to reëstablish hydraulic mining. This took the form of a convention, which petitioned Congress to authorize the construction of restraining dams in the manner recommended by the United States Engineer Corps, to place the construction of these dams under the Engineer Corps of the United States Army, and to promote hydraulic mining under the conditions that the débris should be restrained in such dams. A bill to this effect has passed the House of Representatives.

COPPER.

By C. Kirchhoff.

The largest copper production in the history of the country and an export movement of unexampled magnitude were the special features of the year 1891. The extensions and betterments made by some of the leading producers in the United States in 1890 bore fruit in 1891, the increase in the output being solely due to that cause. No new mines of any consequence entered the lists or materially swelled the totals, and so far as present indications go, there are no prospects that any sensational discoveries will disturb the copper trade. The latter must therefore deal almost entirely with the existing mines, which are controlled by a relatively small group of interests. The capacity of nearly every individual mine, its limitations, and its advantages are so well known that its influence upon the markets can be pretty accurately gauged. It is a matter which is beginning to occasion some comment, and is exercising a distinct influence upon the attitude of producers, that every year, at the present enormous rate of production, is making inroads upon the reserves of our copper mines. It is a grave question whether the influence of the introduction of improved appliances and methods upon the lowering of costs of production is not more than counterbalanced by the increasing outlays created by the growing depth of the mines, and the impoverishment of some of them in lower levels. The expediency is questioned of exhausting our reserves largely for the benefit of foreign consumers, when the gratification of reaching an enormous output is purchased at the sacrifice of fairly remunerative prices. From that point of view the record of the year 1891 should prove a warning example. The increase in the production in the face of a moderate consumption made necessary an enormous export movement which could be attained only by accepting very low prices. The latter put a heavy pressure on the weaker mines, and cut down the returns of the stronger ones very materially.

The year opened with the lake companies holding nominally for 15 cents, having supplied the requirements of the leading consumers at 14½ to 14¾ cents. As a matter of fact lake copper for the moderate current requirements uncovered was available at the lower range noted, while casting brands were purchasable at 12 to 12½ cents. January dragged along with small sales, the purchasers accumulating supplies until early in February export sales were effected covering about 8,000,000 pounds of lake copper at 13 cents and a considerable quantity of Montana matte at about 10 shillings per unit at Liverpool. The nominal rate of 15 cents for the home market was maintained until early in March, when it was lowered to 14 cents without leading to heavy purchases on the part of consumers, who were complaining of a slack demand for manufactured goods. March developed increasing weakness, the market being fed from outside sources down to 13¾ cents for lake. Casting copper, however, became stronger on the announcement of a sale of 10,000 tons of Anaconda matte for export, followed soon after by the closing down of the mine and works on the ostensible ground of differences with the railroad over local rates of freight. In April the price fluctuated between 13½ and 13¾ cents with only a modest volume of business going. The end of May finally brought an open reduction in the price of lake copper to 13 cents, followed early in June by somewhat livelier buying at that rate. The lake companies endeavored to improve their position by selling about 20,000,000 pounds for export at 12½ cents, but could not hold the market, which fell off to 12⅝ cents, and during July gradually fell off to 12½ cents, a tendency which continued in August until 12 cents was reached and passed. More active buying and a reduction in the supply, caused largely by the stoppage of the Anaconda, turned the market in the opposite direction, September opening with lake at 12¼ to 12⅜ cents, while casting brands were held at 11½ to 11¾ cents. A firmer tone developed in the course of the month, sales being made for delivery during the balance of the year at 12½ cents. October brought a disquieting report relating to the resumption of work at the Anaconda, which eventually proved correct. It led to a decline on both sides of the Atlantic, lake copper selling towards the end of the month from first hands down to 11½ cents. The unsettled condition of the market continued during November, the price settling down to 11 cents. Continued pressure to sell dragged the price down to 10¾ cents, until in the middle of December a leading producer marketed a few millions of pounds of lake for delivery during the next few months at 10½ cents, followed toward the close of the year by sales at 10¼ cents, at which considerable quantities found takers.

DOMESTIC PRODUCTION.

The following table, showing the growth in the production of copper in the United States, is compiled, as far as the years previous to 1882 are concerned, from the best data available. Since that year the statistics are those collected by this office, with the exception of the year 1889, when the figures were gathered by the Census Office. It should be stated that the yield of copper from imported ores and of pyrites is not here included.

Production of copper in the United States from 1845 to 1891, inclusive.

Years.	Total production.	Lake Superior.	Calumet and Hecla.	Percentage of Lake Superior of total product.	Years.	Total production.	Lake Superior.	Calumet and Hecla.	Percentage of Lake Superior of total product.
	Long tons.	*Long tons.*	*Long tons.*			*Long tons.*	*Long tons.*	*Long tons.*	
1845	100	12	....	12.0	1869	12, 500	11, 886	5, 497	95. 1
1846	150	26	....	17. 3	1870	12, 600	10, 992	6, 277	87. 2
1847	300	213	....	71. 0	1871	13, 000	11, 942	7, 242	91. 9
1848	500	461	....	92. 2	1872	12, 500	10, 961	7, 215	87. 7
1849	700	672	....	96. 0	1873	15, 500	13, 433	8, 414	86. 7
1850	650	572	....	88. 0	1874	17, 500	15, 327	8, 984	87. 6
1851	900	779	....	86. 6	1875	18, 000	16, 089	9, 586	89. 4
1852	1, 100	792	....	72. 0	1876	19, 000	17, 085	9, 683	89. 9
1853	2, 000	1, 297	....	64. 9	1877	21, 000	17, 422	10, 075	83. 0
1854	2, 250	1, 819	....	80. 8	1878	21, 500	17, 719	11, 272	82. 4
1855	3, 000	2, 593	....	86. 4	1879	23, 000	19, 129	11, 728	83. 2
1856	4, 000	3, 666	....	91. 7	1880	27, 000	22, 204	14, 140	82. 2
1857	4, 800	4, 255	....	88. 6	1881	32, 000	24, 363	14, 000	76. 1
1858	5, 500	4, 088	....	74. 3	1882	40, 467	25, 439	14, 309	62. 9
1859	6, 300	3, 985	....	63. 3	1883	51, 574	26, 653	14, 788	51. 6
1860	7, 200	5, 388	....	74. 8	1884	64, 708	30, 961	18, 069	47. 8
1861	7, 500	6, 713	....	89. 5	1885	74, 052	32, 209	21, 093	43. 5
1862	9, 000	6, 065	....	67. 4	1886	70, 430	36, 124	22, 553	51. 3
1863	8, 500	5, 797	....	68. 2	1887	81, 017	33, 941	20, 543	41. 9
1864	8, 000	5, 576	....	69. 7	1888	101, 054	38, 604	22, 453	38. 2
1865	8, 500	6, 410	....	75. 4	1889	101, 239	39, 364	21, 727	38. 7
1866	8, 900	6, 138	....	69. 0	1890	115, 966	45, 273	26, 727	38. 9
1867	10, 000	7, 824	603	78. 2	1891	126, 839	50, 992	....	40. 2
1868	11, 600	9, 346	2, 276	80. 6					

In detail the production of copper territorially distributed has been as follows since 1883:

Total copper production in the United States, 1883 to 1891, inclusive.

Sources.	1883.	1884.	1885.	1886.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Lake Superior	59, 702, 404	69, 353, 202	72, 147, 889	80, 918, 460
Arizona	23, 874, 963	26, 734, 345	22, 706, 366	15, 657, 035
Montana	24, 664, 346	43, 093, 054	67, 797, 864	57, 611, 621
New Mexico	823, 511	59, 450	79, 839	558, 385
California	1, 600, 862	876, 166	469, 028	430, 210
Utah	341, 885	265, 526	126, 199	500, 000
Colorado	1, 152, 652	2, 013, 125	1, 146, 460	409, 306
Wyoming	962, 468	....	....	....
Nevada	288, 077	100, 000	8, 871	50, 000
Idaho	....	46, 667	40, 381	....
Missouri	260, 306	230, 000	....	....
Maine and New Hampshire	212, 124	249, 018	211, 602	315, 719
Vermont	400, 000	655, 405		
Southern States	395, 175	317, 711	40, 199	29, 811
Middle States	64, 400	2, 114	190, 641	....
Lead-desilverizers, etc	782, 880	950, 870	910, 144	1, 282, 496
Total domestic copper	115, 526, 053	144, 946, 653	165, 875, 483	157, 763, 043
From imported pyrites and ores	1, 625, 742	2, 858, 754	5, 086, 841	4, 500, 000
Total (including copper from imported pyrites)	117, 151, 795	147, 805, 407	170, 962, 324	162, 263, 043

Total copper production in the United States, etc.—Continued.

Sources.	1887.	1888.	1889.	1890.	1891.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lake Superior	76,028,697	86,472,034	88,175,675	101,410,277	114,222,709
Arizona	17,720,462	31,797,300	31,586,185	34,796,689	39,873,279
Montana	78,699,677	97,897,968	98,222,444	112,980,896	112,063,320
New Mexico	283,664	1,631,271	3,686,137	850,034	1,233,197
California	1,600,000	1,570,021	151,505	23,347	3,397,405
Utah	2,500,000	2,131,047	65,467	1,006,636	1,562,098
Colorado, including copper smelters (*a*)	2,012,027	1,621,100	1,170,053	3,585,691	6,336,878
Wyoming		232,819	100,000		
Nevada		50,000	26,420		
Idaho		50,000	156,490	87,243	146,825
Missouri					
Maine and New Hampshire; Vermont	200,000	271,631	72,000	378,840	296,463
Southern States		18,201	18,144		
Middle States					
Lead-desilverizers, etc	2,432,804	2,618,074	3,345,442	4,643,439	4,989,590
Total domestic copper	181,477,331	226,361,466	226,775,962	259,763,092	284,119,764
From imported pyrites and ores	3,750,000	4,909,156	5,190,252	6,017,041	11,690,312
Total (including copper from imported pyrites)	185,227,331	231,270,622	231,966,214	265,780,133	295,810,076

a Copper smelters in Colorado, purchasing argentiferous copper ores and mattes in the open market, sources not known. The quantity of Montana matte which goes to one of these works has been deducted.

The available supply of copper for the domestic markets may be computed as follows:

Supply of copper, 1891.

	Pounds.
Production of domestic copper	284,119,764
Imported ores and pyrites	11,690,312
Imports of pigs, bars, ingots, and old copper	3,154,557
Total	298,964,633
Exports:	
Ingots and bars	69,279,024
Estimated fine copper contents of matte	50,000,000
Reëxports copper in foreign ore	2,082,708
Reëxports foreign pig, bars, and old copper	534,949
Total	121,896,681
Available supply	177,067,952

The home consumption would be arrived at by adding to this figure that quantity of copper which would represent the reduction of stocks during the year. Unfortunately the Calumet and Hecla and the Quincy mining companies decline to furnish the data. Reports of stocks of copper from the producers and the majority of smelters, with the exception of the mining companies named, show a decline from 60,840,870 pounds on the 1st of January, 1891, to 54,888,536 pounds on the 1st of January, 1892. All the lake companies, with the exception of the two named, report 10,161,528 pounds on the former, and 16,154,170 pounds on the latter date, while Montana producers reduced their stock from 33,615,987 pounds to 17,827,866 pounds. An estimate places the stock of the concerns missing at 18,000,000 to 20,000,000 pounds in addition to which there were being carried by foreign owners about

7,000,000 pounds, thus making the total stocks on January 1, 1892, about 80,000,000 to 82,000,000 pounds fine. The consumption of copper in the United States was probably somewhere between 185,000,000 and 190,000,000 pounds fine.

The following is, in detail, the output of the Lake Superior mines, as reported by the companies from 1884 to 1890:

Production of Lake Superior copper mines, 1884 to 1890.

Mines.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Calumet and Hecla	40, 473, 585	47, 247, 990	50, 518, 222	46, 016, 123	50, 295, 720	48, 668, 296	59, 868, 106
Quincy	5, 650, 436	5, 848, 530	5, 888, 517	5, 603, 691	6, 367, 809	6, 405, 686	8, 064, 253
Osceola	4, 247, 630	1, 945, 208	3, 560, 786	3. 574, 972	4, 134, 320	4, 534, 127	5, 294, 792
Franklin	3, 748, 652	4, 007, 165	4, 264, 297	3, 915, 838	3, 655, 751	4, 346, 062	5, 638, 112
Allouez	1, 928, 174	2, 170, 476	1, 725, 463	885, 010	314, 198	1, 762, 816	1, 407, 828
Atlantic	3, 163, 585	3, 582, 633	3, 503, 670	3, 641, 865	3, 974, 972	3, 698, 837	3, 619, 972
Pewabic	227, 834	....	....	....	....	....	....
Central	1, 446, 747	2, 157, 408	2, 512, 886	2, 199, 133	1, 817, 023	1, 270, 592	1, 413, 391
Grand Portage	255, 860	....	....	....	....	....	....
Conglomerate	1, 198, 691	....	....	....	....	....	....
Mass	481, 396	363, 500	247, 179	....	....	58, 349	62, 187
Copper Falls	891, 168	1, 150, 538	1, 378, 679	719, 150	1, 199, 950	1, 440, 000	1, 330, 000
Phœnix	631, 004	344, 355	1, 101, 804	11, 000	....	....	....
Hancock	562, 636	203, 037	150, 000	....	....	....	....
Huron	1, 927, 660	2, 271, 163	1, 992, 695	1, 881, 769	2, 370, 857	2, 219, 473	1, 736, 777
Ridge	74, 030	63, 390	158, 272	84, 902	50, 924	28, 000	21, 569
St. Clair	139, 407	....	....	....	....	....	....
Cliff	28, 225	....	22, 342	....	....	....	....
Wolverine	751, 763	328, 610	3, 125	2, 300	....	....	....
Nonesuch	23, 867	28, 484	....	....	....	....	....
Isle Royale	16. 074	....	....	....	....	....	....
National	87, 368	162, 252	184, 706	25, 187	....	454, 134	123, 879
Minnesota	1, 144	12, 608	....	....	....	....	....
Belt	130, 851	27, 433	7, 300	....	....	....	....
Sheldon and Columbia	9, 828	....	....	....	....	....	....
Adventure	4, 333	4, 000	1, 000	....	....	692	15, 485
Peninsula	1, 225, 981	....	....	....	....	736, 507	1, 108, 660
Tamarack	....	181, 669	3, 646, 517	7, 396, 529	11, 411, 325	10, 605, 451	10, 106, 741
Ogima	1, 106	12, 000	....	....	....	....	....
Kearsarge	....	....	....	21, 237	829, 185	1, 918, 849	1, 598, 525
Evergreen Bluff	954	1, 500	1, 000	....	....	21, 580	....
Ash Bed	1, 517	....	....	....	....	....	....
Sundry companies—tributers	21, 696	34, 000	50, 000	50, 000	50, 000	6, 224	....
Total	69, 353, 202	72, 147, 889	80, 918, 460	76, 028, 697	86, 472, 034	88, 175, 675	101, 410, 277

The permission to publish the report of the Calumet and Hecla Company for the year 1891 has not been given. The following table therefore records only the output of the other leading producers in that district:

Production of Lake Superior copper mines in 1891.

	Pounds.
Tamarack	16, 161, 312
Quincy	10, 542, 519
Osceola	6, 543, 358
Franklin	4, 319, 840
Atlantic	3, 653, 671
Kearsarge	1, 727, 390
Peninsular	1, 599, 670
Copper Falls	1, 427, 000
Huron	1, 257, 059
Allouez	1, 241, 423
Central	1, 237, 500
Centennial	531, 983
Wolverine	321, 112

The following table exhibits the highest and lowest prices of lake copper, monthly, from 1860 to 1891, both inclusive.

Highest and lowest prices of Lake Superior ingot copper, by months, from 1860 to 1891.

[Cents per pound.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860	24	23 1/2	24	23 3/4	23 3/4	23	23 1/2	23	23 1/4	22 1/2	22 1/2	21 3/4
1861	20	19	19 1/2	19	19 3/4	19 1/4	19 3/4	19	19 3/4	19 1/4	19	18
1862	28	27	28	25	25	23	23	21 1/2	21 1/2	20 3/4	23	20 3/4
1863	35	31	37	35	37	31	31	30	30 1/2	30	30 1/2	30
1864	41 1/4	39	42	41 1/4	42 1/2	41 1/2	44	42 1/2	44	43	49	44
1865	59 1/2	46	46	44	44 1/2	34	35	34	34	30	30 1/2	28 1/2
1866	42	38	38	35 1/2	35 1/2	29 1/2	30	28 1/2	31	29	33	31
1867	29 1/4	27	27 3/4	27 1/2	27 1/2	24	24 1/2	23 1/2	24 1/4	24	24 1/2	24
1868	23 1/2	21 1/2	24	22 1/2	24	23 1/4	24 1/4	23 1/4	24 1/4	24	24	23 1/8
1869	26 1/4	23 3/4	27	26	26 3/4	24	24	23 1/4	24 1/4	23 3/4	23 3/4	22
1870	22	21 1/8	21 1/4	20 7/8	20 3/4	19	19 3/4	19 1/4	19 1/2	19	20 5/8	19
1871	22 7/8	22	22 3/8	21 7/8	22	21 1/2	21 3/4	21 1/4	21 3/4	21 3/8	21 1/2	21 1/4
1872	28 1/2	27 1/8	28 3/8	28 1/4	30 1/2	28 3/8	44	30 1/2	42	36	34 3/4	33
1873	35	32 1/2	35	34	35	34 1/2	34 1/2	33 1/2	33 1/2	32	31 1/2	29 1/8
1874	25	24 1/2	25	24 1/3	24 3/4	24	25	24 3/4	25	24 1/2	24 3/4	24 1/4
1875	23 1/2	21 1/2	22 3/4	21 3/4	21 3/4	21 1/2	21 3/4	21 1/2	23 1/4	22 5/8	23	23
1876	23 1/4	23	22 7/8	22 1/2	22 1/4	22	22 5/8	22	22 1/8	21	21	19 1/4
1877	19 1/2	19	20 1/2	19 1/2	19 1/5	19	19 1/2	19 1/4	19 1/4	19	19 3/8	19
1878	17 5/8	17 1/4	17 1/2	17 1/3	17 1/8	16 7/8	17	16 7/8	16 3/4	16 1/4	16 3/8	16 1/4
1879	16	15 1/2	15 1/2	15 1/2	15 3/4	15 3/4	16	15 3/4	16 1/4	16	16 1/4	16 1/8
1880	25	21 3/8	24 1/2	24	24	22 3/4	22 1/2	24	21	18	18 1/2	17 7/8
1881	19 3/8	19 1/3	19 3/8	19 1/8	19 3/8	19	19	18 3/4	18 7/8	18 1/4	18 1/4	16 3/8
1882	20 3/8	20 1/4	20	19	19 1/4	18 7/8	18 7/8	17 7/8	18 1/4	18	18 1/4	18
1883	18 1/8	18	17 7/8	17 3/4	17 5/8	17 1/8	16	15 3/4	16	15 7/8	15 7/8	15
1884	15	14 7/8	15	14 7/8	15	14 7/8	15	14 1/2	14 1/4	14 1/8	14 1/4	14
1885	11 1/2	10 3/8	11 1/8	10 4/5	11 1/8	10 2/5	11 1/4	10 1/10	11 1/2	9 4/5	11 1/2	11
1886	11 5/8	11 3/8	11 5/8	11 3/8	11 1/2	11 3/8	11 1/2	11 3/8	11 1/8	10	10 1/8	10
1887	12	11 1/8	11 1/8	10 1/2	10 1/2	10 3/8	10 1/5	10	10	9 19/20	10 1/4	10
1888	17 4/10	15 17/20	16 6/10	16	16 7/20	15 19/20	16 9/10	16	16 3/4	16 3/10	16 13/20	16 9/20
1889	17 1/2	16 1/2	16 3/4	16 1/2	15 3/4	15	16	15 1/2	12 1/8	12	12 1/4	12
1890	14 1/2	14 1/4	14 1/4	14 1/4	14 1/4	14	14 1/2	14 1/4	15 1/4	14 5/8	16 3/4	15 1/4
1891	15	14 5/8	14 7/8	14 1/4	14 1/4	13 5/8	13 3/4	13 1/2	13 3/4	12 3/4	13	12 7/8

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860	21 3/4	21 1/2	21 1/2	21 1/2	22	21 1/4	22	21 1/2	21 1/2	20 1/4	20 1/4	19 3/4
1861	18	17 1/2	19	17 3/4	20 1/4	19	20 1/4	20	22 1/2	20 1/4	27	22 1/2
1862	24 1/2	22 1/2	24 1/2	24	27	24 1/4	32 7/8	27	32 7/8	30 1/2	31 1/2	30 1/2
1863	32	29	31	29	32 1/4	31	34 1/2	32 1/4	38 1/2	34 1/2	38 3/4	38 1/2
1864	55	49	52 1/2	50	52 1/2	47 1/2	48	47	49	47	50	48 1/2
1865	30 1/4	28	32	30 1/2	32 3/4	31 1/2	33	32 1/2	45 1/2	33	45 1/2	39 1/4
1866	33 1/2	31	31	30	31 1/2	30 3/4	31	30 3/4	30 3/4	26 1/2	29	26 1/2
1867	26	24	26 1/4	25 3/4	27 1/4	26 1/4	26 3/4	22 3/4	23	22 3/4	23	21 1/2
1868	24 1/2	23 1/8	24 1/4	24	24	23 3/4	24	23	24	22 1/2	24 1/2	23 3/4
1869	22 1/4	21 7/8	23 1/8	21 7/8	23	22	22 3/4	22	22 1/2	22	22	21 1/2
1870	20 1/2	20 3/8	21 3/8	20 1/8	21 1/2	20 3/4	21 3/4	21 1/2	23 3/8	21 3/4	22 5/8	22 1/4
1871	22 1/4	21 5/8	23	22 3/8	23 7/8	22 7/8	23 7/8	23 1/4	24 1/4	23 1/4	27	24 1/2
1872	34	33	35	32 1/2	35 1/4	33	34 3/4	31 1/4	32 1/4	30 3/4	32 1/2	30 1/2
1873	29	26 5/8	27 1/2	27	27	25 1/2	25 1/2	24	24	21	25	23
1874	24 1/4	20	21	19	21 1/4	21	22 1/4	21 1/4	23 3/4	22 1/4	23 1/4	23 1/4
1875	23	22 5/8	23 3/8	23	23 7/8	23 1/8	23 1/4	23	23 1/4	23	23 3/8	23 3/8
1876	20	19 1/2	19 1/2	18 3/4	21	18 3/4	21 1/4	20 1/2	20 1/2	20	20	19 5/8
1877	19 1/4	19	19	17 7/8	18 1/2	17 7/8	18	17 3/4	17 3/4	17 5/8	17 3/4	17 1/2
1878	16 1/4	16	16	16	16 1/4	16	16	15 1/2	15 7/8	15 1/2	16	15 7/8
1879	16 1/8	16	16 3/8	16	17	16 1/4	21 1/2	18	21 3/4	21	21 1/2	21
1880	18 7/8	18 1/2	19 1/8	19	18 7/8	18 3/4	18 7/8	18 3/4	18 7/8	18 3/4	19 1/8	18 7/8
1881	16 1/2	16	16 5/8	16 3/8	18 1/8	16 3/4	18 3/8	18	19	18 1/8	20 3/8	19 1/4
1882	18 1/4	18 1/8	18 1/4	18 1/8	18 1/4	18	18 1/4	18	18 1/8	18	18	17 7/8
1883	15 1/8	15	15	15	15 1/4	15 1/8	15 1/4	15 1/8	15	14 7/8	15	14 7/8
1884	14 1/8	13 7/8	14	13 7/8	13 1/8	13	13 1/8	12 7/8	13	12 1/2	12 1/8	11
1885	11 1/4	10 7/8	11 1/4	11	11 1/2	10 19/20	11 1/3	10 4/5	11 1/8	10 1/5	11 1/2	11 1/10
1886	10 1/8	10	10 1/4	10	11 1/8	10 1/4	11 3/4	11 1/8	12	11 3/4	12 1/8	11 7/8
1887	10 3/4	10 1/8	10 3/4	10 3/5	11	10 5/8	12 3/20	10 3/10	14 19/20	11 11/20	17 3/4	14 19/20
1888	16 9/10	16 13/20	17	16 3/5	17 7/10	16 9/10	17 3/5	17 7/20	17 3/5	17 1/4	17 9/20	17 1/10
1889	12	12	12	12	12	11	11	11	13 1/4	11 1/4	14 1/2	14
1890	17 1/4	16 1/2	17 1/4	17	17	17	16 7/8	16 3/4	16 3/4	16 3/4	16	15
1891	12 7/8	12 1/2	12 3/8	12	12 1/2	12 1/8	12 3/8	11 3/8	11 1/2	11	11 1/8	10 1/4

The prices realized for copper in matte are well indicated in the following table compiled from the annual reports of the Boston and Montana Company. The figures for the Tamarack are added for comparison, since they cover the same fiscal years and since the two mines are under the same management.

Prices for Boston and Montana copper in matte compared with lake ingot.

Fiscal years ending June 30—	Boston and Montana copper in matte.		Tamarack lake ingot.	
	Sales.	Price.	Sales.	Price.
	Pounds.	*Cents.*	*Pounds.*	*Cents.*
1887–'88	8, 815, 987	11. 52	10, 389, 867	13. 95
1888–'89	24, 204, 844	11. 60	11, 036, 469	12. 90
1889–'90	26, 003, 604	11. 54	8, 928, 249	11. 99
1890–'91	26, 693, 842	11. 00	14, 076, 957	14. 01
1891–'92	24, 489, 213	9. 23	16, 805, 360	11. 35

The differences are striking in some years, and are partly explained by the fact that one of the companies was for a time delivering on old syndicate contracts. Still, a difference of 2 cents per pound between lake copper and copper in matte may be regarded as normal.

Prices realized for lake copper in 1888, 1889, 1890, and 1891.

Mines.	1888.		1889.		1890.		1891.	
	Sales.	Average price.	Sales.	Average price.	Sales.	Average price.	Sales.	Average price.
	Pounds.	*Cents.*	*Pounds.*	*Cents.*	*Pounds.*	*Cents.*	*Pounds.*	*Cents.*
Allouez	314, 198	13. 71	1, 762, 816	12. 08	1, 407, 828	14. 73	1, 241, 423	12. 06
Franklin	3, 655, 751	15. 07	1, 300, 667	12. 05	2, 529, 542	14. 80	1, 862, 081	12. 61
Atlantic	3, 974, 972	14. 78	3, 698, 837	12. 09	2, 821, 616	15. 21	3, 180, 135	12. 86
Central	1, 817, 023	14. 80	1, 270, 592	12. 57	1, 413, 391	14. 94	1, 313, 197	12. 02
Huron	2, 414, 169	14. 92	1, 900, 081	12. 83	1, 375, 000	14. 86	....	....
Osceola	4, 134, 320	15. 03	4, 534, 127	11. 94	5, 294, 792	15. 51	6, 543, 358	12. 51
Quincy	6, 367, 809	15. 93	6, 405, 686	11. 96	8, 064, 253	15. 36	10, 542, 519	12. 84
Kearsarge	829, 185	16. 60	1, 918, 849	12. 58	1, 598, 525	15. 08	1, 727, 390	12. 38
Tamarack (*a*)	11, 036, 469	12. 90	8, 928, 249	11. 99	14, 076, 957	14. 01	16, 805, 360	11. 35

a Fiscal years ending June 30, 1889, 1890, 1891, and 1892.

The figures furnish the means for estimating fairly well the average prices obtained for the different years. They do not, however, cover the sales of the largest producer, but it may be stated that the average prices realized were 12 cents in 1889, 15 cents in 1890, and 12.50 in 1891.

As covering the longest period, the report of the yearly sales of the Osceola are the most interesting in showing the fluctuations in the price of lake copper. Since 1874 the sales of this company have been as follows:

Sales of copper and average prices by the Osceola Mining Company, 1874 to 1891.

Years.	Sales.	Average price.	Years.	Sales.	Average price.
	Pounds.	*Cts. per lb.*		*Pounds.*	*Cts. per lb.*
1874	936, 002	23. 37	1883	4, 256, 409	14. 96
1875	1, 330, 313	22. 77	1884	4, 247, 630	12. 82
1876	1, 693, 737	20. 57	1885	1, 639, 169	10. 75
1877	2, 774, 777	18. 19	1886	3, 560, 786	10. 51
1878	2, 705, 998	15. 53	1887	3, 583, 723	11. 86
1879	3, 197, 387	17. 79	1888	4, 134, 320	15. 03
1880	3, 381, 061	19. 15	1889	4, 534, 127	11. 94
1881	4, 176, 976	17. 77	1890	5, 294, 792	15. 51
1882	4, 179, 782	17. 70	1891	6, 543, 358	12. 51

Tamarack.—During its fiscal year ending June 30, 1892, the product of the Tamarack attained a total of 22,275,557 pounds of mineral, which at 75.44 per cent. gave 16,805,360 pounds of refined copper, from which has been realized the sum of $1,906,798.40. Adding interest, the receipts were $1,920,694.32, from which were paid out $851,311.46 for running expenses at the mine and $263,117.78 for smelting, transportation, and all other costs of handling, leaving a mining profit of $806,265.08, out of which dividends aggregating $800,000 were paid. The 338,700 tons of rock stamped yielded an average of 49.62 pounds of copper per ton, at a cost at the mine per pound of refined copper of 5.07 cents. The cost of smelting, freight, and all other expenses was 1.56 cents, and the cost for construction 1.01 cent per pound, making the total 7.64 cents per pound laid down in Eastern markets, sold against 9.11 cents, including 2.42 cents for construction, in the previous fiscal year. The construction cost includes the sinking of two shafts, about 1,000 feet each, in section 11, which will tap the lode at much greater depth than any yet arrived at in the Lake Superior district. Prospecting has been done in the Tamarack ground, at great depth on the Osceola conglomerate. Besides crushing Tamarack rock, the stamp mill treated 74,648 tons of Kearsarge stuff, the average cost being 33 cents per ton.

Quincy.—The effect upon the output of the Quincy mine through the increased equipment provided is clearly shown in the following figures covering the years 1889, 1890, and 1891:

Operations of the Quincy copper mine, Lake Superior.

	1889.	1890.	1891.
Rock mined ....tons..	167, 077	187, 244	276 336
Rock hoisted ....do....	123, 998	168, 017	269, 817
Rock stamped ....do....	117, 875	165, 140	263, 678
Product of stamp mineral ....pounds..	6, 641, 785	7, 262, 485	8, 649, 585
Product of masses ....do....	1, 178, 225	2, 740, 365	4, 177, 490
Total refined copper ....do....	6, 405, 686	8, 064, 253	10, 542, 519
Earnings........	$182, 601. 14	$596, 677. 60	$414, 970. 39

During 1891, the gross receipts were $1,357,474.80, from which must be deducted the running expenses at the mine, $494,859.95, the smelting, transportation, and other expenses, $157,551.83, and a building and construction account of $311,859.48, a total of $964,271.26, leaving a mining profit of $393,703.54. During the year 1891, the company took possession of North Quincy property, on which the work of reconstruction was carried on during the greater part of the year.

Osceola.—The company increased its facilities during 1891 by the completion of a new stamp head. There were hoisted 272,781 tons in 1891, against 214,467 tons in 1890, and there were stamped 234,325 tons of rock, at a cost of 36 cents per ton, the yield being 7,120,070 pounds of mineral, to which must be added 470,833 pounds of barrel copper, carrying the total to 7,590,903 pounds, affording, at 86.20 per cent., 6,543,358 pounds of refined copper. The costs were as follows:

Cost of refined copper at the Osceola mine.

	1890.	1891.
Mining cost per ton of stamp rock	$2.39	$2.13
Cost of refined copper at mine	8.31	7.63
Cost of smelting, transportation, and handling	1.51	1.64
Cost for construction	1.42	0.84
Total cost per pound	11.24	10.11

The gross receipts were $819,751.38, while the costs were $661,864.92, including $499,160.65 mine expenses, $107,477.50 for smelting and transportation, and $55,226.77 for mine plant, the latter including $40,089.83 for No. 5 stamp head.

Franklin.—During 1891 the grade of the rock hoisted by the Franklin underwent a reduction in yield, declining to 1.227 per cent. against 1.497 per cent. in 1890 and 1.164 per cent. in 1889. Two fires interfered with the production, so that only 175,978 tons of material was hoisted, against 188,355 in 1890. Of this 40,400 tons, or 23 per cent., was rejected, 135,578 tons going to the stamp mill. The cost of rock hoisted was $1.77 in 1891 against $1.90 in 1890 and $1.84 in 1889. The low price of copper during the year caused the income to drop to $87,524.92 against $373,612.49 in 1890.

Centennial.—In July the Centennial, which adjoins the Calumet and Hecla, started a Ball stamp, and during the balance of the year crushed 28,531 tons of rock, which produced 777,635 pounds of mineral, or 1.363 per cent., which yielded 531,983 pounds of ingot, or 93.2 per cent.

Kearsarge.—The rock stamped by the Kearsarge Company underwent a further lowering in grade, declining to 1.06 per cent. in 1891 against 1.32 per cent. in 1890 and 1.71 per cent. in 1889. Still, owing to the larger quantity hoisted (93,332 tons in 1891 against 74,368 tons in 1890) and stamped (81,424 tons in 1891 as compared with 60,219 tons in 1890), the product was increased from 1,598,525 pounds to 1,727,390 pounds of fine copper. The costs during recent years compare as follows:

Cost of fine copper at the Kearsarge mine.

	1889.	1890.	1891.
	Cents.	*Cents.*	*Cents.*
Cost per pound at mine	7.27	8.64	8.84
Cost per pound, smelting, freight, etc	1.94	1.83	1.65
Total excluding construction	9.21	10.47	10.49
Cost of construction	0.31	0.21	1.03
Total cost, sold	9.52	10.68	11.52

The total income during 1891 was $218,114.84, while the costs were $199,094.31, leaving a mining profit of $19,020.53. The year closed with the stopes averaging with as much ground as the previous year.

Atlantic.—The Atlantic mine contrived to earn enough money to pay for a construction account, in spite of a further lowering in the grade of rock. The following table shows the details of costs for a series of years.

Cost of copper at the Atlantic mine per ton of rock treated.

Items of cost.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Mining, selecting, breaking, and all surface expenses, including taxes	78.62	80.88	87.23	83.73	87.87	104.14	95.29
Transportation to mill	4.80	3.48	3.80	3.47	3.88	3.46	3.86
Stamping and separating	30.36	26.53	27.31	26.89	27.78	27.78	25.82
Freight, smelting, marketing, and New York expenses	25.45	24.25	23.07	21.42	20.22	20.37	18.47
Total working expenses	139.23	135.14	141.41	135.51	139.75	155.75	143.44
Total expenditures	143.60	138.01	145.22	142.82	153.27	166.70	154.51
Net profit	22.05	15.29	30.53	54.36	6.23	27.71	.16
Yield of copper per cent.	0.743	0.709	0.712	0.667	0.663	0.650	0.615

The gross receipts were $461,649.91, while the working expenses at the mine were $426,085.46, leaving a mining profit of $35,564.45, of which $32,859.79 was paid for construction. The surplus at the end of the year was $252,834.69.

Central.—During 1891, explorations on the Central lode below the "slide" failed to discover pay ground, so that the outlays for development area were a heavy charge. Nearly all the copper produced came from the portion of the vein above the slide. The gross income was $159,621.94, while the working expenses were $195,415.61, thus showing a deficiency of $35,793.67, and reducing the surplus to $159,701.10.

Allouez.—The low price of copper and a further decline in the grade of rock worked forced a suspension of work at the Allouez mine. The yield of the ore fell to 12.92 pounds per ton against 14.51 pounds in 1890. Including assessments aggregating $77,553 the receipts were $227,309.26, while the outlays were $226,593.96.

Wolverine.—The Wolverine Copper Mining Company took possession of the old Wolverine mine in August, 1890, opening it after an idleness of nearly six years. It was not till September, 1891, that mine and equipment were again in a condition for regular productive work, which was continued until early in April, 1892, when work was again suspended. During that time 31,524 tons of rock were stamped out of 41,880 tons hoisted. The yield was low, 15.86 pounds of copper per ton of stamp rock, the cost being $1.93. The more extensive openings required for proper development are being made.

THE BUTTE COPPER MINES.

The history of the copper trade of the world furnishes no parallel for the wonderfully rapid rise to prominence as a district which the past decade has witnessed in Butte. With the exception of a few hundred thousand pounds, the entire copper product reported for Montana annually by the United States Geological Survey has come from the relatively small hill which dominates the town of Butte, to-day the greatest mining camp in the world. How rapid that development has been is best reflected by the following record of output, the table giving the entire production of copper in the United States, that at Montana, and the percentage of the latter and of the Lake district:

Montana's proportion of the copper product.

Years.	United States.	Montana.	Montana.	Lake Superior.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*
1882	90,646,232	9,058,284	....	....
1883	115,526,053	24,664,346	21.4	50.1
1884	144,946,635	43,098,054	29.7	48.4
1885	165,875,483	67,797,864	40.9	43.5
1886	156,763,043	57,611,621	36.0	50.1
1887	181,477,331	78,699,677	43.4	41.7
1888	226,361,466	97,897,968	43.3	38.2
1889	226,055,962	98,222,444	43.5	38.7
1890	259,098,092	112,980,896	43.6	38.9
1891	284,119,764	112,063,320	39.4	40.2

The past product of Butte does not in any way represent possible output, since accidents have interfered, and it is only within the last few years that the plant of some of the most important concerns has come up to full capacity. A close investigation of the producing capacity of the Butte mines, concentrating and smelting plants has led to the conclusion that they can easily reach 175,000,000 pounds per annum and if pushed to full capacity can put on the markets of the world not less than 200,000,000 pounds of copper. With the lake mines on record with over 114,000,000 pounds, Arizona close to 40,000,000 pounds, Colorado steadily increasing, the United States can turn out 360,000,000 pounds, or 30,000,000 pounds per month.

The ore deposits consist of a series of parallel veins in granite, coursing east and west and dipping south. The number of these veins is large and they are not confined to the hill, but have also been discovered under the drift in the flats upon which some parts of the city are now built. The number of claims is very large and only a small percentage of them are being worked. By far the greater number of the operations are carried on by a few large companies. On the whole, the circumstances are not such as to encourage the establishment of a large number of small mines. The bulk of the ores are low grade and must be concentrated before smelting, so that a considerable investment of capital is called for. Several of the smelters do custom work, but the market is not on the whole a favorable one. The ores are copper glance, peacock copper, and pyrites, the gangue being quartz. Zinc blende and occasionally galena are associated with the copper-bearing minerals. Practically all of the ores carry moderate quantities of silver and small amounts of gold. The concentrating ores in the camp range from 7 to 10 per cent. in copper. Nearly all of the mines, however, produce some high-grade ores carrying 20 per cent. of copper and upward.

The prices paid for ores vary considerably. One works gives from 4½ cents to 5½ cents per pound for the copper, 90 per cent. of the silver contents, based on the New York market quotation, and deducts $12 per ton of crude ore for treatment. Other works do not bid more than 3¼ cents for the copper. For dry silver ores the prices are usually 85 to 95 per cent. of the silver value, 90 per cent. of the gold if above $2, with a deduction of $16 for working charge per ton.

Anaconda.—From April to October the mines and plant of the Anaconda Company were closed down owing to a disagreement with the railroad which hauls the ore from the mines at Butte to the dressing and smelting works at Anaconda. The mines have a record for months of about 2,750 tons of ore per day, and when in full operation can deliver close upon 3,500 tons. The plant at Anaconda consists of two works, the upper and the lower. The former has an equipment of six Ball stamps with the necessary equipment of washing machinery and a capacity of about 1,250 tons of rock per day. Two smelting plants are a part of the upper works, one with 40 Brueckner washing cylinders and 14 matting furnaces, and the other with 54 calciners and 14 matting furnaces. The lower works, built later, contain 8 Ball stamps with the necessary washing machinery, and is rated at a capacity of 2,500 tons of rock per day. It is coupled with a smelting plant possessing 96 Brueckner cylinders and 28 matting furnaces. The converter plant of the company embraces 12 converters for Bessemerizing matte, with a capacity of about 60 tons of blister copper per day, which is cast with anodes in a plant of three reverberatories, to which is added a refining furnace for electrolytic copper. The electrolytic plant consists of six elements of 105 vats each, with 30 to 40 plates weighing 150 to 180 pounds each. It has a capacity of about 20 tons of electrolytic copper per day. With only a part of the upper smelting plant in operation the Anaconda is known to have produced over 12,000,000 pounds of copper in one month, while with the entire equipment of mines and works in operation it is rated at a capacity of 14,000,000 to 14,500,000 pounds per month.

The Boston and Montana.—One of the oldest concerns in Butte is the Boston and Montana Consolidated Copper and Silver Mining Company. of which A. S. Bigelow is president and Thomas Couch is manager, The company is owned by practically the same men who have made the Tamarack on Lake Superior the great property which it is, and have long been identified with the Osceola. The Boston and Montana Company own a very large amount of mining property at Butte, of which a large part has yet remained unexplored. The principal ore extraction is from the Pennsylvania and Colusa claims, lying on the lower flank of the hill, and the Mountain View, which lies above the Saint Lawrence. The former belt has now a splendidly equipped shaft in the Leonard.

The report of the Boston and Montana Copper and Silver Mining Company possesses special interest because it is the only one which is published and from which data concerning costs in the Butte district can be gathered. The mining costs were as follows:

Cost of mining at the Boston and Montana mine, Butte district, Montana.

Mines.	Mined.	Expenses.	Cost per ton.
	Tons.		
Moose	5,840	$42,939.01	$7.35
Mountain and View	56,600	223,410.71	3.95
Pennsylvania	50,779	187,229.93	3.69
East and West Colusa	50,309	272,615.38	5.42
Total	163,528	726,195.03	4.44

There were delivered to the concentrators 125,295 tons of ore, the cost of treatment of which was $105,032.93, thus showing an average cost of 84 cents per ton. The quantity of material worked in the smelters is not specifically given but the cost of smelting was $699,265.61. Concentrating and smelting together cost $804,298.54 on 151,489 tons of ore or $5.31 per ton; thus making the total $9.75 per ton of ore exclusive of transportation and other expenses which are put down at $158,-073.45, making the total running expenses $1,688,567.02. This is relatively high because the ore was handled by teams from mine to mill, and because the concentrating and smelting plants were old, being superceded by the Great Falls works. On the other hand no underground development work was done during the year. It is understood that another large company is averaging less than $3 per ton for mining. The Boston and Montana Company produced 28,-564,826 pounds of copper from 151,489 tons of ore, an average yield of 9.13 per cent. of copper, which cost 5.91 cents per pound at the mine, exclusive of construction account, or 6.23 cents, including the latter. The cost per pound of freight, commissions, weighing, and Boston expense was 1.78 cents making a total of 8.01 cents per pound for the copper in the matte laid down in New York and sold. The receipts were 9.23 cents on 24,489,213 pounds of copper in matte and 10.62 cents per pound for 4,075,615 pounds of ingot copper. The silver contents of the matte were 286,820 ounces, of which 112,898 ounces was paid for at the rate of 83 cents. Deducting loss at least 250,000 ounces would be paid for after the introduction of the electrolytic plant, thus more than doubling the revenue from this source.

The total receipts were $2,786,537.15 and the expenditures, $2,360,132.64, leaving a mining profit of $426,404.51, out of which dividends aggregating $250,000 were paid, $91,100.43 was expended for mine construction, $6,160 for mining property, $94,000 was spent for redeeming bonds and $134,759.95 for interest on bonded debt and premiums. There are bonds outstanding of $1,667,000. The Great Falls plant thus far has cost $1,483,236.42, and $18,322.43 has been expended for construction of the electrolytic plant, with a fund in reserve for its completion of $231,677.57. The total dividends paid thus far are $2,075,000. Counting in the interest account and the outlays for the redemption of bonds, the cost of copper in matte sold with the old equipment is 8.03 cents per pound, not taking into account the revenue in the sale of silver. This cost will undoubtedly be very considerably reduced when the Great Falls plant is in full and regular operation.

The lower works of the Boston and Montana Company were purchased some years ago from W. A. Clark, and so far as it has been possible without too great an outlay they have been remodeled. The ore is hauled by teams to the concentrator, which is rated at 200 or 220 tons capacity. The ore is crushed in a Blake crusher and two sets of 14 by 22-inch rolls and is elevated to two sets of two trommels. The sized stuff is jigged in 16 Hartz jigs, while the slimes are treated on a round table. The ore is roasted in one 10-ton Brueckner cylinder and three 96-foot O'Hara calciners of 25 tons capacity, fired with coal. Two blast furnaces of 100 tons capacity are used chiefly for raw ore, heap roasted ore, raw concentrates and calcines, making about 25 tons of matte per day Three reverberatories of the usual type produced about 15 tons of matte per day, making a total of about 40 tons daily, carrying from 58 to 60 per cent. of copper and 25 to 70 ounces of silver, special argentiferous mattes being also made at times.

The upper works of the same company, originally built for their predecessors, the Montana Copper Company, have a 200-ton concentrating plant. Formerly all lump ore was calcined in open heaps, but popular indignation at the smoke nuisance led to the building of roasting stalls which are connected with a 120-foot stack. These stalls, of which there are 128, are 10 by 8½ by 7 feet deep, with a capacity of 12 tons. The smelting plant embraces 14 hand calciners varying in size, but averaging 30 feet in length; two blast furnaces, one being held in reserve, and six reverberatory matting furnaces. The works produce 35 tons of 58 to 60 per cent. matte, and 12 to 15 tons of a matte somewhat lower in grade.

Both plants are somewhat antiquated, and local circumstances, notably the scarcity of water, hardly admit of their further expansion. The company therefore decided to erect a new plant at Great Falls.

The Great Falls Works of the Boston and Montana Company possess special interest, because it is the latest plant built; embodies many features which have proved valuable by experience in Butte; has followed new lines in important particulars, and was located and designed with special reference to the conversion of copper matte into blister by the Bessemer process and electrolytic separation, with the utilization of water power. The plant is located on the left bank of the Missouri River, below the town of Great Falls, in the immediate vicinity of the dam, a canal conducting the water to the power house, a substantial two-story building constructed on the slow-combustion principle so generally adopted in New England mills. The lower story contains two penstocks, with their wheels, which are capable of developing about 2,600 horse power.

All of the wheels are of the horizontal Victor type, built by the Stillwell and Bierce Manufacturing Company, of Dayton, Ohio. On one penstock is located a pair of 44-inch turbines, which furnish power for driving the machinery in the concentrator and in the smelter, the present plant absorbing about one-half of the power thus available, the remainder being reserved for driving the dynamos for the electrolytic works.

The rope transmission alluded to is a particularly fine piece of work, practically designed by Mr. H. A. Herrick, and built by E. P. Allis & Co., of Milwaukee. With a very high speed the transmission works very quietly, the main sheaves being 9½ feet in diameter, and the carrier sheaves 6 feet. Power is transmitted to the concentrator building, a distance of about 1,000 feet, and to the smelter, a distance of 1,700 feet, being taken off at right angles at the latter.

On the second penstock are located one 40-inch wheel, a pair of 20-inch and a pair of 22½-inch turbines. The first operates an E. P. Allis 48 by 48 inch duplex vertical blowing engine, with a 26-foot fly wheel arranged for rope transmission. It is to furnish a blast of 17 pounds pressure for the converters in the smelter. The 40-inch wheel can also be used to drive a Wilson & Snyder 9 by 24 high-pressure duplex pump, delivering 700 gallons a minute at 32 revolutions at a pressure of 125 pounds, intensifiers, designed by Henry Aiken, of Pittsburg, being located in the smelting works to handle the hydraulic gear of furnaces and converters. The same 40-inch turbine is arranged to drive two Roots rotary pumps, delivering 3,500 gallons a minute at 70 revolutions for the use of the concentrator. The water works may also be driven by the pair of 22½-inch wheels when the larger turbine is fully employed furnishing power for the converter blowing engine.

The power plant also embraces two 20-inch wheels for a 650-light Thomson-Houston incandescent, a 50-arc light Thomson-Houston dynamo, and a 30-kilowatt 500-volt machine for the electric crane.

The ores are shipped from the mines of the company at Butte by the Great Northern to Great Falls, where, of course, they must first be concentrated. The concentrator is a building placed on the flank of the bluff, its width being 136 feet and its length over all 262 feet. The ore is first crushed in two 10 by 20 rock breakers, screened in two screens and crushed in two sets of two 7 by 10 crushers, going finally to three sets of 15 by 26 rolls for each division. The plant is laid out for three divisions, of which two are now completed and the third is under construction, into which a 15 by 30 inch Ball stamp has been put. Each division has six hydraulic separators and 24 Collum jigs, the middlings being crushed in a pair of rolls, with a Huntingdon mill in reserve, below which are sixteen Collum finishing jigs and 12 double slime tables

16 feet in diameter. The slimes are worked in twenty Frue vanners. They are elevated by sand pumps. The concentrates and slimes are settled in settling tanks, of which there are twenty-four for each section. The concentrates are drawn from them direct into bins placed below them, which bins can be emptied directly into the railroad cars placed on the track below them. The capacity of the present plant is 500 to 600 tons per day.

Near the concentrating plant is a boiler house equipped with two 150 horse-power Heine boilers, fitted with automatic stokers. Lethbridge coal is being tested in them. These boilers furnish the steam for heating the concentrator building and the Ball stamp.

The smelter building is a fine iron structure built by the Berlin Bridge Company, 455 feet wide and 230 feet long. It, too, is built on the flank of the bluff, so that materials once delivered at the top are cheaply moved from one part to the other of the plant. The whole width of the building of 455 feet is occupied by 39 by 20 foot bins, commanded by standard-gauge railroad track, for concentrates, smelting ore, and coal. The whole range of the bins is commanded by a broad track, upon which rests a low truck for the transfer to any point of the ore and coal cars which take material from the bins. This transfer truck is to be handled by an electric winch. On the terrace below the bins, at one end of the mill, are the Brueckner roasting cylinders with their batteries of gas producers, so far as put in. Further on is located the crushing machinery for crushing the ore which does not need concentrating, but does require roasting. Elevators take it to the bins in which it is stored. Farther on are the coal pockets, from whose chutes the coal is delivered to the producer plant of the smelting furnaces.

Returning to the Brueckner plant, the twenty-four cylinders, which are 22 feet long and take a 16-ton charge every thirty-six hours, are placed parallel in groups of six. Each group is commanded by a hopper, which may be moved above any one of the Brueckners in the group. For calcining Sand Coulee nut coal is used. Bins under the calcining furnaces and a transfer track facilitate the handling of the roasted ore to the hoppers of the smelting furnaces. The latter are again placed at a lower level. They consist of eight tilting reverberatories, with 13 by 16 foot hearth, the design, by Henry Aiken, being similar in many respects to the tilting open-hearth furnaces of the Pennsylvania Steel Company at Steelton, Pennsylvania. In fact, the plant in many respects shows the introduction into copper metallurgy of many features of handling materials characteristic of the latest American steel practice. Six of the furnaces were built by the Pennsylvania Steel Company, while two were constructed by Pollock & Co., of Youngstown, Ohio. The whole furnace is borne on three roller guides, bent to the arc of a circle, the bottom of the furnace being carried on three heavy riveted I-beams bent on the same circle. A hydraulic cylinder and rack tilts the furnace. Two of them have been in operation for sometime, and the others are wholly or partly completed. They are heated with fuel gas and are regenerators, the tilting being required to pour off about three-fourths of the slag and for casting the matte. They have a record of having treated 65 tons of calcined ore in twenty-four hours per furnace. A good deal of trouble has been experienced in the effort to use the local coal in the gas producers. It contains fully 20 per cent. of ash and the facilities afforded in the design of the plant seem to encourage wasteful use for the present. The coal was shot direct from the bins into the hoppers of the Wellman gas producers, and the ashes were carried off automatically in launders. The coal is not such that the bed of fuel can be caught by a false grate, and the result was that when the attempt was made to get rid of clinker and ash a good deal of coal was lost. The producers worked irregularly, and they have been replaced by fourteen Taylor producers.

The plan of the designers contemplates the casting of the copper matte into ladles handled by a 20-ton Morgan electric crane, the matte to be cast direct without remelting into 2 Bessemer converters, which occupy a position on the lowest level of the plant. Two more converters have been ordered. These converters are designed for a 5-ton charge, and it is expected that they will make 18 heats per day on 55 per cent. copper matte. This part of the plant has not been in operation as yet. Steel-makers will recognize in it the general plan so successfully introduced at the Sparrow's Point works of the Maryland Steel Company. A set of two Aiken intensifiers occupies a position near the converters. Plant is provided for the crushing and sampling of matte and the grinding and screening of converter lining material.

The electrolytic plant is under construction. The current will be furnished by three 180 kilowatt multipolar Thomson-Houston machines, located in the power house. The electrolytic building, 110 by 174 feet, will contain 288 depositing vats, with a capacity of 1,000,000 pounds of electrolytic copper per month, to be refined in two furnaces. A works for the manufacture of sulphate will follow.

In view of the fact that metallurgical operations are being successfully prosecuted with gas from low-grade fuels elsewhere, there seems every prospect that smelting and calcining will be done at Great Falls with the very cheap local coals. Then, with power for driving machinery and for electrolytic work at the lowest figures, the Great Falls plant must be able to work copper ore at very low figures. The copper trade will watch the outcome with the closest interest.

The Parrot plant.—The Parrot Company controls and works claims on the same vein as the Anaconda and does, a considerable business, besides in treating custom ores. It is largely controlled by the Farrell interest of Ansonia, and is operated as a close corporation. The ore from the Parrot mine is sent down to the works below on a private line.

The concentrating plant, which was originally designed for 150 tons capacity per day, but which actually works from 225 to 300 tons, is equipped with rock breakers and seven sets of rolls. The crushed ore is screened in trommels, making four sizes from $\frac{1}{10}$ to $\frac{3}{8}$ inch mesh, the stuff being handled skillfully in 21 Hartz jigs. The slimes, after sizing in hydraulic classifiers, are treated on 12 Frue & Embrey vanners. The machinery is driven by a very fine tandem compound condensing engine. Considering the high cost of fuel the use of high-class economical engines is not as general in the camp as it should be.

Lump ore is roasted in 120 stalls, while the concentrates are calcined in nine hand calciners 60 feet long and two Spence furnaces. The whole calcining plant will, however, be remodeled at an early date. The smelting plant consists of 2 blast furnaces and 6 reverberatories capable of handling 425 to 500 tons. In the matting furnaces siliceous ores, purchased in the open market, are largely used. In the blast furnaces experiments are now being made with Montana coke, which has 15 to 17 per cent. ash, but costs only $10 to $12 as compared with $16 for Connellsville coke.

The Parrot Company has been the pioneer in this country in the use of the Bessemer converter for converting matte into blister copper. The plant consists of two sets of 3 converters each, the older of which will probably be remodeled. Each has its smelting cupola. Blast is furnished by cross compound compressor delivering at 8 to 10 pounds. The works produce, from ores from the Parrot mines and from purchased ores and mattes, about 2,000,000 pounds of copper and 100,000 ounces of silver per month. The blister copper goes to the electrolytic plant of the Bridgeport Copper Company, at Bridgeport, Connecticut, controlled by the same interests.

The Colorado Mining and Smelting Company, one of the early plants in the Butte District, has since its inception been under the management of Henry Williams, and is practically a branch concern of the famous Boston and Colorado Works, of Argo, near Denver, Colorado. The company owns a number of mining claims and is working chiefly the Gagnon property. It is, however, purchaser of both copper and silver ores, and aims at the production of a high grade of matte carrying large quantities of silver and gold. This matte is shipped to the Argo plant.

The company has completed a very fine concentrating plant, to which the ore is delivered by teams, being dropped into large bins having a storage capacity of 600 tons. The ore is drawn from the bins to rock crushers, from which the material is elevated to two sets of trommels having four sets of screens each. The recrushing is done in three sets of rolls, one of them used for middlings. The coarse ore is concentrated on eight sets of Hartz jigs, while the slimes are sized in hydraulic classifiers, and then go to twelve vanners. The plant is driven by a 65 horse-power tandem compound condensing engine, while water is furnished by centrifugal pumps driven by motors coupled direct, the generators being located at the mill. The calcining plant consists of eight hand calcining furnaces, the smaller ones of which take an 8-ton charge, while the larger ones handle 10 tons. Three Brueckner cylinders are also a part of the plant, handling 14 to 15 ton charges in forty-eight hours. The smelting is done in six reverberatory matting furnaces, one of them, of exceptional size, not having been completed until lately. In these furnaces the ore is smelted to a 45 per cent. first matte, each furnace handling four charges of 7 to 8 tons per day. The slag is skimmed and the matte is allowed to accumulate, being tapped every second day. This first matte is crushed, roasted in calciners, and is smelted again in one of the furnaces especially equipped for this purpose. It is carried up to the grade of 70 per cent. copper, the slag produced in this furnace being tapped direct in a liquid condition into an adjoining ore matting furnace. The works produce about 275 tons of matte per month, this product carrying about 70 per cent. of copper, 375 to 400 ounces of silver, and 1 to 2 ounces of gold. For coarse ore the works are equipped with sixty roasting stalls.

The Butte and Boston.—The Bigelow-Lewisohn interests comprise also the Butte and Boston Mining Company, owning a number of actively worked mines, but have suffered early in the year with a loss by fire of their smelting plant, located, like the two Montana smelters, at Meaghervile, a suburb of Butte. The smelting plant is being rebuilt, and then the company will be in position this fall to be producing from 1,500,000 to 2,000,000 pounds of copper per month.

Mr. W. A. Clark, a prominent banker and mining operator of Butte, controls a plant which is largely used for handling custom ores.

Fine copper contained in ores, and regulus and black copper imported and entered for consumption in the United States, 1867 to 1891, inclusive.

Years ending—	Fine copper contained in ores.		Regulus and black copper. (*a*)		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
June 30, 1867	....	$936,271	....	....	$936,271
1868	3,496,994	197,203	....	....	197,203
1869	24,960,604	448,487	....	....	448,487
1870	1,936,875	134,736	....	....	134,736
1871	411,315	42,453	499	$60	42,513
1872	584,878	69,017	4,247	1,083	70,100
1873	702,086	80,132	1,444,239	279,631	359,763
1874	606,266	70,633	28,880	5,397	76,030
1875	1,337,104	161,903	12,518	2,076	163,979
1876	538,972	68,922	8,584	1,613	70,535
1877	76,637	9,756	1,874	260	10,016
1878	87,039	11,785	....	....	11,785
1879	51,959	6,199	....	....	6,199
1880	1,165,283	173,712	2,201,394	337,163	510,875
1881	1,077,217	124,477	402,640	51,633	176,110
1882	1,473,109	147,416	224,052	30,013	177,429
1883	1,115,386	113,349	....	....	113,349
1884	2,204,070	219,957	2,036	204	220,161
1885	3,665,739	343,793	285,322	20,807	364,600
Dec. 31, 1886	4,5[illegible]0,400	341,558	1,960	98	341,656
1887	3,886,192	194,785	27,650	1,366	196,151
1888	4,850,812	381,477	4,971	324	381,801
1889	3,772,838	274,649	60,525	4,244	278,893
1890	3,448,237	241,732	221,838	15,688	257,420
1891	8,931,554	774,057	2,403,919	214,877	988,934

a Not enumerated until 1871.

Copper imported and entered for consumption in the United States, 1867 to 1891, inclusive.

Years ending—	Bars, ingots, and pigs.		Old, fit only for remanufacture.		Old, taken from bottoms of American ships abroad. (a)		Plates not rolled.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
June 30, 1867	1,635,953	$287,831	569,732	$81,930	....	....	....	....
1868	61,394	6,935	318,705	42,652	....	....	....	....
1869	13,212	2,143	290,780	34,820	....	....	....	....
1870	5,157	418	255,386	31,931	....	....	....	....
1871	3,316	491	369,634	45,672	....	....	430	$129
1872	2,638,589	578,965	1,144,142	178,536	....	....	148,192	33,770
1873	9,697,608	1,984,122	1,413,040	255,711	32,307	$4,913	550,431	97,888
1874	713,935	134,326	733,326	137,087	9,500	930	....	....
1875	58,475	10,741	396,320	55,564	11,636	1,124	8	4
1876	5,281	788	239,987	35,545	10,304	1,981	5,467	600
1877	230	30	219,443	28,608	41,482	5,136	....	....
1878	1	1	198,749	25,585	....	6,004	....	....
1879	2,515	352	112,642	11,997	11,000	1,107	27,074	4,496
1880	1,242,103	206,121	695,255	91,234	....	....	120	11
1881	219,802	36,168	541,074	63,383	14,680	1,504	20	3
1882	6,200	836	508,901	59,629	16,075	1,629	....	....
1883	....	....	330,495	36,166	9,415	666	....	....
1884	(b)542	107	149,701	12,099	....	554	....	....
1885	914	172	81,312	6,658	....	1,160	....	....
Dec. 31, 1886	276	37	37,149	2,407	....	584	....	....
1887	212	22	39,957	2,374	....	129	....	....
1888	1,787	299	37,620	2,535	....	....	....	....
1889	3,160	522	19,912	1,176	....	....	....	....
1890	5,189	859	284,789	26,473	....	....	....	....
1891	3,154,557	276,263	134,407	9,685	....	....	....	....

a Not enumerated until 1873. *b* Includes "plates not rolled" since 1884.

THE PRINCIPAL FOREIGN PRODUCERS.

The copper production of the world, 1884 to 1891, inclusive.

Countries.	1891.	1890.	1889.	1888.	1887.	1886.	1885.	1884.
EUROPE.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Great Britain	(*a*)900	935	905	(*a*)1,500	389	1,471	2,773	3,350
Spain and Portugal:								
Rio Tinto	32,000	30,000	29,500	(*a*)32,000	26,663	(*a*)24,700	23,484	21,564
Tharsis	(*a*)10,500	(*a*)10,300	(*a*)11,000	(*a*)11,500	(*a*)11,000	(*a*)11,000	(*a*)11,500	(*a*)10,800
Mason and Barry	(*a*)4,150	(*a*)5,600	(*a*)5,250	(*a*)7,000	(*a*)7,000	(*a*)7,000	(*a*)7,000	(*a*)7,500
Sevilla	875	870	1,850	1,700	2,300	2,135	1,800	2,000
Portugueza	(*a*)890	(*a*)1,200	1,200	(*a*)900	(*a*)856	1,258	1,665	(*a*)2,300
Poderosa and others	(*a*)5,500	(*a*)4,225	(*a*)6,500	(*a*)7,200	4,050	3,560	2,424	2,251
Germany:								
Mansfeld	14,250	15,800	15,506	13,380	13,025	12,595	12,450	12,582
Other German	(*a*)2,000	(*a*)2,000	(*a*)1,850	(*a*)1,850	(*a*)1,850	1,870	(*a*)2,800	(*a*)2,200
Austria	965	1,210	1,225	1,010	883	733	585	670
Hungary	285	(*a*)300	(*a*)300	858	531	366	504	614
Sweden	(*a*)830	830	830	(*a*)900	905	529	775	662
Norway	(*a*)1,065	(*a*)1,375	1,357	1,570	1,450	2,220	2,560	2,706
Italy	(*a*)2,200	2,200	3,500	(*a*)2,500	(*a*)2,500	900	835	1,325
Russia	4,800	4,800	4,070	4,700	5,000	4,875	(*a*)5,100	4,700
Total Europe	81,210	81,645	84,843	88,568	78,402	75,203	76,255	75,224
NORTH AMERICA.								
United States	126,839	115,966	101,239	101,054	81,017	70,430	74,052	64,708
Canada	3,500	3,050	2,500	(*a*)2,250	1,400	1,440	2,500	236
Newfoundland	2,400	1,735	2,615	2,050	1,180	1,125	778	668

a Estimated.

The copper production of the world, 1884 to 1891, inclusive.—Continued.

Countries.	1891.	1890.	1889.	1888.	1887.	1886.	1885.	1884.
NORTH AMERICA—continued.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Mexico:								
Boleo	4, 100	3, 450	3, 780	2, 766	2, 050	850	375	291
Other Mexican	1, 025	875						
Total North America	137, 864	125, 076	110, 134	108, 120	85, 647	73, 845	77, 705	65, 903
SOUTH AMERICA.								
Chile	19, 875	26, 120	24, 250	31, 240	29, 150	35, 025	38, 500	41, 648
Bolivia:								
Corocoro	2, 150	1, 900	(*a*)1, 200	1, 450	(*a*)1, 300	1, 100	(*a*)1, 500	(*a*)1, 500
Peru	280	150	275	250	50	75	229	362
Venezuela:								
New Quebrada	6, 500	5, 640	6, 068	4, 000	2, 900	3, 708	4, 111	4, 600
Argentine Republic	210	150	190	150	170	180	233	159
Total South America	29, 015	33, 960	31, 983	37, 090	33, 570	40, 088	44, 573	48, 269
AFRICA.								
Algiers	120	120	160	50	150	110	250	260
Cape of Good Hope:								
Cape Colony	5, 000	5, 000	(*a*)7, 700	7, 500	7, 250	6, 015	5, 450	5, 000
Namaqua	900	1, 450						
Total Africa	6, 020	6, 570	7, 860	7, 550	7, 400	6, 125	5, 700	5, 260
ASIA.								
Japan	17, 000	15, 000	15, 000	(*a*)11, 000	(*a*)11, 000	10, 000	(*a*)10, 000	(*a*)10, 000
Total Asia	17, 000	15, 000	15, 000	11, 000	11, 000	10, 000	10, 000	10,000
AUSTRALIA.								
Australia	7, 500	7, 500	8, 300	7, 550	7, 700	9, 700	11, 400	14, 100

a Estimated.

With the exception of the figures for the United States the data in the above table were taken from the annual statistics of Messrs. Henry R. Merton & Co., of London. In 1891 the United States produced 45.6 per cent., or nearly one-half, of the whole output of the world, against 22.4 per cent., or less than a quarter, in the year 1882, when American production statistics were first carefully collected.

RECAPITULATION.

Countries.	1891.	1890.	1889.	1888.	1887.	1886.	1885.	1884.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Europe	81. 210	81, 645	84, 843	88, 568	78, 402	75, 203	76, 255	75, 224
North America	137, 864	125, 076	110, 134	108, 120	85, 647	73, 845	77, 705	65, 903
South America	29, 015	33, 960	31, 983	37, 090	33, 570	40, 088	44, 573	48, 269
Africa	6, 020	6, 570	7, 860	7, 550	7, 400	6, 125	5, 700	5, 260
Asia	17, 000	15, 000	15, 000	11, 000	11, 000	10, 000	10, 000	10, 000
Australia	7, 500	7, 500	8, 300	7, 550	7, 700	9, 700	11, 400	14, 100
Total	278, 609	268, 751	258, 120	259, 878	223, 719	214, 961	225, 633	218, 756

Since 1888, therefore, the production of copper has not materially increased. It is doubtful, in fact, whether the output has kept pace with the large development in the consumption, due chiefly to the requirements for electrical purposes.

Messrs. James Lewis & Son, of Liverpool, estimate as follows the imports of other than Chile copper into Liverpool, London, and Swansea during the years 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, and 1891, which represent the total imports, with the exception of precipitate, into Newcastle and Cardiff, reliable returns of which can not be obtained, but which is estimated to vary from 8,000 to 10,000 tons fine per annum:

Imports of copper product into Liverpool, Swansea, and London.

Countries.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Chile	27, 504	31, 298	28, 985	27, 191	20, 008	24, 479	22, 070	22, 909	14, 378
United States	9, 410	17, 309	24, 037	13, 483	16, 534	25, 730	30, 729	20, 171	26, 120
Spain and Portugal	2, 788	2, 359	4, 655	5, 721	5, 178	5, 915	5, 189	5, 202	4, 734
Spain (precipitate)	11, 249	10, 009	9, 186	10, 038	13, 042	15, 568	17, 192	18, 430	17, 439
Spain (pyrites)	15, 017	14, 077	16, 333	13, 905	14, 940	15, 448	16, 097	16, 422	15, 406
Australia	9, 694	9, 685	8, 951	10, 096	6, 047	6, 746	6, 285	6, 561	6, 265
Cape of Good Hope	5, 670	6, 042	5, 405	7, 073	8, 271	8, 829	11, 507	9, 927	7, 452
New Quebrada	3, 960	3, 675	4, 074	3, 055	2, 261	3, 574	4, 299	5, 245	5, 017
Japan	....	1, 064	3, 010	3, 572	200	4, 469	2, 523	10, 674	7, 852
Italy	1, 091	1, 310	835	889	1, 055	1, 058	1, 043	953	649
Norway	296	289	27	....	....	545	234	80	30
Canada	448	266	....	8	94	156	181	264	189
Newfoundland	1, 185	224	723	891	359	465	631	1, 552	1, 617
Mexico	489	291	374	243	61	158	3, 938	3, 325	3, 616
Peru	426	408	229	68	13	202	271	254	279
River Platte	319	131	233	179	167	135	184	143	211
Other countries	946	284	325	1, 049	1, 074	4, 054	1, 389	225	236
Total tons fine	90, 492	98, 721	107, 382	97, 461	89, 304	117, 531	123, 762	122, 337	111, 490

The exports of coppers from Great Britain, estimating the fine contents of alloys, were as follows:

Exports of copper from Great Britain from 1883 to 1891, inclusive.

Character.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Raw English	16, 777	17, 943	18, 766	19, 036	40, 700	32, 058	48, 189	58, 571	51, 765
Sheets	16, 071	20, 669	21, 108	17, 927					
Yellow metal, at 60 per cent.	11, 918	11, 602	12, 551	11, 958	10, 153	4, 513	9, 195	10, 514	8, 547
Brass, at 70 per cent.	3, 381	3, 735	3, 233	3, 001	3, 146	2, 650	3, 773	3, 721	3, 992
Total	48, 147	53, 949	55, 658	51, 922	53, 999	39, 221	61, 157	72, 806	64, 304
Fine foreign	11, 203	10, 742	6, 422	8, 589	15, 454	a32,845	14, 470	16, 941	11, 752
Total	59, 350	64, 691	62, 080	60, 511	69, 453	72, 066	75, 627	89, 747	76, 056

a Including 22,557 tons Chile bars transferred to France.

LEAD.

By C. Kirchhoff.

In the history of the lead industry of the United States the year 1891 will be singled out as the one in which the production of the metal rose above the 200,000-ton mark, having more than doubled since 1880. Deducting the lead outputs of Mexican ores imported, the output of metal from American ores rose from about 145,000 short tons in 1887 to 152,000 tons in 1888 and to 156,000 tons in 1889. It declined to 143,630 tons in 1890, but rose again to 181,254 tons in 1891. The gross production of lead in the United States since 1887 and the metal contents of Mexican ores smelted in this country has been as follows:

Production of lead from 1887 to 1891.

Years.	Gross production.	Lead contents of Mexican ores.	Net American product.
	Short tons.	*Short tons.*	*Short tons.*
1887	160,700	(*a*) 15,000	145,700
1888	180,555	28,636	151,919
1889	182,967	26,570	156,397
1890	161,754	18,124	143,630
1891	202,406	21,152	181,254

a Estimated.

The following table presents the figures of production of lead in the United States from 1825. Up to the year 1882 the figures have been compiled from the best data available. Since 1882 the statistics are those collected by this office, with the exception of the year 1889, when they were gathered by the Census Office.

Production of lead in the United States from 1825 to 1891, both inclusive.

Years.	Total production.	Desilverized lead.	Non-argentiferous lead.	Percentage of desilverized lead.
	Short tons.	*Short tons.*	*Short tons.*	
1825	1,500			
1830	8,000			
1831	7,500			
1832	10,000			
1833	11,000			
1834	12,000			
1835	13,000			
1836	15,000			
1837	13,500			
1838	15,000			
1839	17,500			
1840	17,000			
1841	20,500			
1842	24,000			
1843	25,000			

Production of lead in the United States from 1825 to 1891, etc.—Continued.

Years.	Total production.	Desilverized lead.	Non-argentiferous lead.	Percentage of desilverized lead.
	Short tons.	*Short tons.*	*Short tons.*	
1844	26,000			
1845	30,000			
1846	28,000			
1847	28,000			
1848	25,000			
1849	23,500			
1850	22,000			
1851	18,500			
1852	15,700			
1853	16,800			
1854	16,500			
1855	15,800			
1856	16,000			
1857	15,800			
1858	15,300			
1859	16,400			
1860	15,600			
1861	14,100			
1862	14,200			
1863	14,800			
1864	15,300			
1865	14,700			
1866	16,100			
1867	15,200			
1868	16,400			
1869	17,500			
1870	17,830			
1871	20,000			
1872	25,880			
1873	42,540	20,159	22,381	47.39
1874	52,080			
1875	59,640	34,909	24,731	58.53
1876	64,070	37,649	26,421	58.76
1877	81,900	50,748	31,152	61.96
1878	91,060	64,290	26,770	70.60
1879	92,780	64,650	28,130	69.68
1880	97,825	70,135	27,690	71.69
1881	117,085	86,315	30,770	73.72
1882	132,890	103,875	29,015	78.17
1883	143,957	122,157	21,800	84.86
1884	139,897	119,965	19,932	85.75
1885	129,412	107,437	21,975	83.02
1886	135,629	114,829	20,800	84.66
1887	160,700	135,552	25,148	84.35
1888	180,555	151,465	29,090	83.89
1889	182,967	153,709	29,258	84.01
1890	161,754	130,903	31,351	80.62
1891	202,406	171,009	31,397	84.48

Included in the above production for 1891 is 4,043 tons of antimonial lead, the refiners having for the first time reported the product of this grade.

The production of lead in 1891 was distributed as follows, between the first and the second half:

1891.	Total product.	Desilverized.	Non-argentiferous.
	Short tons.	*Short tons.*	*Short tons.*
First half	95,121	79,301	15,820
Second half	107,340	91,864	15,577

On the 1st of January, 1892, producers carried a stock of 7,693 short tons as compared with 10,389 short tons on the 1st of January, 1891, and 7,715 short tons on the 1st of January, 1890.

Colorado continues to lead as the greatest lead-smelting State. Returns from every works, which in some instances differ slightly from the published figures, show a total product of base bullion of 95,871 short tons, equal to about 92,000 tons of refined lead. All the companies reported the lead contents of Mexican ores smelted during the year 1891, the total reaching 4,259 short tons, thus showing that this supply constitutes a relatively unimportant addition to the ores of the State. How largely they do draw upon the mines of other sections of the Rocky mountains is indicated by the fact that the two Denver smelters purchased only 10,157 tons of lead in Colorado ores, against 20,468 tons in Idaho and 8,179 tons in Utah ores. The smelters at Leadville and at Pueblo, of course, depend more upon the product of Colorado ores, although they, too, draw largely from Utah. The three works in Utah, which produce 16,800 tons of base bullion, did not work any foreign ore at all. Indeed, one of the principal border smelters did not derive as much as 10 per cent. of base bullion from Mexican ores. The Missouri river works, which work by far the larger part of the Mexican material, did not report. Only insignificant quantities of Canadian ores were worked in the plants most easily accessible to the newly developed lead regions beyond the northwestern border.

Reports from all the important smelting works in the Rocky mountain region and from the majority of the smaller plants indicate that the production of base bullion in 1891 was about 135,000 short tons, the balance of the domestic and foreign ores being worked by refiners on the Missouri river, in the Saint Louis and Chicago districts, and on the Atlantic seaboard.

On the whole, there has been but little change in the sources of the ore supply during the year 1891, and as yet none of the northwestern districts has become an important factor in the situation. Enough is known, however, to indicate that these districts, as soon as they are sufficiently opened up by transportation facilities, which are now being provided, will become very important contributors. Individually they may not rival the Cœur d'Alene, which is now the heaviest producer of lead ore, but collectively they are expected to more than make up for any falling off in the older sections, in which low prices for silver and for lead may cause some suspension of operations and are likely to discourage new developments.

In the Missouri, Kansas, and Wisconsin mining regions production is remaining nearly stationary and no operations looking to a heavy increase are under way. It is believed that the majority of the larger enterprises are in a position to resist protracted periods of depression.

THE LEAD MARKET.

Soon after the opening of the year a reaction occurred after the long period of depression, and prices rose quite rapidly from 4.10 to 4.60 cents, followed, however, by a relapse to 4.30 cents early in February. At this price the market dragged through the balance of the month and the greater part of March, hardening slightly towards its close. A temporary activity with increased sales caused a moderate advance, which, however, was soon lost, the metal declining during April to 4.15 cents. May opened with slightly higher prices, and later on developed a buying movement on the part of consumers, which carried the price up to 4.35 and 4.40 cents at the close, some speculative interest also making its appearance. In June further sales of some magnitude were made at 4.45 cents. After a temporary halt the market carried up to 4.50 cents early in July, but the month brought little business and the market sagged off to 4.35 cents. A firmer tone in early August, coupled with some sales, caused lead to rise to 4.55 cents, but later transactions for future delivery were at a lower price. Buyers in September were taking cautiously, although in good quantities, at 4.50 and 4.52½ cents, and for small quantities these prices prevailed early in October, until the absence of business led to fewer offerings and a drooping market, so that the month closed weak at 4.20 cents. This tendency was emphasized in November, the decline continuing until 4.10 cents was reached. Then an effort was made to stimulate the market, which rose on moderate sales to 4.30 cents. During the whole of December it was practically at a deadlock, buyers being indifferent, while offerings were very reserved.

The following table, prepared from the annual reports of the daily price of lead, compiled by Mr. E. A. Caswell, of New York, shows the monthly average prices from 1884 to June, 1891, inclusive:

Average monthly prices of common pig lead in New York City.

[Cents per pound.]

Months.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
January	4.09	3.65	4.57	4.27	4.80	3.82½	3.82½	4.34½
February	3.98	3.65	4.75	4.43	4.92	3.68	3.79½	4.28½
March	4.12	3.67	4.87	4.35	5.14	3.69	3.91½	4.32½
April	3.84	3.63	4.77	4.29	4.72½	3.64½	3.87½	4.20½
May	3.64	3.67	4.72	4.49	4.24	3.79½	4.13	4.25½
June	3.62	3.73	4.77	4.62	3.88	3.97½	4.37	4.41
July	3.58	4.06	4.88	4.50	3.96	3.88	4.43	4.39
August	3.58	4.25	4.75	4.55	4.43	3.82½	4.51	4.44
September	3.61	4.26	4.63	4.44	4.99	3.92½	4.86	4.50
October	3.69	4.10	4.23	4.30	4.45	3.82½	5.21½	4.34
November	3.46	4.12	4.32	4.35	3.67½	3.79	4.90	4.17
December	3.60	4.57	4.32	5.00	3.73	3.82	4.19	4.00
Yearly average	3.73½	3.94½	4.63	4.46½	4.41	3.80½	4.33½	4.32½

The following table gives the highest and lowest prices monthly for a series of years:

Highest and lowest prices of lead at New York City, monthly, from 1870 to 1891, inclusive.

[Cents per pound.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1870.....	(a)6.30	6.20	6.25	6.17	6.20	6.10	6.25	6.15	6.25	6.20	6.25	6.20
1871.....	(a)6.30	6.15	6.25	6.20	6.20	6.15	6.20	6.10	6.18	6.10	6.15	6.12
1872.....	(a)6.00	5.90	6.00	5.87	6.00	5.87	6.12	5.90	6.62	6.25	6.62	6.40
1873.....	(a)6.37	6.25	6.50	6.40	6.50	6.25	6.50	6.25	6.62	6.35	6.55	6.12
1874.....	(a)6.00	5.90	6.25	6.00	6.25	6.12	6.25	5.90	6.00	5.75	6.00	5.62
1875.....	(a)6.20	6.00	5.90	5.85	5.75	5.62	5.87	5.80	5.95	5.90	5.90	5.75
1876.....	(a)6.00	5.87	6.37	6.00	6.50	6.40	6.40	6.12	6.50	6.10	6.50	6.25
1877.....	(b)6.15	6.12	6.40	6.20	6.75	6.50	6.50	6.25	6.00	5.55	5.70	5.60
1878.....	4.35	4.00	3.87	3.65	3.87	3.62	3.75	3.50	3.50	3.25	3.50	3.12
1879.....	4.50	4.00	4.50	4.50	4.50	3.25	3.25	2.87	3.12	2.87	3.80	3.12
1880.....	6.10	5.50	6.00	5.87	5.95	5.30	5.75	5.40	5.25	4.40	4.75	4.50
1881.....	5.00	4.30	5.10	4.80	4.85	4.62	4.85	4.37	4.70	4.25	4.50	4.25
1882.....	5.15	4.95	5.20	5.00	5.12	4.85	5.00	4.90	4.85	4.60	4.90	4.55
1883.....	4.70	4.60	4.60	4.50	4.65	4.50	4.62	4.40	4.55	4.40	4.45	4.40
1884.....	4.50	3.75	4.10	3.75	4.15	4.10	4.05	3.62½	3.75	3.52½	3.65	3.57½
1885.....	3.70	3.55	3.70	3.60	3.70	3.62½	3.70	3.62½	3.75	3.60	3.85	3.62½
1886.....	4.70	4.50	4.90	4.60	4.95	4.85	4.90	4.65	4.75	4.65	4.90	4.65
1887.....	4.45	4.15	4.50	4.25	4.45	4.25	4.32½	4.20	4.70	4.30	4.70	4.50
1888.....	4.90	4.50	5.15	4.60	5.25	5.00	5.05	4.55	4.62½	4.00	4.10	3.65
1889.....	3.90	3.75	3.75	3.60	3.75	3.65	3.67½	3.60	3.87½	3.60	4.05	3.90
1890.....	3.85	3.80	3.85	3.75	3.95	3.85	4.07½	3.85	4.35	4.00	4.50	4.25
1891.....	4.50	4.05	4.50	4.25	4.37½	4.25	4.32½	4.10	4.37½	4.20	4.50	4.35

a Gold. *b* Currency.

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1870.....	6.30	6.20	6.37	6.32	6.37	6.30	6.37	6.25	6.35	6.25	6.35	6.25
1871.....	6.15	6.10	6.12	6.00	6.10	6.00	6.00	5.87	6.00	5.90	6.00	5.75
1872.....	6.62	6.40	6.50	6.40	6.50	6.30	6.62	6.40	6.60	6.50	6.60	6.42
1873.....	6.12	6.00	6.25	6.00	6.62	6.37	6.75	6.25	6.50	6.00	6.12	6.00
1874.....	5.80	5.62	5.80	5.65	6.10	5.65	6.35	6.10	6.50	6.25	6.40	6.12
1875.....	6.00	5.95	5.95	5.87	5.87	5.70	5.65	5.60	5.87	5.65	5.95	5.87
1876.....	6.35	6.20	6.37	6.25	6.25	6.00	6.00	5.80	5.80	5.70	5.70	5.65
1877.....	5.60	5.37	5.12	4.90	4.85	4.75	4.85	4.25	4.75	4.50	4.60	4.50
1878.....	3.62	3.25	3.50	3.20	3.45	3.25	3.60	3.37	3.95	3.60	4.00	3.90
1879.....	4.10	3.90	4.05	4.00	4.00	3.75	5.50	4.00	5.62	5.00	5.60	5.50
1880.....	4.75	4.25	5.00	4.30	4.90	4.80	4.87	4.65	4.85	4.75	4.75	4.25
1881.....	4.90	4.50	4.95	4.75	5.37	4.95	5.25	4.87	5.25	4.90	5.25	5.00
1882.....	5.15	4.90	5.10	4.95	5.15	4.95	5.15	4.85	4.90	4.50	4.75	4.50
1883.....	4.40	4.30	4.30	4.20	4.32	4.30	4.32	4.12	4.05	3.65	3.75	3.60
1884.....	3.70	3.55	3.70	3.52½	3.75	3.55	3.75	3.60	3.55	3.37½	3.75	3.50
1885.....	4.15	3.87½	4.25	4.12	4.25	4.00	4.25	4.00	4.60	4.00	4.67½	4.50
1886.....	4.90	4.75	4.80	4.75	4.70	4.45	4.30	4.00	4.40	4.10	4.35	4.25
1887.....	4.67½	4.40	4.62½	4.55	4.55	4.25	4.40	4.20	4.75	4.25	5.15	4.90
1888.....	4.07½	3.85	4.97½	4.15	5.12½	4.90	5.12½	3.62½	3.82½	3.60	3.82½	3.60
1889.....	4.05	3.80	3.95	3.75	4.00	3.85	3.90	3.75	3.90	3.75	3.90	3.75
1890.....	4.50	4.40	4.72½	4.35	5.00	4.67½	5.25	5.00	5.25	4.60	4.60	4.05
1891.....	4.45	4.30	4.55	4.40	4.55	4.40	4.55	4.10	4.35	4.10	4.25	4.25

The following table, compiled by Mr. E. A. Caswell, shows the daily fluctuation in prices in 1891:

Price of common pig lead in New York City in 1891.

Days.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	H.	S.	S.	4.32½	4.20	4.42½	4.45	4.40	4.50	4.55	S.	4.25
2	4.05	4.35	4.25	4.32½	4.20	4.42½	4.45	S.	4.50	4.55	4.10	4.25
3	4.05	4.35	4.25	4.32½	S.	4.42½	4.45	4.40	4.50	4.55	H.	4.25
4	S.	4.35	4.25	4.30	4.20	4.50	H.	4.40	4.50	S.	4.10	4.25
5	4.05	4.30	4.35	S.	4.20	4.50	S.	4.52½	4.45	4.50	4.10	4.25
6	4.40	4.30	4.35	4.30	4.20	4.50	4.45	4.55	S.	4.50	4.10	S.
7	4.40	4.30	4.35	4.32½	4.20	S.	4.40	4.55	H.	4.50	4.10	4.25
8	4.40	S.	S.	4.30	4.20	4.45	4.35	4.50	4.45	4.50	S.	4.25
9	4.40	4.30	4.32½	4.25	4.20	4.40	4.40	S.	4.45	4.45	4.05	4.25
10	4.40	4.30	4.32½	4.25	S.	4.40	4.40	4.50	4.45	4.45	4.05	4.25
11	S.	4.25	4.32½	4.25	4.20	4.40	4.40	4.45	4.45	S.	4.05	4.25
12	4.40	4.25	4.32½	S.	4.20	4.35	S.	4.45	4.40	4.45	4.05	4.25
13	4.50	4.25	4.32½	4.25	4.20	4.35	4.40	4.45	S.	4.40	4.05	S.
14	4.50	4.25	4.32½	4.15	4.20	S.	4.40	4.45	4.50	4.35	4.05	4.25
15	4.50	S.	S.	4.15	4.20	4.35	4.40	4.40	4.50	4.35	S.	4.25
16	4.50	4.25	4.32½	4.15	4.20	4.35	4.40	S.	4.50	4.30	4.05	4.25
17	4.50	4.25	4.30	4.15	S.	4.35	4.40	4.40	4.50	4.35	4.30	4.25
18	S.	4.25	4.30	4.15	4.20	4.35	4.35	4.45	4.52½	S.	4.30	4.25
19	4.50	4.25	4.30	S.	4.30	4.35	S.	4.45	4.52½	4.35	4.35	4.25
20	4.40	4.25	4.30	4.10	4.25	4.35	4.35	4.45	S.	4.30	4.30	S.
21	4.35	4.25	4.37½	4.10	4.25	S.	4.35	4.40	4.50	4.25	4.30	4.25
22	4.30	S.	S.	4.12½	4.35	4.35	4.30	4.40	4.52½	4.25	S.	4.25
23	4.30	H.	4.35	4.12½	4.37½	4.35	4.30	S.	4.52½	4.25	4.30	4.25
24	4.25	4.25	4.35	4.12½	S.	4.40	4.30	4.40	4.52½	4.20	4.30	4.25
25	S.	4.30	4.35	4.12½	4.37½	4.45	4.37½	4.40	4.52½	S.	4.25	H.
26	4.25	4.25	4.35	S.	4.37½	4.50	S.	4.40	4.55	4.20	H.	4.25
27	4.25	4.25	4.35	4.12½	4.35	4.45	4.40	4.40	S.	4.20	4.25	S.
28	4.27½	4.25	4.35	4.20	4.35	S.	4.40	4.40	4.55	4.15	4.25	4.25
29	4.27½	......	S.	4.20	4.35	4.45	4.40	4.40	4.55	4.15	S.	4.25
30	4.37½	......	4.35	4.20	H.	4.45	4.40	S.	4.55	4.15	4.25	4.25
31	4.35	......	4.32½	......	S.	......	4.40	4.40	......	4.10	......	4.25
Average.	4.34	4.28	4.32	4.21	4.25	4.41	4.39	4.44	4.50	4.34	4.17	4.25

Lead imported and entered for consumption in the United States, 1867 to 1891, inclusive.

[Calender years ending December 31 from 1886 to 1890; previous years end June 30.]

Years.	Ore and dross.		Pigs and bars.		Sheets, pipe, and shot.		Shot.		Not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*			
1867	611	$25	65,322,923	$2,812,668	185,825	$9,560	....	....	$6,222	$2,828,475
1868	6,945	239	63,254,677	2,668,915	142,137	7,229	....	....	6,604	2,682,987
1869	....	....	87,865,471	3,653,481	307,424	15,531	....	....	18,885	3,687,897
1870	5,973	176	85,895,724	3,530,837	141,681	6,879	....	....	10,444	3,548,336
1871	316	10	91,496,715	3,721,096	86,712	4,209	....	....	8,730	3,734,045
1872	32,331	1,425	73,086,657	2,929,623	15,518	859	....	....	20,191	2,852,098
1873	....	....	72,423,641	3,233,011	105	12	420	$50	21,503	3,254,576
1874	....	....	46,205,154	2,231,817	....	....	30,219	1,349	36,484	2,269,650
1875	13,206	320	32,770,712	1,559,017	....	....	58	4	25,774	1,585,115
1876	....	....	14,329,366	682,132	....	....	20,007	1,204	27,106	710,442
1877	1,000	20	14,583.845	671,482	....	....	16,502	1,242	1,041	673,785
1878	....	....	6,717,052	294,233	....	....	15,829	963	113	295,309
1879	....	....	1,216,500	42,983	....	....	3,748	209	930	44,122
1880	....	....	6,723,706	246,015	....	....	1,120	54	371	246,440
1881	5,981	97	4,322,068	159,129	....	....	900	65	1,443	160,734
1882	21,698	500	6,079,304	202,603	....	....	1,469	99	2,449	205,651
1883	600	17	4,037,867	130,108	....	....	1,510	79	8,030	138,234
1884	419	13	3,072,738	85,395	15,040	630	....	....	1,992	88,030
1885	4,218	57	5,862,474	143,103	971,951	22,217	....	....	1,372	166,749
1886	715,588	9,699	17,582,298	491,310	27,357	1,218	....	....	964	503,191
1887	153,731	21,487	7,716,783	219,770	27,941	1,286	....	....	302	242,845
1888	88,870	2,468	2,582,236	69,891	23,103	1,202	....	....	977	74,538
1889	328,315	7,468	2,773,622	76,243	35,859	1,417	....	....	1,297	86,425
1890	493,463	12,947	19,336.233	593,671	68,314	3,338	....	....	1,133	611,089
1891	105,898	6,721	3,392,562	104,184	334,179	12,406	....	....	604	123,915

Old and scrap lead imported and entered for consumption in the United States, 1867 to 1890, inclusive.

Years ending—	Quantity.	Value.	Years ending—	Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1867	1, 255, 233	$53, 202	June 30, 1879	42, 283	$1, 153
1868	2, 465, 575	101, 586	1880	213, 063	5, 262
1869	2, 983, 272	123, 068	1881	123, 018	2, 729
1870	3, 756, 785	150, 379	1882	220, 702	5, 949
1871	2, 289, 688	94, 467	1883	1, 094, 133	31, 724
1872	4, 257, 778	171, 324	1884	160, 356	4, 830
1873	3, 545, 098	151, 756	1885	4, 866	106
1874	395, 516	13, 897	Dec. 31, 1886	24, 726	882
1875	382, 150	13, 964	1887	136, 625	4, 323
1876	265, 860	9, 534	1888	33, 100	904
1877	249, 645	8, 383	1889	50, 816	1, 494
1878	106, 342	3, 756	1890	(a)	(a)

a Included in pigs and bars after 1889.

Lead and manufactures of lead, of domestic production, exported from the United States.

Years ending—	Manufactures of— Lead.		Manufactures of— Pewter and lead.	Bars, shot, etc.		Total value.
	Quantity.	Value.	Value.	Quantity.	Value.	
	Pounds.			*Pounds.*		
Sept. 30, 1790	13, 440	$810				$810
1803 (barrels)	900					
1804	19, 804					
1805	8, 000					
1808	40, 583					
1809	126, 537					
1810	172, 323					
1811	65, 497					
1812	74, 875					
1813	276, 940					
1814	43, 600					
1815	40, 245					
1816	35, 844					
1817	111, 034	9, 993				9, 993
1818	281, 168	22, 493				22, 493
1819	94, 362	7, 549				7, 549
1820	25, 699	1, 799				1, 799
1821	56, 192	3, 512				3, 512
1822	66, 316	4, 244				4, 244
1823	51, 549	3, 098				3, 098
1824	18, 604	1, 356				1, 356
1825	189, 930	12, 697				12, 697
1826	47, 337	3, 347	$1, 820			5, 167
1827	50, 160	3, 761	6, 183			9, 944
1828	76, 882	4, 184	5, 545			9, 729
1829	179, 952	8, 417	5, 185			13, 602
1830	128, 417	4, 831	4, 172			9, 003
1831	152, 578	7, 068	6, 422			13, 490
1832	72, 439	4, 483	983			5, 466
1833	119, 407	5, 685	2, 010			7, 695
1834	13, 480	805	2, 224			3, 029
1835	50, 418	2, 741	433			3, 174
1836	34, 600	2, 218	4, 777			6, 995
1837	297, 488	17, 015	3, 132			20, 147
1838	375, 231	21, 747	6, 461			28, 208
1839	81, 377	6, 003	12, 637			18, 640
1840	882, 620	39, 687	15, 296			54, 983
1841	2, 177, 164	96, 748	20, 546			117, 294
1842	14, 552, 357	523, 428	16, 789			540, 217
June 30, 1843 (9 months)	15, 366, 918	492, 765	7, 121			499, 886
1844	18, 420, 407	595, 238	10, 018			605, 256
1845	10, 188, 024	342, 646	14, 404			357, 050
1846	16, 823, 766	614, 518	10, 278			624, 796
1847	3, 326, 028	124, 981	13, 694			138, 675
1848	1, 994, 704	84, 278	7, 739			92, 017
1849	680, 249	30, 198	13, 196			43, 394
1850	261, 123	12, 797	22, 682			35, 479
1851			16, 426	229, 448	$11, 774	28, 200
1852			18, 469	747, 930	32, 725	51, 194

Lead and manufactures of lead of domestic production, etc.—Continued.

Years ending—	Manufactures of—			Bars, shot, etc.		Total value.
	Lead.		Pewter and lead.			
	Quantity	Value.	Value.	Quantity.	Value.	
	Pounds.			*Pounds.*		
June 30, 1853			$14,064	100,778	$5,540	$19,604
1854			16,478	404,247	26,874	43,352
1855			5,233	165,533	14,298	19,531
1856			5,628	310,029	27,512	33,140
1857			4,818	870,544	58,624	63,442
1858			27,327	900,607	48,119	75,446
1859			28,782	313,988	28,575	57,357
1860			56,081	903,468	50,446	106,527
1861			30,534	109,023	6,241	36,775
1862			28,832	79,231	7,334	36,166
1863			30,609	237,239	22,634	53,243
1864			30,411	223,752	18,718	49,129
1865			29,271	852,895	132,666	161,937
1866			44,483	25,278	2,323	46,806
1867			27,559	99,158	5,300	32,859
1868			37,111	438,040	34,218	71,329
1869			17,249			17,249
1870		$28,315				28,315
1871		79,880				79,880
1872		48,132				48,132
1873		13,392				13,392
1874		302,044				302,044
1875		429,309				429,309
1876		102,726				102,726
1877		49,835				49,835
1878		314,904				314,904
1879		280,771				280,771
1880		49,899				49,899
1881		39,710				39,710
1882		178,779				178,779
1883		43,108				43,108
1884		135,156				135,156
1885		123,466				123,466
Dec. 31, 1886		136,666				136,666
1887		140,065				140,065
1888		194,216				194,216
1889		161,614				161,614
1890		181,030				181,030
1891		173,887				173,887

ZINC.

BY C. KIRCHHOFF.

The year 1891 has been chiefly remarkable for an unprecedented increase in the production of spelter. Reports from all the works in the United States show that the production has been as follows:

Production of spelter in the United States.

Years.	Short tons.	Years.	Short tons.
1873	7,343	1885	40,688
1875	15,833	1886	42,641
1880 (census year ending May 31)	23,239	1887	50,340
1882	33,765	1888	55,903
1883	36,872	1889	58,860
1884	38,544	1890	63,683
		1891	80,337

The increase in one year was, therefore, 16,654 short tons, or nearly 26 per cent., the production having nearly doubled since 1885.

Nearly every important producer in the country increased his output in 1891, all the leading districts contributing to the total.

Grouped by States, the product has been as follows:

Production of spelter in the United States, 1882 to 1891, inclusive, by States.

States.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Illinois	18,201	16,792	17,594	19,427	21,077	22,279	22,445	23,860	26,243	28,711
Kansas	7,366	9,010	7,859	8,502	8,932	11,955	10,432	13,658	15,199	22,747
Missouri	2,500	5,730	5,230	4,677	5,870	8,660	13,465	11,077	13,127	16,253
Eastern and Southern States	5,698	5,340	7,861	8,082	6,762	7,446	9,561	10,265	9,114	12,626
Total	33,765	36,872	38,544	40,688	42,641	50,340	55,903	58,860	63,683	80,337

During the year the Bertha Zinc Company increased its capacity to 300 tons per month; the Weir Company added two furnaces at Weir, Kansas; the Pittsburg and Saint Louis Company very considerably enlarged its plant; a new works was started at Wenona, Illinois, and a further new producer is being established in the Indiana natural-gas belt. These extensions have had their effect, the production for the first half of 1892 having risen to the following figures:

Production of spelter in the United States during the first six months of 1892.

	Short tons.
Illinois	15, 483
Kansas	14, 161
Missouri	8, 954
Eastern and Southern States	6, 901
Total	45, 499

Stock reports show the following totals:

Stocks of spelter.

States.	January 1—			
	1889.	1890.	1891.	1892.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Illinois	360	268	68	....
Kansas	800	1, 075	233	294
Missouri	....	43	45	61
East and South	1, 621	1, 149	788	2, 360
Total	2, 781	2, 535	1, 134	2, 715

PRICES OF ZINC.

The following table summarizes the prices of spelter since 1875:

Prices of common western spelter in New York City, 1875 to 1891, inclusive.

[Cents per pound. Figures in parentheses are combination prices.]

Years.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1875	6. 75	6. 37	6. 67	6. 25	6. 50	6. 20	(7. 00)	6. 50	(7. 25)	7. 15	(7. 25)	7. 15
1876	(7. 60)	7. 40	(7. 75)	7. 50	(7. 75)	7. 62	(8. 00)	7. 60	(8. 00)	7. 75	(8. 00)	7. 25
1877	6. 50	6. 25	6. 62	6. 50	6. 50	6. 37	6. 37	6. 25	6. 25	6. 00	6. 12	5. 87
1878	5. 75	5. 50	5. 62	5. 25	5. 62	5. 25	5. 25	5. 00	5. 00	4. 62	4. 62	4. 25
1879	4. 50	4. 25	4. 62	4. 40	4. 62	4. 37	4. 75	4. 25	4. 50	4. 25	4. 37	4. 12
1880	6. 50	5. 87	6. 75	6. 37	6. 75	6. 50	6. 50	6. 12	6. 00	5. 62	5. 50	5. 12
1881	5. 25	4. 87	5. 25	5. 12	5. 00	4. 87	5. 12	4. 75	5. 00	4. 87	5. 00	4. 75
1882	6. 00	5. 75	5. 75	5. 62	5. 62	5. 37	5. 50	5. 25	5. 62	5. 25	5. 37	5. 25
1883	4. 62	4. 50	4. 62	4. 50	4. 75	4. 62	4. 75	4. 60	4. 75	4. 50	4. 62	4. 37
1884	4. 37	4. 20	4. 40	4. 25	4. 60	4. 40	4. 65	4. 50	4. 60	4. 45	4. 60	4. 45
1885	4. 50	4. 12	4. 30	4. 25	4. 30	4. 12	4. 30	4. 12	4. 25	4. 10	4. 10	4. 00
1886	4. 50	4. 30	4. 55	4. 30	4. 60	4. 50	4. 60	4. 50	4. 60	4. 40	4. 40	4. 35
1887	4. 60	4. 50	4. 60	4. 40	4. 60	4. 40	4. 65	4. 45	4. 65	4. 45	4. 65	4. 50
1888	5. 37	5. 20	5. 35	5. 25	5. 25	4. 87	4. 87	4. 60	4. 65	4. 60	4. 60	4. 50
1889	5. 00	5. 00	5. 00	4. 90	4. 87	4. 70	4. 65	4. 65	4. 85	4. 62	5. 00	5. 00
1890	5. 45	5. 35	5. 35	5. 20	5. 20	5. 00	5. 00	4. 90	5. 45	5. 00	5. 60	5. 35
1891	6. 00	5. 25	5. 25	5. 00	5. 10	5. 00	5. 10	4. 90	4. 90	4. 85	5. 10	4. 90

Prices of common western spelter in New York City, etc.—Continued.

Years.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1875	(7.35)	7.25	(7.25)	7.10	(7.25)	7.10	(7.40)	7.15	(7.40)	7.15	(7.40)	7.15
1876	7.25	7.12	7.25	7.00	7.12	6.80	6.75	6.62	6.62	6.37	6.50	6.37
1877	5.87	5.62	5.90	5.80	5.87	5.75	5.90	5.70	5.87	5.62	5.75	5.50
1878	4.75	4.50	4.87	4.50	4.87	4.75	4.82	4.50	4.75	4.50	4.37	4.25
1879	4.75	4.37	5.62	4.80	6.00	5.62	6.37	6.00	6.25	5.87	6.25	6.00
1880	5.00	4.87	5.25	4.87	5.12	4.75	5.00	4.87	4.90	4.65	4.75	4.65
1881	5.00	4.75	5.12	5.00	5.25	5.00	5.37	5.25	5.87	5.50	6.00	5.87
1882	5.37	5.12	5.50	5.12	5.37	5.12	5.37	5.12	5.12	4.87	4.87	4.50
1883	4.50	4.30	4.40	4.30	4.50	4.40	4.45	4.35	4.40	4.37	4.37	4.35
1884	4.55	4.45	4.62	4.52	4.62	4.50	4.55	4.40	4.40	4.30	4.25	4.00
1885	4.40	4.10	4.60	4.40	4.62	4.50	4.62	4.50	4.60	4.45	4.60	4.45
1886	4.40	4.30	4.40	4.30	4.40	4.25	4.30	4.25	4.30	4.25	4.50	4.35
1887	4.50	4.50	4.60	4.55	4.65	4.60	4.65	4.50	4.80	4.52	5.87	5.00
1888	4.55	4.50	4.87	4.50	5.12	4.75	5.12	4.87	5.12	4.87	5.12	4.87
1889	5.10	5.00	5.20	5.15	5.15	5.10	5.15	5.10	5.25	5.05	5.35	5.30
1890	5.60	5.40	5.55	5.40	5.65	5.50	6.00	5.65	6.10	5.90	6.00	5.90
1891	5.10	5.05	5.10	5.00	5.00	4.85	5.15	4.95	4.90	4.75	4.75	4.65

It will be observed that the course of prices during 1891 was nearly uninterruptedly downward. Opening with a nominal quotation of 6 cents per pound, the first serious buying movement was satisfied quickly, in the middle of the month of January, at 5¼ cents. Business dragged through February and into March, the market settling down to 5 cents. A moderate amount of buying caused a firmer feeling to develop among smelters, and 5.10 cents was for some weeks the asking price. But a slow demand and accumulating supplies caused the market to soften gradually during April, the month closing at 4.85 cents. May and the greater part of June witnessed a dragging market, until finally freer buying carried the metal back above the 5-cent mark. During July smelters adhered to 5.10 cents as the selling price, but the volume of sales was small. It was only early in September that sellers began to make more tempting offers, transactions being on the basis of 4.90 cents. A revival of buying toward the end of the month created a rising tendency, and temporarily, early in October, spot metal brought as much as 5.20 cents. The withdrawal of buyers, however, caused a reaction, which continued during the whole of November, and brought spelter down to 4.75 cents. The tendency continued during the last month, the year closing with the market weak at 4.65 cents.

Messrs. Henry R. Merton & Co., of London, make the following report on the spelter production of Europe:

Estimate of the production of zinc in Europe.

Countries.	1891.	1890.	1889.	1888.	1887.	1886.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Rhine district and Belgium	139,695	137,630	134,648	133,245	130,995	129,020
Silesia	87,080	87,475	85,483	83,375	81,375	81,630
Great Britain	29,410	29,145	30,806	26,783	19,339	20,730
France and Spain	18,360	18,240	16,785	16,140	16,028	15,305
Poland	3,760	3,620	3,026	3,785	3,580	4,145
Austria	6,440	7,135	6,330	4,977	5,338	5,000
Total	284,745	283,245	277,078	268,305	256,655	255,830

Estimate of the production of zinc in Europe—Continued.

Countries.	1885.	1884.	1883.	1882.	1881.	1880.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Rhine district and Belgium	129, 754	129, 240	123, 891	119, 193	110, 989	98, 830
Silesia....	79, 623	76, 116	70, 405	68, 811	66, 497	64, 459
Great Britain	24, 299	29, 259	28, 661	25, 581	24, 419	(*a*) 22, 000
France and Spain	14, 847	15, 341	14, 671	18, 075	(*a*) 18, 358	15, 000
Poland	5, 019	4, 164	3, 733	4, 400	(*a*) 4, 000	(*a*) 4, 000
Austria	5, 610	6, 170	6, 267	6, 709	5, 825	5, 970
Total	259, 152	260, 290	247, 628	242, 769	230, 088	210, 259

a Estimated.

The output of the works in the different districts was as follows:

Production of zinc by principal foreign producers.

Districts.	1891.	1890.	1889.	1888.	1887.	1886.	1885.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Rhine district and Belgium:							
Vieille Montagne	53, 820	52, 865	52, 016	51, 670	51, 517	50, 790	50, 687
Stolberg Co....	15, 040	14, 855	14, 634	14, 036	14, 070	14, 065	14, 452
Austro-Belge	9, 425	9, 250	9, 245	9, 140	9, 280	9, 130	9, 610
G. Dumont & Frères....	8, 370	8, 350	8, 863	8, 759	8, 368	8, 000	7, 072
Rhein-Nassau Co	8, 075	7, 960	7, 470	7, 586	7, 588	7, 730	7, 676
L. de Laminne	6, 810	6, 760	6, 693	6, 597	6, 745	6, 550	7, 039
Escombrera Bleyberg....	5, 770	5, 630	5, 560	4, 930	4, 925	5, 315	5, 835
Grillo....	5, 390	5, 490	5, 353	5, 299	5, 100	5, 075	5, 158
Märk, Westf., Bergw., Ver....	5, 600	5, 485	5, 805	5, 537	5, 553	4, 950	4, 429
Nouvelle Montagne....	5, 550	5, 350	5, 090	5, 032	4, 975	4, 995	5, 079
Berzelius	5, 155	5, 175	4, 910	4, 818	4, 890	4, 985	5, 046
Eschger Ghesquière & Co	3, 840	4, 065	4, 303	4, 137	4, 079	3, 710	3, 792
Société Prayon	4, 130	4, 100	3, 956	3, 906	3, 905	3, 725	3, 879
Société de Boom	2, 720	2, 295	*a* 750	1, 798	....	....	....
	139, 695	137, 630	134, 648	133, 245	130, 995	129, 020	129, 754
Silesia:							
Schlesische Actien-Gesellschaft	25, 245	24, 840	23, 675	22, 917	22, 680	22, 730	21, 750
G. von Giesche's Erben....	18, 700	18, 550	18, 206	17, 594	17, 600	17, 505	16, 782
Herzog von Ujest....	16, 795	16, 355	16, 202	15, 456	15, 835	15, 610	15, 595
Graf H. Henckel von Donnersmarck..	11, 230	11, 670	11, 392	11, 193	11, 565	9, 355	9, 680
Graefin Schaffgotsch	5, 310	6, 265	6, 405	6, 402	6, 430	6, 505	6, 091
Graf G. Henckel von Donnersmarck..	3, 905	4, 090	3, 943	4, 114	1, 565	1, 670	1, 682
Graf Lazy Henckel von Donnersmarck (included in Graf H. Henckel v. D.)	....	....	....	....	....	2, 450	2, 165
H. Roth....	1, 730	1, 750	1, 660	1, 555	1, 670	1, 675	1, 733
Wünsch	1, 920	1, 880	1, 907	1, 906	1, 885	1, 860	1, 858
Vereinigte Königs & Laurahütte	1, 180	1, 020	1, 130	1, 166	1, 065	1, 185	1, 305
Baron v. Horschitz'sche Erben....	850	830	963	935	910	915	876
Fiscus....	215	225	170	137	170	170	106
	87, 080	87, 475	85, 653	83, 375	81, 375	81, 630	79, 623
Great Britain:							
Vivian & Sons....	7, 235	6, 605	6, 842	6, 510	4, 840	7, 389	8, 048
English Crown Spelter Co. (Limited)..	5, 180	4, 945	4, 981	4, 980	4, 007	3, 248	3, 500
Dillwyn & Co	3, 580	3, 930	4, 540	3, 904	2, 843	3, 015	2, 967
Swansea Vale Spelter Co....	1, 840	1, 615	2, 161	2, 150	1, 798	2, 060	2, 185
Villiers Spelter Co....	2, 125	1, 890	2, 180	1, 993	1, 810	1, 880	1, 985
Pascoe, Grenfell & Sons	1, 060	1, 160	1, 272	1, 330	1, 124	727	1, 082
Nenthead & Tynedale Co....	1, 440	1, 530	1, 507	1, 516	1, 317	1, 193	1, 380
John Lysaght (Limited)....	4, 185	4, 450	5, 113	3, 750	1, 600	1, 218	1, 952
Staffordshire Knot....	....	350	1, 100	150	....	....	700
Minera Mines	2, 265	2, 170	610	....	....	....	....
H. Kenyon & Co	500	500	500	500	500	500	500
	29, 410	29, 145	30, 806	26, 783	19, 839	21, 230	24, 299
France and Spain:							
Asturienne....	18, 360	18, 240	16, 785	16, 140	16, 028	15, 305	14, 847
Austria:							
Sagor	1, 280	1, 430	1, 210	1, 087	866	1, 000	970
Cilli	1, 810	1, 880	1, 670	1, 240	1, 272	1, 360	1, 440
Siersza-Niedzieliska....	3, 350	3, 825	3, 450	2, 650	3, 200	2, 640	3, 200
	6, 440	7, 135	6, 330	4, 977	5, 338	5, 000	5, 610
Poland....	3, 760	3, 620	3, 026	*a* 3, 785	3, 580	4, 145	5, 019

a Estimated.

Zinc imported and entered for consumption in the United States, 1867 to 1891, inclusive.

Years ending—	Blocks or pigs.		Sheets.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*			
June 30, 1867	5, 752, 611	$256, 366	5, 142, 417	$311, 767	$1, 835	$569, 968
1868	9, 327, 968	417, 273	3, 557, 448	203, 883	1, 623	622, 779
1869	13, 211, 575	590, 332	8, 306, 723	478, 646	2, 083	1, 071, 061
1870	9, 221, 121	415, 497	9, 542, 687	509, 860	21, 696	947, 053
1871	11, 159, 040	508, 355	7, 646, 821	409, 243	26, 366	943, 964
1872	11, 802, 247	522, 524	10, 704, 944	593, 885	58, 668	1, 175, 077
1873	6, 839, 897	331, 399	11, 122, 143	715, 706	56, 813	1, 103, 918
1874	3, 593, 570	203, 479	6, 016, 835	424, 504	48, 304	676, 287
1875	2, 034, 252	101, 766	7, 320, 713	444, 539	26, 330	572, 635
1876	947, 322	56, 082	4, 611, 360	298, 308	18, 427	372, 817
1877	1, 266, 894	63, 250	1, 341, 333	81, 815	2, 496	147, 561
1878	1, 270, 184	57, 753	1, 255, 620	69, 381	4, 892	132, 026
1879	1, 419, 791	53, 294	1, 111, 225	53, 050	3, 374	109, 718
1880	8, 092, 620	371, 920	4, 069, 310	210, 230	3, 571	585, 721
1881	2, 859, 216	125, 457	2, 727, 324	129, 158	7, 603	262, 218
1882	18, 408, 391	736, 964	4, 413, 042	207, 032	4, 940	948, 936
1883	17, 067, 211	655, 503	3, 309, 239	141, 823	5, 606	802, 932
1884	5, 869, 738	208, 852	952, 253	36, 120	4, 795	249, 767
1885	3, 515, 840	113, 268	1, 839, 860	64, 781	2, 054	180, 103
Dec. 31, 1886	4, 300, 830	136, 138	1, 092, 400	40, 320	9, 162	185, 620
1887	8, 387, 647	276, 122	926, 150	32, 526	11, 329	319, 977
1888	3, 825, 947	146, 156	295, 287	12, 558	12, 080	170, 794
1889	2, 052, 559	77, 845	1, 014, 873	43, 356	19, 580	140, 781
1890	1, 997, 524	101, 335	781, 266	43, 495	9, 740	154, 570
1891	808, 094	41, 199	21, 948	1, 460	....	42, 659

Imports of zinc oxide from 1885 to 1891, inclusive.

Years ending—	Dry.	In oil.
	Pounds.	*Pounds.*
June 30, 1885	2, 233, 128	98, 566
Dec. 31, 1886	3, 526, 289	79, 788
1887	4, 961, 080	123, 216
1888	1, 401, 342	51, 985
1889	2, 686, 861	66, 240
1890	2, 631, 458	102, 298
1891	2, 839, 351	128, 140

Exports of zinc and zinc ore of domestic production, 1864 to 1891, inclusive.

Years ending—	Ore or oxide.		Plates, sheets, pigs, or bars.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Cwt.		*Pounds.*			
June 30, 1864	14,810	$116,431	95,738	$12,269	....	$128,700
1865	99,371	114,149	184,183	22,740	....	136,889
1866	4,485	25,091	140,798	13,290	....	38,381
1867	3,676	32,041	312,227	30,587	....	62,628
1868	8,344	74,706	1,022,699	68,214	....	142,920
1869	....	65,411	....	....	....	65,411
1870	15,286	81,487	110,157	10,672	....	92,159
1871	9,621	48,292	76,380	7,823	....	56,115
1872	3,686	20,880	62,919	5,726	....	26,606
1873	234	2,304	73,953	4,656	....	6,960
1874	2,550	20,037	43,566	3,612	....	23,649
1875	3,083	20,659	38,090	4,245	$1,000	25,904
1876	10,178	66,259	134,542	11,651	4,333	82,243
1877	6,428	34,468	1,419,922	115,122	1,118	150,708
1878	16,050	83,831	2,545,320	216,580	567	300,978
1879	10,660	40,399	2,132,949	170,654	....	211,053
1880	13,024	42,036	1,368,302	119,264	....	161,300
1881	11,390	16,405	1,491,786	132,805	168	149,378
1882	10,904	13,736	1,489,552	124,638	....	138,374
1883	3,045	11,509	852,333	70,981	734	83,224
1884	4,780	16,685	126,043	9,576	4,666	30,927
1885	6,840	22,824	101,685	7,270	4,991	35,085
Dec. 31, 1886	26,620	49,455	917,229	75,192	13,526	138,173
1887	4,700	17,286	136,670	9,017	16,789	43,092
1888	4,560	18,034	62,234	4,270	19,098	41,402
1889	26,760	73,802	879,785	44,049	35,732	153,583
1890	77,360	195,113	3,295,584	126,291	23,587	344,991
1891	3,791	149,435	4,294,656	278,182	38,921	466,538

QUICKSILVER.

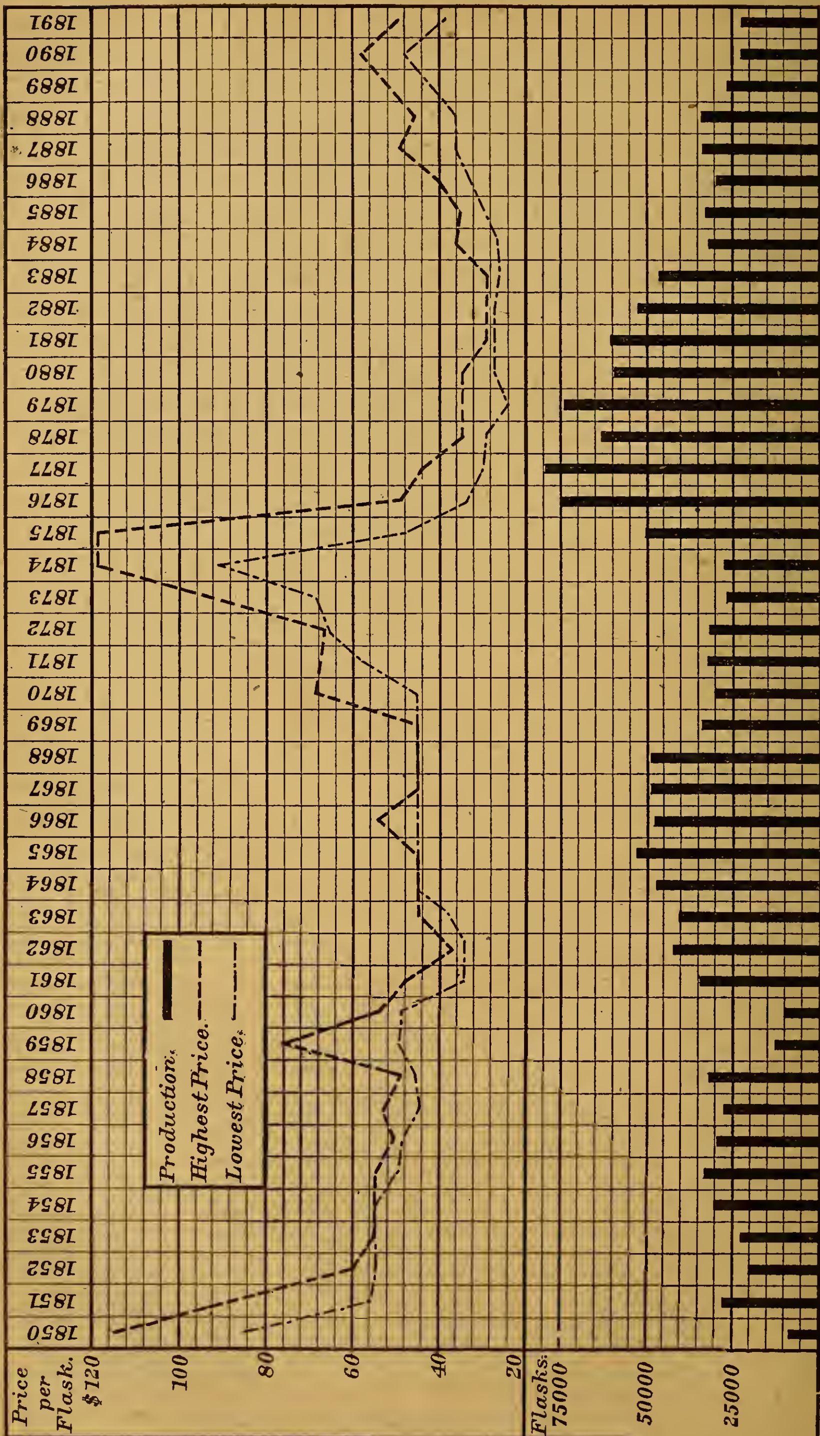
In spite of a considerable decline in the product of the principal producer, the New Almaden mine, the total product in California was practically the same in 1891 as in 1890; that is, 22,904 flasks in 1891, worth $1,036,386, and 22,926 in 1890, worth $1,203,615. The average price decreased from $48.33 per flask to $45.25. The New Almaden mine was operated at a loss of $6 per flask. This decline at New Almaden was compensated by the mines in Napa county, which, however, increased their output markedly. The prospect is for an increase in product in 1892, the producing capacity of two or three mines, notably the Bradford, being considerably augmented. At the latter two new furnaces are nearly completed and a third is in course of construction. It is probable that for a few months after the new furnaces begin operations the product of this mine may reach a thousand flasks a month.

Total product of quicksilver in the United States.

[Flasks of 76½ pounds, net.]

Years.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Great Western.	Napa Consolidated. (a)	Great Eastern.	Bradford.	Various mines.	Total yearly production of California mines.
1850	7,723	Production from 1858 to 1866, 17,455 flasks—no yearly details obtainable—included in production of various mines.								7,723
1851	27,779									27,779
1852	15,901								4,099	20,000
1853	22,284									22,284
1854	30,004									30,004
1855	29,142								3,858	33,000
1856	27,138								2,862	30,000
1857	28,204									28,204
1858	25,761								5,239	31,000
1859	1,294								11,706	13,000
1860	7,061								2,939	10,000
1861	34,429								571	35,000
1862	39,671		444						1,885	42,031
1863	32,803		852						6,876	40,589
1864	42,489		1,914						3,086	47,489
1865	47,194		3,545						2,261	53,000
1866	35,150	6,525	2,254						2,621	46,550
1867	24,461	11,493	7,862						3,184	47,000
1868	25,628	12,180	8,686						1,234	47,728
1869	16,898	10,315	5,018						1,580	33,811
1870	14,423	9,888	4,546						1,220	30,077
1871	18,568	8,180	2,128						2,810	31,686
1872	18,574	8,171	3,046						1,830	31,621
1873	11,042	7,735	3,294		340				5,231	27,642
1874	9,084	6,911	6,678	573	1,122				3,388	27,756
1875	13,648	8,432	7,513	5,372	3,384		412		11,489	50,250
1876	20,549	7,272	9,183	8,367	4,322	573	387		22,063	72,716
1877	23,996	6,316	9,399	10,993	5,856	2,229	505		20,101	79,395
1878	15,852	5,138	6,686	9,465	4,963	3,049	1,366		17,361	63,880
1879	20,514	4,425	4,516	9,249	6,333	3,605	1,455		23,587	73,684
1880	23,465	3,209	2,139	10,706	6,442	4,416	1,279		8,270	59,926
1881	26,060	2,775	2,194	11,152	6,241	5,552	1,065		5,812	60,851
1882	28,070	1,953	2,171	5,014	5,179	6,842	2,124		1,379	52,732
1883	29,000	1,606	1,894	2,612	3,869	5,890	1,669		185	46,725
1884	20,000	1,025	881	890	3,292	4,307	332		1,186	31,913
1885	21,400	1,144	385	1,296	3,469	3,506	446		427	32,073
1886	18,000	1,406	409	1,449	1,949	5,247	735		786	29,981
1887	20,000	1,890	673	1,490	1,446	5,574	689	1,543	520	33,825
1888	18,000	1,320	126	2,164	625	5,024	1,151	3,848	992	33,250
1889	13,100	980	812	2,283	556	4,590	1,345	1,874	924	26,464
1890	12,000	977	505	1,608	1,334	3,429	1,046	1,290	737	22,926
1891	8,200	792	442	1,375	1,844	4,454	1,660	1,686	2,451	22,904
Total	924,559	132,058	100,195	86,058	62,566	68,287	17,666	10,241	186,730	1,588,360

a Includes Ætna.



Production and Price of Quicksilver in the United States.

Production of quicksilver, in flasks, in California, from 1880 to 1891, by months.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna. (a)	Napa. (a)	Great Eastern.	Bradford. (b)	Various mines.	Total.
1880.												
January	1,539	203	142	760	1,000	550	......	205	39	......	232	4,670
February	1,809	96	310	965	535	565	......	375	110	......	130	4,895
March	2,155	443	239	1,286	730	565	......	251	210	......	98	5,977
April	1,667	165	103	611	645	574	......	161	96	......	239	4,261
May	1,938	226	356	1,130	560	572	......	315	164	......	90	5,351
June	1,985	269	127	819	550	585	......	420	142	......	386	5,283
July	1,688	250	135	933	......	540	......	455	118	......	70	4,189
August	2,360	312	189	878	340	525	......	455	133	......	68	5,260
September	2,166	245	175	687	300	452	......	480	122	......	81	4,708
October	1,858	216	166	865	1,100	557	......	358	57	......	98	5,275
November	2,238	539	96	1,209	500	467	......	591	42	......	66	5,748
December	2,062	245	101	563	410	490	......	350	46	......	42	4,309
Total	23,465	3,209	2,139	10,706	6,670	6,442	......	4,416	1,279	......	1,600	59,926
1881.												
January	2,259	330	140	895	1,300	451	......	430	13	......	43	5,861
February	2,187	171	32	635	600	399	......	233	......	......	4	4,261
March	2,466	206	354	1,100	350	400	......	505	179	......	......	5,560
April	2,507	158	284	706	357	447	......	466	123	......	23	5,071
May	1,346	200	218	1,163	500	681	......	659	97	......	25	4,889
June	1,780	201	196	1,463	340	801	......	621	94	......	68	5,564
July	2,208	110	160	1,057	255	714	......	481	47	......	156	5,188
August	2,260	209	190	1,139	300	585	......	490	57	......	120	5,350
September	2,090	212	187	1,076	201	457	......	592	113	......	37	4,965
October	2,223	140	165	969	400	414	......	485	106	......	63	4,965
November	2,572	577	180	588	375	434	......	310	166	......	30	5,232
December	2,162	261	88	361	250	458	......	280	70	......	15	3,945
Total	26,060	2,775	2,194	11,152	5,228	6,241	......	5,552	1,065	......	584	60,851
1882.												
January	1,632	179	178	623	50	395	......	430	144	......	33	3,664
February	1,924	121	145	460	210	348	......	440	98	......	21	3,767
March	2,078	160	70	359	200	505	......	459	91	......	24	3,946
April	2,110	127	174	319	229	486	......	525	57	......	......	4,027
May	2,446	269	211	354	13	521	......	737	55	......	5	4,611
June	2,318	121	131	522	30	456	......	485	76	......	28	4,167
July	2,522	169	195	579	......	410	......	380	111	......	15	4,381
August	2,432	130	184	418	50	490	......	582	388	......	11	4,685
September	2,766	129	225	430	140	513	......	641	348	......	17	5,209
October	2,844	266	251	370	60	516	......	580	229	......	13	5,129
November	2,619	156	96	280	81	200	......	718	306	......	55	4,511
December	2,379	126	311	300	75	339	......	865	221	......	19	4,635
Total	28,070	1,953	2,171	5,014	1,138	5,179	......	6,842	2,124	......	241	52,732
1883.												
January	2,497	112	367	280	77	390	......	590	262	......	7	4,582
February	2,150	133	181	310	7	364	......	295	156	......	4	3,600
March	2,230	142	202	335	7	305	......	485	162	......	14	3,875
April	1,756	76	243	310	......	294	......	530	142	......	3	3,354
May	2,344	144	135	350	......	293	......	325	164	......	13	3,768
June	2,214	137	165	91	......	400	......	360	184	......	10	3,561
July	2,618	85	141	130	......	446	......	452	150	......	2	4,024
August	3,000	139	94	112	......	315	......	695	76	......	......	4,431
September	3,010	164	45	265	......	297	......	750	81	......	30	4,642
October	2,672	272	109	206	......	215	......	521	134	......	......	4,129
November	2,212	115	78	160	......	208	......	613	102	......	......	3,488
December	2,297	87	134	63	......	342	......	274	56	......	18	3,271
Total	29,000	1,606	1,894	2,612	84	3,869	......	5,890	1,669	......	101	46,725
1884.												
January	1,440	103	127	263	......	373	329	135	28	......	7	2,805
February	1,458	59	104	......	......	241	276	174	9	......	......	2,321
March	1,606	36	123	68	......	223	249	152	2	......	......	2,459
April	1,785	75	50	76	......	232	422	69	......	......	......	2,709
May	1,672	125	53	200	......	169	245	6	......	......	......	2,470
June	1,859	44	118	......	200	258	215	......	......	......	......	2,694

a Production of Ætna and Napa mines from 1880 to 1883 under heading of Napa mine. *b* New mine.

Production of quicksilver, in flasks, in California, etc.—Continued.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna.	Napa.	Great Eastern.	Bradford.	Various mines.	Total.
1884.												
July	1,543	29	71	52	200	258	374	101	......	......	......	2,628
August	1,804	63	47	20	306	334	228	110	......	......	......	2,912
September	1,448	67	52	35	58	354	136	169	58	......	......	2,377
October	1,625	115	68	25	160	328	153	90	104	......	......	2,668
November	1,900	157	32	53	150	230	132	240	91	......	......	2,985
December	1,860	152	36	98	105	292	172	130	40	......	......	2,885
Total	20,000	1,025	881	890	1,179	3,292	2,931	1,376	332	......	7	31,913
1885.												
January	1,700	190	40	24	......	172	189	131	37	......	......	2,483
February	1,506	70	24	85	35	245	96	180	75	......	......	2,316
March	1,500	80	......	83	......	314	88	145	33	......	19	2,262
April	2,003	80	......	69	......	340	142	145	37	......	......	2,816
May	2,000	75	......	194	......	269	62	190	......	......	3	2,793
June	1,750	62	50	91	......	330	112	250	63	......	5	2,713
July	1,750	75	43	209	......	321	45	191	50	......	10	2,694
August	2,104	80	49	150	......	324	118	175	......	......	47	3,047
September	1,936	95	57	85	......	347	201	180	......	......	77	2,978
October	1,598	85	42	123	......	236	52	185	65	......	82	2,468
November	1,576	122	43	61	......	292	54	190	43	......	87	2,468
December	1,977	130	37	122	......	279	150	235	43	......	62	3,035
Total	21,400	1,144	385	1,296	35	3,469	1,309	2,197	446	......	392	32,073
1886.												
January	1,431	70	42	100	......	339	162	147	73	......	34	2,398
February	1,100	175	24	108	......	274	132	192	53	......	45	2,103
March	1,522	20	21	91	......	226	209	218	43	......	75	2,425
April	1,256	90	36	172	......	115	328	172	62	......	62	2,293
May	1,600	101	18	36	......	99	228	128	76	......	95	2,381
June	1,806	110	19	113	......	126	276	123	71	......	78	2,732
July	1,572	95	24	98	......	138	345	138	64	......	127	2,601
August	1,240	105	35	119	......	156	313	74	76	......	84	2,202
September	1,210	179	30	100	......	107	303	82	64	......	33	2,108
October	1,280	106	50	150	......	171	392	124	65	......	52	2,390
November	1,900	180	76	191	......	109	477	209	55	......	35	3,232
December	2,083	175	34	171	......	89	313	162	33	......	66	3,126
Total	18,000	1,406	409	1,449	......	1,949	3,478	1,769	735	......	786	29,981
1887.												
January	1,904	162	76	185	......	56	450	181	51	......	12	3,077
February	1,700	149	43	40	......	86	240	150	......	......	......	2,408
March	1,584	110	48	95	......	105	125	275	74	......	140	2,456
April	1,671	157	29	105	......	90	200	212	91	......	31	2,586
May	2,040	126	27	50	......	152	100	215	80	......	40	2,830
June	1,700	127	93	170	......	126	200	220	82	......	104	2,822
July	1,567	175	57	125	......	194	200	205	56	201	40	2,820
August	1,517	160	61	90	......	108	200	275	72	220	78	2,881
September	1,535	297	42	120	......	123	400	160	26	195	25	2,923
October	1,405	171	64	140	......	132	300	304	66	228	49	2,859
November	1,225	113	71	214	......	127	165	247	82	295	74	2,613
December	2,152	143	62	156	......	147	300	250	9	232	34	3,485
Total	20,000	1,890	673	1,490	......	1,446	2,880	2,694	689	1,371	627	33,760
1888.												
January	2,650	118	......	292	......	61	246	235	84	179	84	3,949
February	1,730	82	......	156	......	64	105	223	79	243	51	2,733
March	1,400	90	......	150	......	43	95	288	108	270	37	2,481
April	1,579	110	......	138	......	95	143	324	153	292	28	2,862
May	1,610	125	......	155	......	69	226	320	80	357	95	3,037
Jnne	1,500	120	......	189	......	26	94	345	110	454	118	2,956
July	1,100	120	......	167	......	34	50	248	94	463	83	2,359
August	1,109	110	......	215	......	29	......	347	93	527	117	2,547
September	1,178	60	......	195	......	42	......	370	58	357	88	2,348
October	1,269	185	36	180	......	47	......	444	88	294	96	2,635
November	1,400	90	30	176	......	28	......	475	82	220	103	2,604
December	1,475	110	60	151	......	87	......	450	122	192	92	2,739
Total	18,000	1,320	126	2,164	......	625	959	4,065	1,151	3,848	992	33,250

Production of quicksilver, in flasks, in California, etc.—Continued.

Months.	New Almaden.	New Idria.	Redington.	Sulphur Bank.	Guadalupe.	Great Western.	Ætna.	Napa.	Great Eastern.	Bradford.	Various mines.	Total.
1889.												
January	1,200	65	......	173	......	81	......	385	94	230	109	2,337
February	829	65	......	173	......	45	......	400	76	182	52	1,813
March	1,290	70	......	175	......	34	......	380	89	116	63	2,217
April	1,249	70	......	215	......	30	......	320	92	119	108	2,203
May	870	70	206	192	......	......	......	445	97	132	73	2,085
June	950	75	117	235	......	......	......	415	211	152	63	2,218
July	966	70	124	211	......	41	......	340	135	110	69	2,066
August	1,000	70	64	216	......	17	......	450	168	170	68	2,223
September	970	75	73	224	......	97	......	360	77	136	61	2,073
October	1,300	80	89	164	......	70	......	385	87	214	64	2,453
November	1,300	130	139	150	......	80	......	380	107	134	72	2,492
December	1,185	140	......	155	......	61	......	330	112	179	122	2,284
Total	13,100	980	812	2,283	......	556	......	4,590	1,345	1,874	924	26,464
1890.												
January	952	100	60	109	......	55	......	270	46	75	41	1,708
February	728	60	......	186	......	11	......	245	126	46	60	1,462
March	1,000	57	11	80	......	110	......	265	77	121	111	1,832
April	779	70	1	89	......	48	......	210	109	82	......	1,388
May	1,100	60	......	82	......	70	......	175	84	93	5	1,669
June	1,066	65	......	178	......	111	......	155	74	85	68	1,802
July	1,100	70	......	131	......	106	......	210	70	127	95	1,909
August	1,000	100	80	147	......	129	......	190	153	119	69	1,987
September	1,000	55	120	174	......	202	69	195	66	136	38	2,055
October	1,064	95	111	127	......	203	308	135	58	173	42	2,311
November	1,084	165	97	143	......	115	326	238	78	125	68	2,439
December	1,127	80	25	162	......	174	233	210	105	108	140	2,364
Total	12,000	997	505	1,608	......	1,334	931	2,498	1,046	1,290	737	22,926
1891.												
January	850	60	22	170	......	131	347	260	119	142	216	2,317
February	814	75	70	93	......	274	135	296	121	132	85	2,095
March	827	22	50	130	......	94	......	365	166	75	......	1,729
April	968	65	60	109	......	164	......	315	153	96	48	1,978
May	800	70	123	120	......	76	......	240	67	151	100	1,747
June	700	55	61	126	......	210	......	101	187	104	177	1,721
July	545	55	27	92	......	131	......	235	113	111	164	1,473
August	620	......	27	57	......	243	......	336	98	141	126	1,648
September	500	65	......	122	......	46	......	359	72	49	256	1,469
October	500	95	......	100	......	145	......	413	201	139	97	1,690
November	455	100	2	105	......	130	125	380	136	296	202	1,931
December	621	130	......	151	......	200	242	305	227	250	980	3,106
Total	8,200	792	442	1,375	......	1,844	849	3,605	1,660	1,686	2,451	22,904

Prices.—It is somewhat unusual that with production and stocks decreasing, the price of quicksilver should not have advanced in 1891. Instead of that, the tables below show that in London the highest price in 1891 was below the lowest of 1890 and the prices in the United States were nearly proportionate. An increase in price is expected in 1892.

Highest and lowest prices of quicksilver in 1891.

Months.	San Francisco.		London.					
	Highest.	Lowest.	Highest.			Lowest.		
			£	s.	d.	£	s.	d.
January	$51.00	$49.00	8	12	6	8	10	0
February	47.50	47.50	8	10	0	8	7	6
March	46.50	45.00	8	10	0	8	5	0
April	45.00	42.00	8	2	6	7	15	0
May	45.00	43.00	8	0	0	7	15	0
June	43.00	42.00	8	0	0	7	12	6
July	42.00	39.50	7	15	0	7	12	6
August	45.00	41.00	7	10	0	7	5	0
September	41.00	41.00	7	7	6	7	5	0
October	46.50	45.00	8	0	0	7	10	0
November	47.50	47.50	8	2	6	8	0	0
December	48.00	47.50	8	0	0	7	17	6

The following table shows the range in price of quicksilver in the San Francisco and London markets for the past forty-two years:

Highest and lowest prices of quicksilver during the past forty-two years.

Years.	Price in San Francisco, per flask.		Price in London, per flask.					
	Highest.	Lowest.	Highest.			Lowest.		
			£	s.	d.	£	s.	d.
1850	$114.75	$84.15	15	0	0	13	2	6
1851	76.50	57.35	13	15	0	12	5	0
1852	61.20	55.45	11	10	0	9	7	6
1853	55.45	55.45	8	15	0	8	2	6
1854	55.45	55.45	7	15	0	7	5	0
1855	55.45	51.65	6	17	6	6	10	0
1856	51.65	51.65	6	10	0	6	10	0
1857	53.55	45.90	6	10	0	6	10	0
1858	49.75	45.90	7	10	0	7	5	0
1859	76.50	49.75	7	5	0	7	0	0
1860	57.35	49.75	7	0	0	7	0	0
1861	49.75	34.45	7	0	0	7	0	0
1862	38.25	34.45	7	0	0	7	0	0
1863	45.90	38.25	7	0	0	7	0	0
1864	45.90	45.90	9	0	0	7	10	0
1865	45.90	45.90	8	0	0	7	17	6
1866	57.35	45.90	8	0	0	6	17	0
1867	45.90	45.90	7	0	0	6	16	0
1868	45.90	45.90	6	17	0	6	16	0
1869	45.90	45.90	6	17	0	6	16	0
1870	68.85	45.90	10	0	0	6	16	0
1871	68.85	57.35	12	0	0	9	0	0
1872	66.95	65.00	13	0	0	10	0	0
1873	91.80	68.85	20	0	0	12	10	0
1874	118.55	91.80	26	0	0	19	0	0
1875	118.55	49.75	24	0	0	9	17	6
1876	53.55	34.45	12	0	0	7	17	6
1877	44.00	30.60	9	10	0	7	2	6
1878	35.95	29.85	7	5	0	6	7	6
1879	34.45	25.25	8	15	0	5	17	6
1880	34.45	27.55	7	15	0	6	7	6
1881	31.75	27.90	7	0	0	6	2	6
1882	29.10	27.35	6	5	0	5	15	0
1883	28.50	26.00	5	17	6	5	5	0
1884	35.00	26.00	6	15	0	5	2	6
1885	33.00	28.50	6	15	0	5	10	0
1886	39.00	32.00	7	10	0	5	16	3
1887	50.00	36.50	11	5	0	6	7	6
1888	47.00	36.00	10	0	0	6	12	6
1889	50.00	40.00	9	15	0	7	10	0
1890	58.00	47.00	10	10	0	9	1	0
1891	51.00	39.50	8	12	6	7	5	0
Extreme range in forty-two years	118.55	25.25	26	0	0	5	2	6

Foreign sources.—The production of the world shows a decline. The principal mine at Almaden, Spain, and the Italian mines are responsible for this. The product at each place, in 1891, declined 2,000 flasks. In Russia, on the other hand, the product increased considerably in 1890 and to a still higher total in 1891. The total product here, however, is not great and little is known as to the ability of the one mine to continue production at a profit on such low-grade ore. The deposit is sandstone impregnated with cinnabar and yielding from 0.5 to 1.5 per cent. of quicksilver. The mine is the property of Messrs. A. Auerbach & Co. It is located near Nikitovka Station, in the province of Ekaterinoslav in the Bakhmoot district, on the Vurstkarkoff and Azoff railroad. The mine was opened in 1885 and began producing in 1887. It is fairly well equipped with hoisting machinery and pumps for a considerable volume of water. The mine worked down to water level long before the present history of the place. The present developments do not extend to a costly depth. The sorting sheds are well arranged, and hence the possibility of profit on an ore no richer than that at New Almaden. As for the other quicksilver localities in Russia they are not worked at present. Cinnabar is found in many of the gold mines of the Ural mountains, particularly in Oleno-Travilansk in gravels. In the Altai mountains it has been found in the auriferous gravels of Pesask; also in the Trans-Baikal province, Nertchinsk district, at Ildekansk, not far from the Serentuev mine. There are also indications of quicksilver ores in Okhotosh district and in Kamtschatka. Cinnabar has lately been discovered in the Caucasus, in the district of Daghestan, near a settlement called Geptze. The quality of this last-mentioned ore deposit has not yet been sufficiently ascertained. Press reports indicate that the Russian Government intends to tax the product of cinnabar.

In Servia the product from Mount Avala amounts to 1,000 flasks a year, produced from 4,000 tons of ore. There are four furnaces which are worked very economically and with small loss.

Production of the Almaden mine (Spain) and the Idria mine (Austria) from 1850 to the close of 1891.

Years.	Almaden.	Idria.
	Flasks.	*Flasks.*
1850		4,100
1851		4,092
1852	101,517	4,085
1853		4,409
1854		4,060
1855		4,446
1856		5,935
1857	110,058	9,189
1858		4,977
1859		8,239
1860		4,821
1861		6,493
1862	122,117	4,712
1863		5,878
1864		7,263
1865		4,908
1866		5,327
1867	153,224	7,532
1868		8,253
1869		9,179
1870		10,745
1871		10,904
1872	165,608	11,116
1873		10,939
1874		10,789
1875		10,717
1876		10,794
1877	208,200	11,020
1878		10,403
1879		11,153
1880	41,640	12,356
1881	50,353	11,333
1882	46,591	11,663
1883	46,143	13,152
1884	43,099	13,967
1885	46,739	13,503
1886	51,199	14,496
1887	53,276	14,676
1888	51,872	14,962
1889	49,477	15,295
1890	50,202	14,000
1891	47,993	15,000

The world's production of quicksilver for twelve years.

[Flasks of 34.5 kilograms, or 76.5 pounds avoirdupois.]

Years.	California.	Spain.		Austria-Hungary.		Italy.(*c*)	Russia.	Estimated consumption.	Estimated stock in London, England.	Total supply.
		Almaden.	Various.(*a*)	Idria.	Various.(*b*)					
1880	59,926	45,322	(*d*)	12,356	712	4,220	....	95,600	68,500	122,536
1881	60,851	44,989	(*d*)	11,333	720	4,785	....	106,300	84,899	122,678
1882	52,732	46,716	2,795	11,663	588	4,900	....	116,200	88,000	119,394
1883	46,725	49,177	2,165	13,152	709	6,930	....	124,800	82,014	118,858
1884	31,913	48,098	2,219	13,967	733	8,500	....	111,300	76,105	105,430
1885	32,073	45,813	2,046	13,503	773	7,540	....	108,300	69,467	101,748
1886	29,981	51,199	2,277	14,496	1,400	8,235	....	123,050	54,000	107,588
1887	33,760	53,276	2,894	14,676	1,030	9,220	1,855	131,700	39,000	116,711
1888	33,250	51,872	1,877	14,962	1,018	10,200	4,777	109,900	47,000	117,956
1889	26,464	49,477	(*d*)	15,295	(*e*) 1,125	11,174	10,307	115,740	45,100	113,842
1890	22,926	50,202	(*d*)	14,000	....	12,470	8,918	119,442	39,500	108,516
1891	22,904	47,993	(*d*)	15,000	....	10,440	10,000	118,496	30,500	107,317
Total	453,505	584,134	16,273	164,403	8,808	98,614	35,857	1,380,828	724,085	1,362,574

a Comprises mines in the provinces of Oviedo, Granada, and Cuidad Real.
b Comprises mines in Carniola and in Hungary.
c Figures prior to 1890 taken from monograph on the quicksilver mines of Monte Amiata by P. De Ferrari M. E.
d Quantities unknown.
e Comprises mines in Carniola only, the production of Hungary not being known.

Quicksilver imported and entered for consumption in the United States, 1867 to 1891, inclusive.

Years ending—	Quantity.	Value.	Years ending—	Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1867	....	$15,248	June 30, 1880	116,700	$48,463
1868	152	68	1881	138,517	57,733
1869	....	11	1882	597,898	233,057
1870	239,223	107,646	1883	1,552,738	593,367
1871	304,965	137,332	1884	136,615	44,035
1872	370,353	189,943	1885	257,659	90,416
1873	99,898	74,146			
1874	51,202	52,093	Dec. 31, 1886	629,888	249,411
1875	6,870	20,957	1887	419,934	171,431
1876	78,902	50,164	1888	132,850	56,997
1877	38,250	19,558	1889	341,514	162,064
1878	294,207	135,178	1890	802,871	445,807
1879	519,125	217,770	1891	123,966	61,355

Imports of quicksilver vermilion from 1867 to 1891.

Years ending—	Quantity.	Value.	Years ending—	Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1867	....	$123,506	June 30, 1880	11,952	$5,997
1868	....	90,648	1881	14,243	7,391
1869	247,382	145,665	1882	12,496	6,214
1870	104,523	57,262	1883	19,549	8,795
1871	79,195	43,935	1884	....	10,472
1872	120,067	49,237	1885	....	8,244
1873	87,008	65,796			
1874	42,324	39,443	Dec. 31, 1886	....	11,016
1875	9,460	10,831	1887	....	16,542
1876	18,981	17,679	1888	....	9,342
1877	23,315	14,660	1889	....	3,263
1878	9,843	5,772	1890	....	6,916
1879	11,382	6,105	1891	....	24,152

Mercurial preparations imported and entered for consumption in the United States, 1867 to 1883, inclusive. (a)

Fiscal years ending June 30—	Blue mass.		Calomel.		Mercurial preparations not otherwise specified.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Pounds.*			
1867	....	......	....	$4,242	....	$4,242
1868	....	......	....	4,440	....	4,440
1869	....	......	....	4,516	....	4,516
1870	....	......	....	6,306	....	6,306
1871	....	......	....	3,147	....	3,147
1872	1,009	$667	8,241	6,590	$629	7,886
1873	919	660	5,520	5,240	699	6,599
1874	259	192	6,138	6,676	4,334	11,202
1875	125	109	2,424	2,817	52	2,978
1876	489	365	5,433	5,820	92	6,277
1877	455	327	4,649	4,305	90	4,722
1878	397	252	4,133	3,576	363	4,191
1879	485	266	5,875	4,635	6,453	11,354
1880	533	262	4,780	3,230	30	3,622
1881	395	236	8,177	5,640	116	5,992
1882	207	124	5,215	3,411	58	3,593
1883	188	79	8,732	5,503	190	5,772

a Not specified since 1883.

MANGANESE.

By Joseph D. Weeks.

The ores of manganese are divided into four general classes in the present report: (1) Manganese ores; (2) manganiferous iron ores; (3) manganiferous silver ores; and (4) manganiferous zinc ores. In previous volumes of this series the dividing line between manganese and manganiferous iron ores has been taken at 70 per cent. of manganese dioxide, or 44.252 per cent. of metallic manganese. Those containing less than this percentage were classed as manganiferous iron ores. While this percentage is still regarded as the proper dividing line between these two classes of ores and was always preserved when the chief use of manganese was in chemical manufacture, the growing demand for manganese for use in steel making has resulted in many ores being known commercially as manganese ores that would formerly have been termed manganiferous iron ores. While, so far as possible, the former distinction will still be preserved in these reports, in some cases ores certainly somewhat less than 44.252 per cent. of manganese will be classed as manganese ores. In the third class are included the argentiferous manganese ores of Colorado and Montana, which are utilized chiefly for the silver they contain, while the fourth class includes only the manganiferous residuum from New Jersey zinc ores.

The long ton of 2,240 pounds is used in this report.

Production.—On the basis of the above classification the total production of all classes of manganese and manganiferous ores in the United States in 1891 was as follows:

Total production of all classes of manganese ores in the United States in 1891.

Ores.	Quantity.	Total value.	Value.
	Long tons.		*Per ton.*
Manganese	23,416	$239,129	$10.21
Manganiferous iron	132,511	314,099	2.37
Manganiferous silver	79,511	397,555	5.00
Manganiferous zinc	38,228	57,432	1.25
Total and average	273,666	1,008,215	3.68

Statements similar to the above have been collected only for the years 1889, 1890, and 1891. The total production and value of all classes of ore carrying manganese for these years has been as follows:

Production and value of all classes of manganese ores in the United States from 1889 to 1891.

Years.	Total production.	Total value.	Average value per ton.
	Long tons.		
1889	216,266	$794,254	$3.67
1890	187,947	692,845	3.69
1891	273,666	1,008,215	3.68

The coincidence of the average value per ton in each of these three years is striking, though the averages of the four items that make up the total differed greatly in these three years. The average of the manganese ores was $9.94 in 1889, $8.53 in 1890, and $10.21 in 1891. The average value per ton of the manganiferous iron ores in each of these three years was $3.26, $3.74, and $3.37, respectively; of the silver ores $3.50, $3.50 and $5, and of the zinc ores $1.25 in each year.

Production of manganese ores in 1891.—In 1891 the product of manganese ores in the United States aggregated 23,416 tons, valued at $230,129, an average of $10.21 per ton. In 1889 the production was 24,197 tons, worth $240,559, an average of $9.94 per ton. The production of 1890 was 25,684 tons, worth $219,050, an average of $8.53 per ton.

From the above figures it will appear that, though the production of 1891 was 781 tons less than in 1889 and 2,268 tons less than in 1890, the total value of the production was but $1,430 less than in 1889, and $20,079 more than in 1890, though, as stated, the production was 2,268 tons less. These facts are shown more forcibly in the statement of the average value per ton, which was $9.94 in 1889 as against $10.21 in 1891, a difference of 27 cents a ton in favor of 1891, while in 1890 the value was but $8.53 a ton compared with $10.21 in 1891, a difference of $1.68 a ton in favor of 1891. This indicates the growing scarcity in this country of high-grade ores, such as are classed as manganese ores.

The amount and value of manganese ores produced in the United States in 1890 and 1891 is shown the following table:

Amount and value of manganese ores produced in the United States in 1890 and 1891.

States.	1890.			1891.		
	Production.	Total value.	Value per ton.	Production.	Total value.	Value per ton.
	Long tons.			*Long tons.*		
Arkansas	5,339	$59,861	$11.21	1,650	$18,150	$11.00
California	386	3,176	8.23	705	3,830	5.44
Colorado	6,397	25,588	4.00	964	7,220	7.50
Georgia	749	4,920	6.57	3,575	27,825	7 78
Indian Territory				206	1,174	5.70
Nevada	100	300	3.00			
North Carolina	14	84	6.00			
South Dakota				19	152	8.00
Vermont				49	245	5.00
Virginia	12,699	125,121	9.85	16,248	180,533	11.17
Total	25,684	219,050	*a* 8.53	23,416	239,129	*a* 10.21

a Average.

As heretofore, the chief production of manganese has been in Virginia, Georgia, and Arkansas, the production of Virginia in 1891 being 16,248 tons, of Georgia 3,575 tons, and of Arkansas 1,650 tons. The chief production in Virginia is at the Crimora mines; in Georgia, in the Cartersville district, and in Arkansas in the Batesville district.

In the following table is shown the production of manganese ores in the United States from 1880 to 1891, the production of the three chief producing States being reported separately, while the production of the other States, which vary greatly, are consolidated.

Production of manganese in the United States from 1880 to 1891.

Years.	Virginia.	Arkansas.	Georgia.	Other States.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1880	3,661	....	1,800	300	5,761
1881	3,295	100	1,200	300	4,895
1882	2,982	175	1,000	375	4,532
1883	5,355	400	....	400	6,155
1884	8,980	800	....	400	10,180
1885	18,745	1,483	2,580	450	23,258
1886	20,567	3,316	6,041	269	30,193
1887	19,835	5,651	9,024	14	34,524
1888	17,646	4,312	5,568	1,672	29,198
1889	14,616	2,528	5,208	1,845	24,197
1890	12,699	5,339	749	6,897	25,684
1891	16,248	1,650	3,575	1,943	23,416
Total	144,629	25,754	36,745	14,865	221,993

Product of manganiferous iron ores.—As has already been stated, most of the hematite iron ores of the United States are more or less manganiferous. While in most cases the amount of manganese in these ores does not increase their value over what the same ores would be worth as iron ores were the manganese absent, it makes the ore more desirable for certain purposes. No attempt has been made to collect the statistics of these manganese-bearing iron ores except in cases where the manganese has added somewhat to their value.

All the manganiferous iron ores reported as produced in 1891, which amount to 132,511 tons, were from the Lake Superior district. Of this amount 8,000 tons are reported as carrying from 8 to 16 per cent. of manganese; 5,711 tons as carrying 4.68 to 17.96 per cent. of manganese; 11,015 tons as averaging 10 per cent. of manganese; 9,213 tons as averaging 9.68 per cent. of manganese, and 98,572 tons as averaging 5.38 per cent. The average analysis of the 9,213 tons was as follows:

Analysis of Lake Superior (Wisconsin) manganiferous iron ore.

	Per cent.
Iron	52.46
Manganese	9.68
Phosphorus	.059

The above ore, as well as all of the ores except the 98,572 tons, amounting to a total of 33,939 tons, was valued at $98,241.

The analysis of the 98,572 tons, which averaged 5.38 per cent. of manganese, was as follows:

Analysis of Lake Superior manganiferous iron ore.

	Per cent.
Iron	57.67
Manganese	5.38
Phosphorus	.058

This ore was valued at $215,854. This would make the total value of the manganiferous iron ore $314,099, or $2.37 a ton free on board at the mines.

This differs somewhat from the figures given in 1889 and 1890. In 1889 the total production was 83,434 tons, worth $271,680, or $3.26 a ton. In 1890 the production was 61,863 tons, valued at $231,655, or $3.74 a ton.

Production of manganiferous silver ores.—In the statement made elsewhere in this chapter of the production of manganese-bearing ores in Colorado, a full account is given regarding the manganiferous silver ores produced in that state, which comprise the total production of this class of ores in the United States. From this it appears that there were 19,560 tons of manganiferous silver ores produced in that state in 1891, carrying 20 per cent. and upwards of manganese, and 59,951 tons carrying an average of 15 per cent., making a total of 79,511 tons, valued at $397,555, or $5 a ton.

The total production of manganiferous silver ores in the United States for the years 1889 to 1891, for which returns have been received, are as follows, the entire production being in Colorado:

Production of manganiferous silver ores in the United States, 1889–1891.

Years.	Containing 20 per cent. and over.	Containing less than 20 per cent.	Total.	Total value.	Average value per ton.
	Long tons.	*Long tons.*	*Long tons.*		
1889	9,987	55,000	64,987	$227,455	$3.50
1890	7,826	44,014	51,840	181,440	3.50
1891	19,560	59,951	79,511	397,555	5.00

Production of manganiferous zinc ores in the United States.—The manganiferous zinc ore produced in the United States is the manganiferous residuum from New Jersey zinc ores, chiefly franklinite. These deposits have been thoroughly described in previous volumes of "Mineral Resources." The ore is used in the production of spiegeleisen in New Jersey and Pennsylvania.

In the following table is shown the product of manganiferous zinc ores in the United States from 1889 to 1891:

Product of manganiferous zinc ores in the United States, 1889–1891.

Years.	Quantity.	Value.
	Long tons.	
1889	43,648	$54,560
1890	48,560	60,700
1891	38,228	57,432

Imports of manganese.—The following table shows the amount of manganese, including both that classed as manganese ore and oxide of manganese, imported and entered for consumption into the United States in the years 1889 to 1891, these imports being for calendar year.

Manganese imported and entered for consumption into the United States, 1889–1891.

Years.	Ore.		Oxide of.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1889	4, 135	$72, 391	151	$6, 000
1890	33, 998	509, 704	156	7, 196
1891	28, 624	371, 594	201	9, 024

Prices of manganese.—The chief buyer of manganese is the Carnegie Steel Company of Pittsburg. The schedule of prices for manganese ores delivered at Bessemer, Pennsylvania, December, 1891, was as follows:

Prices paid for manganese ore delivered at Bessemer, Pennsylvania, December, 1891. (*a*)

	Price.	
	Iron (cents per unit).	Manganese (cents per unit).
Ore containing over 49 per cent. metallic manganese	10	31
Ore containing from 47 to 49 per cent. metallic manganese	10	30
Ore containing from 45 to 47 per cent. metallic manganese	10	29
Ore containing from 43 to 45 per cent. metallic manganese	10	28
Ore containing from 40 to 43 per cent. metallic manganese	10	27
Oro containing from 36 to 40 per cent. metallic manganese	10	26
Ore containing from 32 to 36 per cent. metallic manganese	10	25
Ore containing from 28 to 32 per cent. metallic manganese	10	23
Ore containing from 24 to 28 per cent. metallic manganese	10	21
Ore containing from 20 to 24 per cent. metallic manganese	10	20
Ore containing from 16 to 20 per cent. metallic manganese	10	19
Ore containing from 12 to 16 per cent. metallic manganese	10	18

a Prices are based on ores containing not less than 8 per cent. silica and not less than 0.100 per cent. phosphorus, and are subject to deductions as follows: For each 1 per cent. silica in excess of 8 per cent., 15 cents per ton; for each 0.020 per cent. phosphorus in excess of 0.100 per cent., 1 cent per unit of manganese. Settlements are based on analyses made of samples dried at 212 degrees; the percentage of moisture in samples as taken being deducted from the weight.

ARKANSAS.

Little can be added to what has been said in previous volumes of "Mineral Resources" regarding the manganese ore deposits of Arkansas. There are two localities in the state in which the ore is found in quantities, one covering portions of Independence and Izard counties in the northeastern part of the state, and known as the Batesville region; the other in the southwestern portion of the state, extending from Pulaski county on the east to Polk county and the Indian Territory on the west. All of the manganese ore produced commercially in this state has been from the Batesville region. The work done in the southwestern portion of the state has been chiefly in the way of development.

The production of manganese in Arkansas in 1891 was 1,650 tons, with a total value of $18,150, an average of $11 a ton. This is the smallest production of this region since 1885. The pockety character of deposits of manganese ore is well shown by this variation in the production of this region, which is one of the most important in the United States, it being excelled in production only by the Crimora district of Virginia and the Cartersville district of Georgia. The manganese, however, is of a high character. The average analysis of the shipments from this district in 1891 was 52 per cent. of manganese and 0.156 per cent. of phosphorus.

The production of manganese in Arkansas since the beginning of shipments in 1850, as far as can be ascertained, is shown in the following table. The authorities for the figures are quoted in each instance. It has been estimated that the total production of manganese in Arkansas from 1850 to 1885 amounted to 5,000 tons, but this is probably exaggerated. The product from 1881 to 1884, inclusive, has been obtained from the railroad reports of shipments and may be considered fairly reliable. From 1885 to 1888 and for 1890 and 1891, the statistics were collected for Mineral Resources of the United States, while those for 1889 are from the mineral volume of the Eleventh Census. The figures from 1885 to 1891 have been verified by statements of shipments kindly furnished by the officers of the Saint Louis, Iron Mountain and Southern railroad.

Production of manganese in the Batesville district of Arkansas to December 31, 1891.

Years.	Authority.	Long tons.
1850 to 1867	Estimated	400
1868	do	10
1881	Railroad reports of shipments	100
1882	do	175
1883	do	400
1884	do	800
1885	Mineral Resources of the United States	1,483
1886	do	3,316
1887	do	5,651
1888	do	4,312
1889	Census	2,528
1890	Mineral Resources of the United States	5,339
1891	do	1,650

CALIFORNIA.

But little exact information has ever been obtained regarding the production of manganese in California. It is produced in a small way for use in the manufacture of chlorine for gold-smelting purposes. It was estimated in the report on Manganese in the Mineral Resources volume for last year that the total amount of manganese produced in California up to the close of 1890 was between 6,000 and 6,500 tons. This is on the basis that 5,000 tons were mined for shipment to England from 1867 to 1874. After 1874 only small amounts were produced each year, the product for 1889 being 53 tons, and for 1890, 386 tons. The production for 1891 is reported as 705 tons, worth $3,830 or $5.44 a ton.

As nearly as can be ascertained the following represents the production of manganese in California from the beginning of mining:

Total production of manganese in California to December 31, 1991.

Years.	Tons.
1874 to 1888	6,000
1889	53
1890	386
1891	705
Total	7,144

All of this manganese produced in 1891 was from two mines, one in Alâmeda, the other in San Joaquin county.

COLORADO.

Colorado produces two classes of manganese-bearing ores, a manganiferous iron ore, used to some extent in the production of spiegeleisen, and a manganiferous silver ore, used as a flux in the smelting of silver-lead ores. The manganiferous iron ores carry, as a rule, but little silver. These ores are all from the upper workings of the Leadville silver deposits, and carry manganese in varying quantities, from 5 up to 25 per cent., and occasionally 30 to 35 per cent., with 0 to 20 ounces of silver, 0 to 4 per cent. of lead, 7 to 18 per cent. in silica, and 30 to 50 per cent. of iron. It is stated that there are not more than three properties in the Leadville silver district where the ores do not carry iron and manganese.

As stated above, those high in manganese and low in silver are sold for the manufacture of spiegeleisen, while those carrying silver and not too high in silica are sold to the silver smelters and paid for according to the content of silver. It is usual for the smelters to buy these ores according to their so-called "silica excess"—that is, the excess of iron and manganese over silica. This "silica excess" is placed at 40 per cent.—that is, there must be an excess of 40 per cent. of manganese and iron over the silica in the ore, and it is then accepted and paid for, not according to its iron and manganese contents, but its silver. When the "excess" is above 40 per cent. the excess is paid for at 10 cents a unit. Thus, an ore with the following composition: metallic manganese, 25 per cent.; metallic iron, 30 per cent.; silica, 2.5 per cent., and silver, 5 ounces, would have an excess of iron over silica of 52.5 per cent., or 12.5 per cent. above the 40 per cent. minimum excess. This, at 10 cents a unit, would be $1.25; the 5 ounces of silver, at 45 cents an ounce, would be $2.25, and the ore would be worth $3.50. It will not pay to produce these ores at less than $3.50, free on board at mines.

The total amount of ore shipped to spiegel furnaces in 1891 was 964 tons, which contained an average of 34.4 per cent. of manganese. This was to fill orders that had been taken in 1890. No contracts for this class of ore having been made with spiegel furnaces in 1891, though ore carrying as high as the above average was mined in 1891. It was used in silver smelting. It is estimated that this ore was worth $7.50 a ton free on board at the mines. In addition to this ore 59,951 tons of manganiferous silver ore, carrying an average of 15 per cent. manganese, and 19,560 tons carrying 20 per cent. and upwards of manganese were produced. There is no way of getting at the value of this ore except as stated above, that is both its silver and manganese must be considered. It has been estimated that the average value of this 79,511 tons would be $5 a ton. As heretofore, the writer is again greatly indebted to Mr. Franklin Ballou for assistance in collecting these statistics of production in Colorado.

The statistics of production of manganese in Colorado, 1889 to 1891, are as follows:

Production of manganiferous ores in Colorado, 1889, 1890, and 1891.

	1889.	1890.	1891.
	Long tons.	*Long tons.*	*Long tons.*
Manganiferous iron ores used for spiegeleisen	2,075	....	964
Manganiferous silver ores, with 20 per cent. and over of manganese	9,987	7,826	19,560
Manganiferous silver ores, with less than 20 per cent. of manganese	55,000	44,014	59,951
Total	67,062	51,840	80,475

The total value of the ore produced in 1891 was $404,775.

GEORGIA.

Georgia still holds the second position among the states as a manganese producer, its production in 1891 being 3,575 tons. This amount was exceeded by only one state, Virginia, which produced 16,348 tons. Little can be added to what has been said in previous reports as to the ore-producing districts of this state. Manganese mining was begun in the Cartersville district as early as 1866, 550 tons being mined and sold in that year.

The chief deposit, the Cartersville, is in the northwestern part of the state in Bartow county, extending into Cherokee county. Other deposits have been found in the extreme northwestern part of the state, in what is known as the Cave Spring district, but the production is almost entirely from the Cartersville region.

Quite recently there has been considerable agitation in Georgia regarding the building of furnaces to manufacture ferro-manganese and spiegeleisen from Georgia ores instead of shipping them to Johnstown, Pittsburg, and other places in the north for smelting. The Georgia Manganese and Mining Company contemplates, with some prospect of success, the building of a 10-ton furnace near Cave Spring. The company owns some 420 acres at this point, having a washing plant with a capacity of 20 tons per twenty-four hours. An average analysis of 117,000 pounds of this ore made by Carnegie Brothers & Company shows as follows:

Analysis of Georgia manganese ore.

	Per cent.
Phosphorus	0.062
Iron	5.239
Silica	9.4
Metallic manganese	46.401

The production of manganese in Georgia in the years since 1879, since which time we have had fairly correct reports, has varied from 749 tons in 1890, the year of the lowest production, to 9,024 tons in 1887. The production arose in 1891 to 3,575 tons. This, however, does not nearly equal the average production from 1886 to 1889, inclusive.

The following table shows the annual production of manganese ores in Georgia, so far as it could be ascertained:

Production of manganese ore in Georgia from 1866 to 1891, inclusive.

Years.	Quantity.	Years.	Quantity.
	Long tons.		*Long tons.*
1866	550	1879	2,400
1867		1880	1,800
1868		1881	1,200
1869		1882	1,000
1870	5,000 (1867–1873)	1883	....
1871		1884	....
1872		1885	2,580
1873		1886	5,981
1874	2,400	1887	9,024
1875	2,400	1888	5,568
1876	2,400	1889	8,208
1877	2,400	1890	749
1878	2,400	1891	3,575

INDIAN TERRITORY.

Indian Territory appears in 1891 for the first time as a producer of manganese. In this year 206 tons were mined and sent to Chicago for manufacture into spiegeleisen. As the deposit was some 20 miles from the railroad, the cost of hauling the ore to the point of shipment was so great as to forbid the continuance of mining for the manufacture of spiegeleisen at a distance from the deposit. A project to erect a furnace at the mine is under consideration. The ores as shipped run from 36 to 40 per cent. of manganese, though analyses of sample ores would indicate a content of from 40.28 to 63.50 per cent. The deposit is in the Chicasaw Nation, Indian Territory, some 60 miles north of Denison, Texas, and 15 miles west of Lehigh in the Indian Territory. It is stated that the deposit lies on the Lower Silurian, just below the Middle Silurian limestones, occurring in pockets of greater or less magnitude, which contain both the black oxide and the carbonate of manganese, the black oxide lying usually in the upper part of the pockets, though they are sometimes found at the bottom, under the carbonates.

Analyses of 11 samples of ore from this bed are given below:

Analyses of Indian Territory manganese ore.

Silica.	Iron.	Manganese.	Phosphorus.	Sulphur.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
.30	2.46	51.78	.053	....
.75	3.07	59.55	.026	....
.85	4.92	40.28	.046	....
1.30	1.23	43.18	.036	....
2.00	1.84	49.34	.053	....
.60	5.53	52.35	.056	....
1.40	5.95	42.95	*a* .050	....
.35	1.23	63.50	*b* .023	....
.83	2.46	46.05	.047	.024
.73	3.58	44.07	.033	.04
....	....	42.71	.060	....

a Sampling from one carload.
b Clay ore. Another analysis of clay ore showed 67 per cent. of manganese.

The carbonates are stated to contain from 25 to 44 per cent. of manganese and to be quite low in phosphorus, silica, and iron.

The deposit has been examined for some 15 miles. It is in close proximity to coal, iron ore, and lime.

While, as stated above, the 200-ton shipments in 1891 did not run as high in manganese as it was hoped they would from the sample analyses, it is reported that better deposits have been found since the beginning of 1892.

The total production of manganese in the Indian Territory in 1891 was 206 tons, valued at $1,174 or $5.70 a ton, free on board cars.

MICHIGAN.

It is reported that quite a quantity of high grade manganese was found in the Mastodon mines of the Lake Superior Company. The deposit lay above the iron ore, was a small lead, from 6 inches to 3 feet in thickness, lying on top of 4 to 6 feet of bog ore, which, in turn, was underlaid by 30 feet of sand, resting upon a ledge of jasper and lean ore.

A number of analyses of this ore are reported, of which the highest and lowest are as follows:

Analyses of Lake Superior manganese.

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Iron	0.50	17.46
Phosphorus	trace	.064
Silica	3.00	9.10
Manganese	61.50	29.81

Three other analyses give the percentage of manganese at 51.50, 50.84, and 48.30. No further information regarding this deposit than the above has been obtained.

MONTANA.

Argentiferous manganese ores, similar in character to those mined in Colorado, are found in Montana. So far as has been learned, however, no ore was produced in this State in 1891 and sold as manganese ore or for any additional sum because of the manganese contained in it.

NEVADA.

So far as has been learned only one deposit is known in this State, at Golconda, on the Central Pacific Railroad. The product of this mine in 1891 was reported at fifteen tons, worth $83. In 1890 the amount taken out was stated to be 100 tons, worth $300.

NORTH CAROLINA.

No manganese ores were mined in North Carolina in 1891. The amounts reported as being mined in this State heretofore have been only for experimental purposes. According to our returns, the production for the years since 1886 has been as follows:

Production of manganese in North Carolina from 1886 to 1891.

Years.	Long tons.
1886	15
1887	14
1888	50
1889	47
1890	14
1891	....

SOUTH CAROLINA.

No product of manganese in this State was reported for the years 1890 and 1891. There are quite extensive deposits of manganese and manganiferous iron ores in this State, but they are either so inconveniently located or the content of manganese is so low as not to justify the working of the mines.

The total production of manganese ore in South Carolina, so far as the same has been ascertained, is as follows:

Total production of manganese ore in South Carolina.

Years.	Tons.
1885 and 1886	300
1887	45
1888	50
1889	124
1890	....
1891	....

SOUTH DAKOTA.

A small amount of manganese ore was produced in South Dakota in 1891, one car load of 19 tons having been shipped from Custer county, netting at the shipping point $8 a long ton. An analysis of this ore was as follows:

Analysis of South Dakota manganese ore.

	Per cent.
Metallic manganese	46.05
Metallic iron	3.93
Phosphorus	.050
Silica	8.00
Moisture	4.70

The ore is stated to be in vertical veins, but development has not proceeded far enough to determine its extent.

TENNESSEE.

Though the first manganese produced in the United States was mined in Tennessee for use in coloring earthenware, the state has never assumed any importance as a source of manganese. The production at the mine referred to, which began in 1837 and which has never amounted to more than a few hundred pounds each year, still continues. Outside of this the total production of the state, so far as has been learned, has been but 96 tons, all of which has been mined since 1885.

VERMONT.

This state, which some years ago produced considerable manganese, and which in 1888 and 1889 gave promise of being an important source of the ore in the future, has again fallen to its former insignificance, but 49 tons, worth $245 or $5 a ton, being reported as having been mined in Vermont in 1891.

The production of manganese in Vermont for the last four years is given as follows:

Production of manganese in Vermont 1888 to 1891.

Years.	Long tons.
1888	1,000
1889	1,576
1890	0
1891	49

VIRGINIA.

Virginia still continues the most important manganese-producing state in the Union, its production in 1891 being 16,248 tons out of a total of 23,416. This is the largest production reported in this state since 1888. The total value of this 16,248 tons was $180,533, the average value being $11.17 a ton.

As has been the case for many years the larger part of the production of Virginia is from the Crimora mine or from the group of mines at Crimora. Of the total of 16,248 tons in Virginia in 1891, 13,645 were from Crimora.

The manganese deposits of Virginia have been so thoroughly described in previous volumes of "Mineral Resources" that it is not necessary to repeat this description here.

The production from 1880 to 1891 is as follows:

Production of manganese in Virginia from 1880 to 1891.

Years.	Long tons.
1880	3, 661
1881	3, 295
1882	2, 982
1883	5, 355
1884	8, 980
1885	18, 745
1886	20, 567
1887	19, 835
1888	17, 646
1889	14, 616
1890	12, 699
1891	16, 248

CHILE. (a)

Geological researches undertaken some years since by the Chilean government developed the existence of immense deposits of manganese ores, especially in the northern provinces of the republic. In most cases, however, these deposits are too far from the coast to be profitably worked and sent to market under present conditions, as, in addition to the cost of transportation to the coast by most expensive methods of carriage, the ore must also bear the cost of transportation to England and the United States, where it finds market, there being no local demand.

There are in Chile two manganese mining districts known as the Coquimbo and the Carrizal. The latter is sometimes known as the Huasco. The Coquimbo district takes its name from the province in which the mines are situated, the port of shipment also being Coquimbo. Both of the names of the second district are from the ports of shipment, which are 35 to 40 miles distant from the mines. The mining district is known as Chanar Quemada, and is in the province of Atacama. Production in the latter district began in 1886; in Coquimbo some years prior to that date.

The first attempts at mining manganese ores in Chile were made in 1881, when a bed in the province of Santiago was opened, the ore being taken to Valparaiso for shipment to England. The cost of conveying the ore to this port, however, proved an insuperable obstacle to the success of the undertaking, and it was abandoned.

a Condensed from *American Manufacturer* of December 25, 1891, and July 8, 1892.

After the abandonment of the Santiago mines a deposit in the province of Coquimbo was opened, and in 1885, 4,106,045 kilograms, equal to 4,041 long tons, were exported to England, the average content of manganese being 45 to 55 per cent., averaging 52 per cent. The beds of manganese worked in the province of Coquimbo are chiefly surface deposits, requiring no expensive or scientific mining. The cost, therefore, of producing the ore is trifling; the ore runs in ridges, the tops of which are visible, the ore being extracted chiefly by crowbar and sledge. The great expense, however, is the cost of transportation, which, though the beds are worked in close proximity to the railroad, and though the ore is conveyed to a port of shipment on very liberal terms, make it cost $5 to $7.50 (American money) per ton by the time it is placed alongside a vessel at Coquimbo. The ore from this district contains considerable peroxide, and is softer than that from the Carrizal district.

The second, and at present the only other producing district, is that known as the Carrizal, and sometimes as the Carrizal and Huasco from the ports of shipment. The manganese mines of this district were discovered in 1886, and at the end of that year a small lot was sent to the coast to be shipped. The lode had been often assayed before this, but as it was neither copper nor silver it was not considered of any value. The mines are situated from 35 to 40 miles from the port of Carrizal, and about the same distance from Huasco, but for most of the mines Carrizal is the shortest road to the sea.

Carrizal is situated in south latitude 28° 4′, and west longitude 71° 11′, and is connected with the manganese mine by a railway which goes in to the conchas of the principal mine; the other mines have cart roads, and are from 2 to 3 miles distant from the railway.

The manganese ore is found in nearly vertical lodes of from a few inches to about 10 feet wide, or more, but the commoner width is about 3 feet. There were heavy outcrops on the surface forming walls or dikes 10 or more feet high. These were worked as open quarries, and many open quarries yet exist, but now the ore is usually worked underground as mines. The walls of the lode are not well formed, nor is there any natural cleavage between the ore and the walls, nor is the manganese regularly continuous for any great distance; there are sudden "faults" or disappearance of the manganese, it having been pushed to one side or other, making it difficult to find the lode again.

The ore averages 50 per cent. of metallic manganese, is hard and brittle, with a glassy fracture, and has no soft powder-like deposits as some of the Coquimbo manganese. Every pound of it must be taken out by blasting.

A production of about 15,400 tons a year, the average of the last four years, can not be regularly exceeded, for though there is no indication of exhaustion of the mines some of them are getting deep, which will make it more difficult and expensive to get out every year. The low range of hills which contains these mines rises some 500 feet above the inland plain, which plain is 1,200 above sea level and 25 miles distant from the sea in a straight line to a point about equal distance between Carrizal and Huasco. The hill and lode run due north and south for a distance of about 7 miles. The principal mines are situated within 3 miles of the north end, then after a barren piece of about 3 miles, where no manganese crops out, there is over a mile of outcropping mines, with good ore, but capricious and much broken-up lodes. This is the south end of the mineral and is not worked at present.

No other lode of manganese rich enough to work has been discovered in north Chili.

The production of Coquimbo since 1885 and Carrizal since 1886, and the total production of Chile since 1885 in tons of 2,240 pounds, is as follows:

Production of Chilean manganese, 1885 to 1891.

	Coquimbo.	Carrizal.	Total Chile.
	Long tons.	*Long tons.*	*Long tons.*
1885	4,041	....	4,041
1886	23,701	227	23,928
1887	38,234	9,287	47,521
1888	12,132	6,581	18,713
1889	9,145	19,538	28,683
1890	23,409	24,577	47,986
1891	16,462	18,000	34,462

Twelve vessels cleared from Carrizal in 1891, carrying 18,000 tons of manganese. Of these two were lost.

No statistics of production prior to 1885 have been obtained.

The following analyses of Chilean manganese are from a paper by Messrs. John and H. N. Pattinson. They are made from samples taken from cargoes of about 1,000 tons each, and may be regarded as representing the nature of the Chilean ores heretofore imported:

Analyses of Chilean manganese.

	I.	II.	III.
	Per cent.	*Per cent.*	*Per cent.*
Peroxide of manganese	69.23	55.06	66.03
Protoxide of manganese	11.92	23.05	10.39
Peroxide of iron	1.67	4.71	1.50
Oxide of lead	0.09	0.06	0.05
Oxide of copper	0.15	None.	0·14
Oxide of zinc	0.10	None.	None.
Alumina	4.21	2.80	1.60
Baryta	None.	None.	3.58
Lime	1.13	2.33	5.36
Magnesia	0.24	0.56	0.13
Potash	2.86	0.46	0.15
Soda	0.08	0.26	0.11
Silica	4.17	7.30	4.75
Carbonic acid (CO^2)	None.	0.18	2.53
Sulphuric acid (SO^3)	0.05	0.13	1.57
Phosphoric acid (P^2O^5)	0.12	0.14	0.05
Arsenic	(?)	0.15	0.04
Combined water	3.90	3.00	1.96
Total	99.92	100.19	99.94
Metallic manganese	53.00	52.66	49.79
Sulphur	0.02	0.05	0.63
Phosphorus	0.05	0.06	0.02

The analyses were made on samples dried at 100° C., at which temperature they lost, respectively, 2.47 per cent., 1.08 per cent., 0.98 per cent. of hygroscopic moisture.

No. I comes from the neighborhood of Santiago; Nos. II and III are from the vicinity of Coquimbo and Carrizal. Nos. I and II are very hard, compact, amorphous ores, of a bluish-black color, and often exhibit a conchoidal fracture; No. III, which contains more peroxide than the others, is softer and of rather a darker color. Crystals of calcium carbonate are frequently disseminated through it.

A characteristic of Chilean manganese ores is the large percentage of protoxide of manganese they contain. In Caucasian and Spanish ores there is not often more than from 1 to 2 per cent. of protoxide. It is known that manganese dioxide acts the part of the feeble acid, and when precipitated carries down with it as manganites protoxide of manganese, baryta, lime, potash, and other bases with which it was in solution, and it is probable that in these ores the protoxide of manganese, the potash, and portions of the baryta, lime, and other bases shown in the above analyses have been precipitated in combination with the peroxide in the form of manganites.

Baryta is frequently found in other manganese ores. Some Caucasian ore contains as much as 2.04 per cent. Potash also is found in other ores, though not often in such quantities as in No. I. "We have, however," state the Messrs. Pattinson, "met with one specimen, not Chilean, which contained as much as 4.15 per cent. The silica in Chilean ore occurs sometimes as quartz and sometimes as silicate of manganese."

The percentage of phosphorus in Chilean ores is very low, a matter of great importance to the steel maker. The amount varies to a slight extent in various cargoes, and about 0.1 per cent. has sometimes been found. No. II contains a small quantity of arsenic, which has been shown by Pattinson and Stead (Journal of the Iron and Steel Institute, 1888, Part I) not to be so deleterious an ingredient of steel as phosphorus.

No statement as to costs and prices could be obtained except those given above. The ore workings are so irregular, and the distance the ore is carried to the seaport, at which point the price would be fixed, varies so greatly, that no satisfactory average could be given. The selling price is controlled entirely by the value of the ore in England and the United States, and fluctuates not only as these values change, but with the rates of freight obtainable in sailing vessels.

CUBA. (a)

The principal Cuban deposits of manganese are located in the province of Santiago de Cuba. The topography of that part of the country is somewhat broken. The range of mountains called the Sierra Maestra, with its highest peak towering 7,670 feet above sea level, skirts the southern coast. This great range is broken into much smaller and lower ranges of mountains or foothills, at the summit or on the flanks of which the manganese deposits are usually found. The most abundant ores are pyrolusite of a highly crystalline variety and psilomelane. Wad is also found to a large extent at some of the mines.

The mode of occurrence does not differ from that observed in other deposits. The ore is found in pockets usually embedded in clay. Sometimes these pockets contain several hundred tons of ore, forming a more or less compact mass almost entirely free from impurities. At other times the ore is found in lumps of various sizes and more or less mixed up with clay and fragments of jasper. The large lumps can be picked out by hand, but the small ones have to be wasted unless washing is resorted to.

The most extensive deposits are those forming the Ponupo group of mines, which covers an area of 752 acres.

From the Vencendora mine of this group some 6,000 tons have been taken, and pits already sunk have developed a body of at least 300,000 tons more. The ore pockets are 20 feet wide. The quality of the ore is varied, but is always of as rich a grade as pyrolusite, practically free from phosphorus, with little silica, and carrying 50 to 56 per cent. metallic manganese. The ore was mined in a very primitive way and without the aid of any machinery whatever. The transportation to the railroad station at Cristo was by means of carts and teams, which occasioned great expense and loss of time, and which, moreover, is only practicable in the dry season. The ore was sold to Carnegie Brothers & Company, of Pittsburg, Pennsylvania, and the price paid ranged from 30 to 36 cents delivered for every unit of metallic manganese with allowances for iron, silica, etc., which represents an average of $19 per ton. Work has been stopped pending negotiations for the construction of a railroad.

At the Sultana mine explorations show the existence of some 200,000 tons of ore; at the Balkanes, 100,000 tons; in the Generala and the Serrallo, 150,000 tons, and at other mines not developed large deposits are known to exist. On the whole it has been estimated that 800,000 tons of manganese can be won in this group. The following statement as to the actual cost of producing ore in this group of mines by the primitive methods that have been in use and an estimate of the cost with improved methods and a railroad have been given:

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a Condensed from the *American Manufacturer*, May 27, 1892.

Costs for producing Cuban manganese.

Cost to the owner:		Cost to the proposed company:	
Extraction	$0.50	Extraction	$0.50
Bagging	.30	Freight, railroad to Cristo	.60
Transportation in cars to Cristo	6.00	Freight to Cuba	1.27½
Freight railroad to Cuba	1.27½	Freight to New York	2.50
Loading and unloading	.30	Administration	.50
Shipping and freight to New York	4.50	Royalty	2.50
Administration	1.00	Cost in United States	7.87½
	13.87½		

Considerable ore has been taken from the Marguerita group of mines. At the Pabelita mine, in this group, work was begun in 1889. This mine is 3,180 meters from the railroad station at Cristo, at an elevation of 180 feet. The ore is largely pyrolusite, assaying more than 50 per cent. metallic manganese. Some 15,000 tons of ore have been mined here. Quite a quantity of the ore produced is wasted for want of a washing plant. From the Marguerita mine some 300 tons have been produced; from the Balsford, 700; from the Pilar, 500 tons; the Thiers, 1,000 tons; the Fodera, 2,000 tons; and various smaller amounts from other mines. From the Boston mine some 12,000 tons have been extracted from one pocket. The dimensions of this pocket are 300 feet long, 30 feet wide, and 32 feet deep. The ore analyzes 48 per cent. to 52 per cent.

The Bueney group of mines is the smallest. It comprises the San José and Gloria, from which some 2,000 tons of a 54 per cent. to 58 per cent. manganese have been extracted. In the Magdalena group, near the Sigua Iron Company's mines, there is an abundance of rich ore. The Portello mines have not been worked to any extent.

The exportation of manganese ores from the mines near Santiago since 1888 is as follows:

Exportation of manganese ores from Santiago district, Cuba, from 1888 to 1891.

Years.	Tons.
1888	1,942
1889	704
1890	21,810
1891	21,987
Total	46,443

GREAT BRITAIN.

Small quantities of manganese ore, usually in the form of psilomelane with some pyrolusite, are found in Merionethshire. It occurs in the Lower Silurian. In a recent paper read before the North of England

Mining and Mechanical Engineers, by Edward Halse, he stated that in one of the hills northeast of Arenig, consisting mainly of Upper Trappean ash, with a mass of feldspathic porphyry cropping out of the northern side, various veinlike fissures of manganese and iron ore are traced. A sample of this ore is as follows:

Analysis of Merionethshire manganese ore.

	Per cent.
Manganese	46.07
Silica	14.00
Phosphorus	0.147
Iron	1.7

Regarding this deposit Mr. Halse stated: "In one vein the rib was 21 inches thick, and was separated from a 9-inch rib by 11 feet of moderately soft rock, and near what appeared to be the hanging wall were several ribs of ore, separated by soft decomposed rock. Another vein was found 3 feet wide, and the contents consisted of impure earth, brown oxide of iron, with patches of pyrolusite or psilomelane. From a careful examination of this and other veins it would appear that there is no distinct evidence of these being fissure veins, the manganese merely locally filling the joints and certain superficial fissures in the country rocks. It appears that the manganese has come from the feldspathic ash itself, and as a result of surface erosion and decomposition has been leached out from it and deposited in the joints and fissures. It would be interesting to know to what depth the manganese ore actually penetrated, and can be profitably extracted from the veins and veinlike fissures."

Though the ores of manganese above noted are found in Merionethshire, the chief ore produced in Great Britain is a carbonate found in the same county.

The total production of manganese ore in England and Wales for 1891 is as follows:

Production of manganese ore in England and Wales in 1891.

Counties.	Quantity.	Value at the mine.
	Tons.	
Carnarvonshire	235	£152
Derbyshire	71	36
Devonshire	130	181
Merionethshire	8,990	5,769
Somersetshire	50	75
Total	9,476	6,213

The total production of manganese in Great Britain for the years from 1882 to 1891 is as follows:

Production of manganese in Great Britain, 1882 to 1891.

Years.	Tons.	Value.
1882	1,548	£3,907
1883	1,287	2,976
1884	....	....
1885	1,688	....
1886	12,763	....
1887	13,777	11,110
1888	4,342	1,934
1889	8,852	6,478
1890	12,444	6,733
1891	9,476	6,213

It is estimated that from 1835 to 1839 the production of manganese in Great Britain was 5,000 tons a year. In 1873 it was 8,254 tons. In 1875 there were sixteen mines in operation, which produced 3,725 tons.

NEW ZEALAND.

Manganese ore has been produced in New Zealand continuously since 1878, in which year this mineral appears for the first time among the exports from the colony. As none of the ore is consumed in New Zealand the exports are practically the measure of the production. The largest export in any one year was in 1878, when 2,516 tons, valued at $50,413 were exported. It hardly seems possible that this can be the correct value of the ore produced, as it would make it worth about $20 a ton, a price it would hardly bring, even after freight to England had been paid.

The commercial ores of New Zealand are chiefly braunite, with some pyrolusite, the latter occurring sparingly.

The statistics of production available are not complete. It is stated in the Handbook of New Zealand Mines, published in 1887, that 12,000 tons of manganese, valued at over $193,600, had been exported up to the close of 1885. Another report gives the total quantity produced up to the close of 1890 as 15,303 tons, valued at $248,248. The same remark regarding valuation can be made as is given above. The value seems especially high in view of the fact that in the details for 1890 no ore is valued above £2 5*s*, which would be $12.10 a ton.

The production of New Zealand for the years for which detailed statements have been secured is as follows:

Production of manganese ore in New Zealand, 1878–1890.

Years.	Tons.	Value.
1878	2,516	$50,413
1879	2,140	40,356
1880	....	....
1881	1,271	15,890
1882	....	....
1883	....	....
1884	318	3,911
1885	602	8,305
1886	....	....
1887	....	....
1888	1,085	11,635
1889	1,080	5,227
1890	1,170	12,741

RUSSIA.

Most of the production of manganese in Russia is in the southern part, chiefly in the Caucasus, the shipping points being Poti and Batoum. One statement of the exports since 1886 from these two ports is reported as follows:

Exports of Russian manganese, 1886 to 1890.

Years.	Poti.	Batoum.	Total.
	Tons.	*Tons.*	*Tons.*
1886	35, 413	19, 304	54, 717
1887	49, 360	9, 977	59, 337
1888	41, 952	6, 891	48, 843
1889	40, 700	11, 219	51, 919
1890	120, 336	10, 362	130, 698
Total	187, 761	57, 753	245, 514

According to a statement published in the *Viestnik Finançoff*, manganese is produced in the Ural, Orenburg, Caucacus, Ekaterinoslav, the production from May, 1889, to April, 1890, being 102,468⅛ metric tons, and for a corresponding period, 1890–'91, 77,942⅛ metric tons. The manganese of the Uural is smelted at local works; that for Ekaterinoslav at the works of Briansk and Novorassisk, the only manganese exported being from the Caucasus.

ALUMINUM.

By R. L. Packard.

Aside from the merely industrial aspect of the subject, the history of aluminum is unique in affording an opportunity to study the growth, absolutely *ab initio* and within the space of one generation of men, of a metallurgical industry operating upon a new metal. Thirty-five years ago aluminum was as much a chemical curiosity as any one of the rare metals is to-day. Through the efforts of Deville it first acquired a commercial character, and its extraction was transferred from the sphere of laboratory experiment to become a metallurgical process. Since his day the development of electro-metallurgy, largely due to the attempts to produce aluminum economically, has increased to such an extent that the chemical process founded by him has now given way to the electrical form of metallurgy in extracting the new metal. Following this change in metallurgy and the increase in its production, attention has been drawn to other materials as sources of the metal than the cryolite formerly used, and new occurrences of the ore of aluminum, which has now acquired an increased value, are sought for. This increase of commercial demand, in turn, has caused the new ore and its deposits to be studied and explained by the aid of the most recent scientific methods. From the technical and industrial point of view, we have now to deal with ores of aluminum as well as ores of iron. From the scientific standpoint, while much is known of the origin of iron ores, little special attention has yet been paid to the genesis of ores of aluminum on account of the recent appearance of the latter metal in the arts. This metal, however, has the advantage of making its debut in the full light of every known modern means of investigation—chemical, mineralogical, geological, and petrographical—and the scientific explanation of its origin will doubtless be speedy and full. To supplement the technology of the metal, it is deemed advisable to collect and introduce here what is at present known of its ores and their occurrence and origin.

In the census bulletin on aluminum, prepared under the supervision of this Division, it was stated that the aluminum produced in this country (by the Pittsburg Reduction Company) was then (1889) mainly obtained from Greenland cryolite. No workable deposits of cryolite have been authentically reported in this country. The deposit at the southern base of Pike's Peak, Colorado, described by Messrs. Cross and

Hillebrand, in Bulletin No. 20 of the U. S. Geological Survey, was shown by them to be only of mineralogical interest. Bauxite deposits and "alum beds" of considerable extent have, however, been found, and the former mineral is used as a source of aluminum. It is the ore of aluminum and occurs in Georgia, Alabama, and Arkansas.

The mineral received its name from Baux, a village in the south of France, where it was first found, and the more highly ferriferous variety was regarded and worked as an iron ore, but proved too refractory. It sometimes ran as high as 42 per cent. metallic iron. The analysis by Berthier revealed its true character. The geological occurrence of the bauxite of Baux was studied by H. Coquand (*Bull. de la Société Geologique de France*, vol. 28, p. 98, 1871), who describes the mineral as of three varieties, pisolitic, compact, and earthy. The pisolitic variety does not differ in structure from the iron ores of Franche Comté and Berry, although the color and composition are different. It occurs in highly tilted beds alternating with limestones, sandstones, and clays, belonging to the upper cretaceous period, and in pockets or cavities in the limestone. The limestone containing the bauxite and that adjacent thereto is also pisolitic, some nodules being as large as the fist, and the pisolitic bauxite has sometimes a calcareous cement, and at others is included in a paste of the compact mineral. M. Coquand supposed that the alumina and iron oxide composing the bauxite were brought to the ancient lake bed in which the lacustrine limestone was formed by mineral springs, which, discharging in the bottom of the lake, allowed the alumina and iron oxide to be distributed with the other sediment. In some cases the discharge occurred on land, and the deposit then formed isolated patches. He refers to other similar deposits of bauxite of the same period in France. Sometimes the highly ferriferous mineral predominates over the aluminous (white), at others diaspose is found enveloping the red mineral, while in other cases it is mixed with it, predominating largely, and sometimes manganese peroxide replaces ferric oxide. In some places the ground was strewed with fragments of tuberous menilite, very light and white.

M. Angé (*Bull. Soc. Geolog. de France*, 16, p. 345, 1888) describes the bauxite of Var and Hérault and gives analyses of it. Over 20,000 tons were being mined in this region annually at the time of writing his report (1888). In the red mineral of Var druses occur with white bauxite running as high as 85 per cent. Al_2O_3, and 15 per cent. H_2O, corresponding to the formula $Al_2O_3+H_2O$. He refers to the prevailing theory of the formation of bauxite, according to which solutions of the chlorides of aluminum and iron in contact with carbonate of lime undergo double decomposition, forming alumina, iron oxide, and calcium chloride. Other deposits in the south of France, in Ireland, Austria, and Italy, he says, confirm this view, because they also rest upon or are associated with limestone. The bauxite deposit in Puy de Dome which he studied could not, however, be explained by this theory because it was not associated with limestone, but rested directly upon gneiss and was partly covered by basalt. The geological sketch map of the deposit near Madriat, Puy de Dome, which he gives shows gneiss, basalt, with uncovered bauxite largely predominating, and patches of miocene clays, while a geological section of the deposit near Villeveyrac, Hérault, shows the bed of bauxite conformably following the flexures of the limestone formation when covered by more recent beds, and when exposed and denuded occupying cavities and pockets in the limestone. This occurrence is substantially the same as that of the neighboring Baux. M. Angé agrees with M. Coquand in attributing the bauxite to geyserian origin. He uses as an illustration of the contemporaneous formation of bauxite the deposits from the geysers of the Yellowstone park, which is evidently due to a misunderstanding. He made no petrographical examination of the bauxite of Puy de Dome, nor did he attempt to trace any genetic relation between the latter and the accompanying basalt. The occurrence is, however, noteworthy, and an examination might show that it is another instance of the direct derivation of bauxite from basalt, which is maintained in the two following instances, somewhat imperfectly in the first to be sure, but with greater detail in the second.

The first is a paper by Lang in the Berichte der Deutschen Chemischen Gesellschaft, Vol. 17, p. 2892, 1884. He describes the bauxite in Ober-Hessen, which is found in the fields in round masses up to the size of a man's head, embedded in a clay which is colored with iron oxide. The composition varies very widely. The petrographical examination showed silica, iron oxide, magnetite, and augite. The chemical composition and petrographical examination shows the bauxite to be a decomposition product of basalt. By the weathering of the plagioclase feldspars, augite, and olivine, nearly all the silica had been removed, together with the greater part of the lime and magnesia; the iron had been oxidized and hydrate of alumina formed as shown by its easy solubility in hydrochloric acid. The residue of the silica had crystallized as quartz in the pores of the mineral.

The more detailed account of the derivation of bauxite from basalt is given in an inaugural dissertation by A. Liebreich, abstracted in the *Chemisches Centralblatt*, 1892, No. 3, p. 94. This writer says that the well-known localities of bauxite in Germany are the southern slope of the Westerwald near Mühlbach, Hadamar, in the neighborhood of Lesser Steinheim, near Hanau, and especially the western slope of the Vogelsberg. Chemical analyses show certain differences in the composition of bauxite from different places, the smaller amount of water in the French bauxite referring it to diaspore, while the Vogelsberg mineral is probably Gibbsite (hydrargillite). The bauxites of Ireland, of the Westerwald, and the Vogelsberg, show by certain external indications their derivation from basalt. The bauxite of the Vogelsberg occurs in scattered lumps or small masses, partly on the surface and partly imbedded in a grayish white to reddish brown clay, which contains also similar masses of basaltic iron ore and fragments of more or less weathered basalt itself. Although the latter was associated intimately with the bauxite, a direct and close connection of the two could not be found, but an examination of thin sections of the Vogelsberg bauxite showed that most specimens still possessed a basaltic (anamesite) structure, which enabled the author to determine the former constituents with more or less certainty. The clays from different points in the district carrying basalt, basaltic iron ore, and bauxite were examined, some of which showed clearly a sedimentary character. Some of the bauxite nodules were a foot and a half in diameter and possessed no characteristic form. They were of an uneven surface, light to dark brown, white, yellowish, and gray in color, speckled and pitted, sometimes finely porous and full of small colorless or yellowish crystals of hydrargillite. The thin sections showed distinct medium-granular anamesitic structure. Lath-shaped portions filled with a yellowish substance preponderated (the former plagioclases) and filling the spaces between these were cloudy, yellow, brown, and black transparent masses which had evidently taken the place of the former augite. Laths and plates of titanic iron, often fractured, were commonly present and the contours of altered olivine could be clearly made out. The anamesitic basalt of the neighborhood showed a structure fully corresponding with the bauxite. Olivine and titanic iron oxide were found in the clay by washing. The basaltic iron ore also showed the anamesite structure.

The American occurrences of bauxite so far observed are in Alabama, Georgia, and Arkansas. Prof. Eugene A. Smith, state geologist of Alabama, has kindly furnished the following information in regard to the bauxite of that State. He writes:

"The mining of bauxite was begun in Alabama in November, 1891, by the Southern Bauxite Mining and Manufacturing Company, of Piedmont, Alabama, which has shipped up to date (November, 1892) about 3,600 tons. In July, 1892, the Republic Mining and Manufacturing Company, of Hermitage, Georgia (which is the pioneer in the business), secured a lease of the mines of the Bass Furnace Company, at Rock Run, Cherokee county, and has shipped up to date, about 1,300 tons. In addition to this both companies have several hundred tons under sheds drying out. The ore goes to Philadelphia and Natrona, Pennsylvania; Syracuse, Buffalo, Brooklyn, New York, and other places. * * * It comes into competition with the ore from Baux in France, which can be purchased at a lower price than that at which this region can furnish it; but it is claimed by the manufacturers that our ore is more soluble, and therefore more valuable, though containing slightly less alumina. * * * [Our] alumina runs from 56 per cent. to 60 per cent. average carload analysis. Of the insoluble matter silica is the chief ingredient. The ore contains from 2 to 3 per cent. of titanic acid, and will average from 25 per cent. to 30 per cent. of water. The ore occurs associated with limonites and kaolins in irregular beds, in the region underlaid by the Knox dolomite of the Lower Silurian formation. In Alabama these occurrences are always near to the foothills of the mountains formed of the Weisner quartzite or sandstone, which is a member of the Cambrian in this State. The bauxite therefore seems to be associated chiefly with the lower beds of the Knox dolomite. The best known occurrences are near Rock Run furnace in Cherokee county, where it has been followed for a few miles towards the Georgia line. This is the only place in Alabama where any systematic mining is done, and this by the two companies above named whose mines are closely contiguous. Near Jacksonville, Alabama, in Calhoun county, the ore has also been discovered, but not yet mined commercially.

"The mines are in S. 25, T. 11, R. 11, about 3½ miles northeast of Rock Run furnace and close to the Georgia line. In mining the limonite in one place great quantities of bauxite were moved and lie now in the dump pile. This was before it was recognized as bauxite."

The statistical information in the foregoing was furnished to Prof. Eugene A. Smith, State Geologist of Alabama, by Mr. J. M. Garvin, superintendent of the Rock Run Furnace Company.

He sends analyses, which are included with the others on a subsequent page.

The Georgia bauxite occurs in the same formation. The Bureau is indebted to Mr. J. W. Spencer, State Geologist of Georgia, for the following account of its occurrence:

"It occurs in the residual clay from decomposition of the Knox (calciferous) dolomite formation, which series is greatly developed in Georgia. The principal belt commences near Adairsville and widens out, extending in a southwest direction to Alabama. It occurs in the vicinity of brown iron and manganese ores. Indeed, the bauxite-bearing portion of the Knox series is nearly coincident with the manganese deposits. It occurs in pockets, often of great extent, and is usually covered with a few feet of clayey surface. A kaolin is often associated with it. It is mostly in concretionary nodules forming large masses or small kidney-shaped masses scattered through the clay. Much of the bauxite is light colored, but other portions contain much iron. At one locality Gibbsite occurs associated with it. It evidently has a similar origin with the brown iron or manganese ores, and was probably deposited in lagoons from solution of decomposed crystalline rocks, which occur 18 or 20 miles to the east. Alumina is slightly soluble in water containing CO_2, as are also the other metals." The analyses of the Georgia bauxite by Prof. H. C. White are given below.

An estimate of the quantity of bauxite remined in Georgia, furnished to this division by Mr. Wm. G. Neilson, of Philadelphia, gives 728 tons for 1889, 1,850 tons for 1890, and 3,300 for 1891. The total output for Alabama up to June, 1892, was 3,200 tons.

The Arkansas bauxites occur in Tertiary areas and in the neighborhood of eruptive syenites, to which they seem to be genetically related. The mineral is pisolitic in structure, and varies in color and chemical composition (analysis below). It has been mined for iron ore, some specimens yielding 50 per cent. metallic iron, and is of great abundance (Prof. J. C. Branner, *American Geologist*, VII, p. 181).

Having now traced the ore of aluminum to its origin, as far as present information will allow, the following analyses will show the wide variations in its composition.

Analyses of bauxite, from Baux.

[Analyst, Deville.]

	Compact variety.	Pisiform.	Hard and compact calcareous paste.	Bauxite from Calabres.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
SiO_2	2.8	4.8		2.0
Al_2O_3	57.6	55.4	30.3	33.2
Fl_2O_3	25.3	24.8	34.9	48.8
H_2O	10.8	11.6	22.1	8.6
TiO_2	3.1	3.2		1.6
$CaCO_3$	.4	.2	12.7	
Corundum				5.8
Total	100.0	100.0	100.0	100.0

French bauxites of two different types.

	Red bauxite from Thoronet, Var.	White bauxite from Villeveyvae Hérault.
	Per cent.	*Per cent.*
SiO_2	0.30	2.20
Al_2O_3	69.30	76.90
Fe_2O_3 and FlO	22.90	.10
H_2O	14.10	15.80
TiO_2	3.40	4.00
Total	110.00	99.00

Analyses of German bauxite.

FROM WOCHEIN.

[Analyst, Lill.]

	Per cent.
SiO_2	6.29
Al_2O_3	64.24
Fe_2O_3	2.40
CaO	.85
MgO	.38
SO_3	.20
P_2O_5	.46
H_2O	25.74
Total	100.56

FROM LANGSDORF.

[Analyst, Lang.]

	Brownish red.	Light red.
	Per cent.	*Per cent.*
SiO_2	5.14	10.27
Al_2O_3	50.85	49.02
Fe_2O_3	14.36	12.90
FeO	0.35	not det.
CaO	.41	.62
MgO	.11	trace.
K_2O	.09	.11
Na_2O	.17	.20
H_2O (ign.)	27.03	25.88
H_2O (100°)	1.35	.93
CO_2	trace.	.26
P_2O_5	.48	.38
	100.34	100.57

FROM VOGELSBERG.

[Analyst, Liebreich.]

	Per cent.
SiO_2	1.10
Al_2O_3	50.92
Fe_2O_3	15.70
CaO	.80
MgO	.16
H_2O (ign.)	27.75
H_2O (100°)	.85
TiO	3.20
	100.48

Analyses of Alabama bauxite.

[Analyst, Dr. Wm. B. Phillips.]

	From Cherokee county.	Jacksonville, Calhoun county.	Jacksonville, Calhoun county, red.	Jacksonville, Calhoun county, white.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
SiO_2	37.87	18.67	7.73	23.72
Al_2O_3	39.44	45.94	47.52	41.38
Fe_2O_3	2.27	11.86	19.95	.85
H_2O hygroscopic	9.20	1.40	} 23.57	23.72
H_2O combined	12.80	21.20		
TiO_2	....	....	....	....

Analyses of bauxite from Jacksonville, Calhoun county, Alabama.

[Analyst, W. F. Hillebrand.]

	Red.	White.
	Per cent.	*Per cent.*
SiO_2	10.25	21.08
Al_2O_3	41.00	48.92
Fe_2O_3	25.25	2.14
TiO_2	2.53	2.52
P_2O_5	trace.	trace.
H_2O (100°)	.65	.45
H_2O (ign.)	20.43	23.41
Total	100.11	98.62

CaO, MgO, and alkalies, not looked for.

Analyses of bauxite from Floyd county, Georgia.

[Analyst, Nichols.]

	Per cent.	Per cent.	Per cent.
SiO_2	2.80		2.30
Al_2O_3	52.21	57.25	56.88
Fe_2O_3	13.50	3.21	1.49
TiO_2	3.52	3.60	3.55
H_2O	27.72		
P_2O_5			.07
Total	99.75		

Analyses of bauxite from Georgia.

[Analyst, Prof. H. C. White.]

	1	2	3	4	5	6	7
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
SiO_2	19.56	41.47	2.56	8.29	6.62	35.88	1.98
Al_2O_3	52.13	39.75	56.10	58.61	59.82	45.21	61.25
Fe_2O_3	1.12	1.62	10.64	2.63	2.16	0.52	1.82
H_2O	24.21	16.14	30.10	27.42	31.10	17.13	31.43
TiO_2	2.08			3.15			2.38
Total	99.10	98.98	99.30	100.10	99.70	98.74	98.86

Number 7 is on the Barnsley estate, Dinwood Station. It is a large deposit and is being now largely opened for working. It always contains titanic acid and usually traces of alkalies, etc.

Bauxite from Pulaski county, Arkansas.

	Black.			Red.	
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
SiO_2	10.13	11.48	5.11	4.89	3.34
Al_2O_3	55.59	57.62	55.89	46.40	58.60
Fe_2O_3	6.08	1.83	19.45	22.15	9.11
H_2O	28.99	28.63	17.39	26.68	28.63
Total	100.79	99.56	97.84	100.12	99.68

	Per cent.	Per cent.	Per cent.
SiO_2	2.00	10.38	16.76
Al_2O_3	62.05	55.64	51.90
Fe_2O_3	1.66	1.95	3.16
TiO_2	3.50	3.50	3.50
H_2O (ign.)	30.31	27.62	24.86
Total	99.52	99.09	100.28

Metallurgy.—The electrolytic process by which aluminum is extracted from its oxide, alumina, is now well understood by all persons interested in the subject. In this country it is carried on by the Pittsburg Reduction Company. The principle is that alumina is decomposed in the presence of a melted fluoride by the electric current, and metallic aluminum is liberated. Powerful dynamos furnish the current for this purpose. In practice the alumina is dissolved in the fused flux, consisting of fluorides of aluminum and sodium, which is regarded as serving as a vehicle for the alumina. The furnace for effecting the operation is made in the form of an open iron-cased box which is thickly lined with carbon and is provided with a spout at the bottom for tapping off the aluminum. A large block, or series of bars of carbon, carried on an adjustable support and arranged to dip into the center of the furnace, forms the anode, the furnace itself forming the cathode. After the flux and alumina have been introduced the carbon anode is brought well down into the furnace and the current turned on. At first considerable resistance is offered, but as the materials in the furnace become highly heated this decreases, and the anode can be raised somewhat. Decomposition soon begins, the alumina being resolved into oxygen and metallic aluminum, the former being liberated at the anode, and, combining with the carbon of which it is composed, passes off as carbonic oxide, while the metallic aluminum, being heavier than the melted bath, sinks to the bottom of the latter and is tapped off from time to time. As the alumina is used up the increase in resistance indicates the progress of the reduction, and fresh alumina is added. The operation is therefore continuous.

Several new processes were patented during the year 1891 in Europe and in this country, the published character of which describe variations (improvements) on those already well known. It would be without the scope of this report to describe these processes until there is evidence to show that they have been put in operation in this country. The Pittsburg Reduction Company and the Cowles Company were the only producers in 1891.

Production.—The amount of aluminum produced in this country during 1891, including small experimental concerns and that contained in alloys, amounted to 150,000 pounds. The Pittsburg Reduction Company's plant was in operation only five months of the year, owing to its removal to Kensington. In the preceding year the production was 47,881 pounds; and in 1889, 19,200 pounds. This is exclusive of the quantity produced as alloys, of which no statistics are available for 1891.

In 1889 it was estimated that the total amount of aluminum extracted up to that date was about 116 tons, but that the indications then were that the annual production would soon exceed that amount. This prediction has been more than verified. The Neuhausen Company was producing at the rate of 1,000 kilos a day at the close of 1891. (*Dingler*, 282, 2, p. 431.) A branch of this company at Fuges produces about 400 kilos daily, and altogether it is safe to say that over 500 tons of aluminum are being produced annually in this country and Europe. Although the American production has been far outstripped by the European there are indications that the year 1892 will show an improvement in this industry in this country.

Price.—In the United States the price of aluminum ranged from 75 cents to 90 cents per pound, according to quantity. At the beginning of 1892 it was quoted at 50 cents wholesale in the market reports. The European price was 5 marks per kilo at the latter date.

Uses.—Besides the metallurgical use of aluminum in casting iron and steel, to be referred to below, the metal is used for an infinity of small articles as has always been the case, and for which its lightness, strength, and freedom from tarnish eminently adapt it. Indeed, with a total production of between 500 and 600 tons, of which, perhaps, 300 only are available for manufactured articles, no extensive use on the large scale could be expected. The newspapers have frequently spoken of the Swiss steam launch of aluminum. A life-boat of aluminum was under construction at Stralsund, Prussia, in December, 1891. It was expected that the lightness of the metal would be of great advantage in dragging the boat over the sands and in hoisting and lowering it. The list of proposed uses continues to increase. Disregarding them, the actual use is sufficiently varied. Small articles, viz., drinking cups, rulers, and paper-cutters, perfumery stands, smokers' sets, ash-receivers, toothpick and match holders, watch cases, lemonade shakers, card-receivers, butter dishes, rings, spoons, picture frames, bracelets, napkin rings, sleeve and collar buttons, scarf and shawl pins, pen-racks, dog collars, key chains, padlocks and chains, hairpins, pencil cases, and pannikins are advertised.

In Germany aluminum tubing is used for penholders, umbrella handles, walking sticks, billiard cues, chair legs, photograph frames, and newspaper-holders.

Powdered aluminum mixed with chlorate of potassium has been used for flash lights instead of magnesium. It is said to make an excellent light and to give no smoke like magnesium.

Mr. Alfred E. Hunt, president of the Pittsburg Reduction Company, in a lecture delivered in March, 1891, gives some information in regard to the use of aluminum in railroad work. He says that the metal has been used, on account of its lightness, for slide valves (experimentally); for valves to control the passage of the air from the storage to the brake cylinders in the new and larger forms of the Westinghouse air brake, the inertia of the heavy iron or brass valves being a serious consideration; for the fan blades and frames of windmills; in semaphore signal disks and their moving frame work.

The use of aluminum for canteens and military equipments in the German army has suggested a similar use in this country, and aluminum curb bits, saber-belt plates, canteens, meat cans, cartridge-belt plates, and spoons and forks have been submitted to the War Department in Washington for consideration. The object is to save weight and avoid rust.

The substitution of aluminum for glass flasks for the army and its use in general for vessels which are designed for holding foods and drinking fluids have given rise to experiments in Germany to test the action of various fluids upon the metal. The results are on the whole favorable to its employment for such purposes. It must be remembered that the aluminum of commerce contains small quantities of other metals and metalloids, sometimes amounting to 2 per cent., so that it is virtually an alloy. The resistance of aluminum to acids has long been a popular belief, and, before giving the results of the experiments as to the action of drinking fluids upon aluminum, the following account of some experiments with nitric and sulphuric acids is given to show that the former belief in the resistance of the metal to all acids except hydrocloric must be modified. Undoubtedly the physical condition of the metal operated on as well as its chemical composition makes a great difference in its power to resist the action of acids, a finely divided metal being much more easily attacked than the same metal in large pieces. G. A. LeRoy (*Chemisches Centralblatt* 1892, Bd., I No. 2, p. 51.) found that nitric and sulphuric acids of different strengths acted upon aluminum as shown below under the conditions specified. He used aluminum foil having the composition 98.29 per cent. to 99.6 per cent. aluminum, 1.60 per cent. to 0.30 per cent. iron, and 0.10 per cent. to 0.25 per cent. silicon. The foil was polished, freed from fat with caustic soda, washed with alcohol, dried in the air bath, cut up, weighed, and introduced into the acids. In this fine condition the action of the acids was as shown in the following table, the weight being the amount of metal disolved expressed in grams per square meter. The action lasted twelve hours.

Action of various acids on aluminum foil.

Acids.	Specific gravity.	Temperature (centigrade.)	Samples.			
			A.	B.	C.	D.
			Grams	*Grams.*	*Grams.*	*Grams.*
Pure H_2SO_4	1.842	15°–20°	18.40	18.90	16.40	14.50
Common H_2SO_4	1.842	15°–20°	21.00	21.30	17.50	16.40
Pure H_2SO_4	1.711	15°–20°	24.50	25.00	22.00	20.00
Common H_2SO_4	1.711	15°–20°	25.80	25.70	24.60	22.40
Pure H_2SO_4	1.580	15°–20°	19.00	18.00	17.90	16.30
Pure H_2SO_4	1.263	15°–20°	4.60	....	2.60	3.40
Pure $H\ NO_3$	1.383	15°–20°	17.00	16.00	15.50	14.50
Common $H\ NO_3$	1.383	15°–20°	20.50	19.60	18.00	16.60
Common $H\ NO_3$	1.332	15°–20°	16.30	16.30	14.00	13.40
Pure H_2SO^4	1.842	150°	240.	225.	150.	200.
Common H_2SO_4	1.842	150°	267.	250.	210.	220.
Pure $H\ NO_3$	1.382	100°	....	....	Violent	Violent
Common $H\ NO_3$	1.382	100°	....	....	action.	action.

According to these results almost pure aluminum, 99.5 per cent., is attacked even in the cold by nitric and sulphuric acids, so that the metal should not be used in apparatus for preparing these acids.

As to the action of drinking fluids, coffee, tea, beer, wines, brandy, etc., the following appears to be the state of the case: Messrs. Lübbert and Roscher (*Chem. Centralbl.*, 1891, Bd. II, No. 18, p. 780) tested the resistance of aluminum to the action of alcohol, ether, aldehyde, coffee, tea, wines, and antiseptics, by allowing aluminum leaf to remain in concentrated solutions of the different liquids four days at the temperature of the room, and the fluids were examined either directly for alumina or were evaporated and the ignited residue so examined. The conclusion reached was that aluminum possesses only a slight degree of resistance to the agents named, except alcohol, ether, and aldehyde, and that it is therefore unsuitable for wares which are to be used for acid drinks, coffee, tea, etc., or articles which are to be cleaned with soda or soap. Its application in daily life would therefore be very limited.

On the other hand, G. Rupp (*Dingler*, 283, I, January 21, 1892), criticises the methods employed by Lübbert and Roscher for determining the action of the fluids by estimating the alumina contained in them, as well as the use of aluminum leaf for their experiments, which is attacked much more easily than the compact metal, the former being acted on even by boiling water, while the latter is unaffected. His own experiments were made upon aluminum vessels (canteens, drinking cups, etc.) and foil, the object being to determine the availability of the metal for use in the army. The carefully dried and weighed vessels were filled with the different fluids or the foil was immersed in them, and the action was allowed to continue four, eight, and twenty-eight days, at the temperature of the room with frequent stirring. The fluids included wines of different kinds, beer, kirschwasser, cognac, coffee, tea, milk, drinking water, 1 per cent. solution of tartaric acid, acetic acid (1 per cent., 4 per cent., 10 per cent. solutions), vinegar (10 per cent.), soda solution (1 per cent.), besides butter, honey, and preserved fruits. The articles were then cleaned, dried, and weighed, to determine the loss of weight. The results, which fill a large table, showed that in most cases there was absolutely no action and in the few cases where there was a perceptible loss of weight it was so trifling as to be disregarded. To the objection that continued drinking of fluids containing a small quantity of alumina would eventually be dangerous, the author points out that the ash of all the fluids usually drank contains alumina, as well as most foods and drinking water itself. His conclusion is that there is no objection to the use of aluminum for canteens and similar vessels.

These conclusions of Rupp were confirmed by Dr. A. Arche (*Dingler*, Vol. 284, No. 11, p. 255), whose experiments show that the purity of aluminum (using the percentage of silicon as a means of classification) has much to do with its power of resisting the solvent action of fluids, and they also show that the mechanical preparation of the metal is an important factor. He found that hammered aluminum was least attacked, rolled metal came next, and then the drawn metal, while cast metal was much more easily attacked (by acetic acid).

Metallurgical use.—The quantity of aluminum used in this country in the manufacture of iron and steel castings is probably from 25 to 30 per cent. of the total production. In Europe it is estimated by Professor Wedding to be 54 per cent. This use, as was explained in the last number of this series, consists in adding from 0.10 to 0.15 per cent. of aluminum to iron or steel just before casting, by which blow-holes are prevented and sounder castings are produced. This use is becoming general. The beneficial effect, as was shown by experiments referred to last year, is due in part at least to the deoxidizing action of aluminum upon carbon monoxide at a high temperature, a reaction which was demonstrated directly between the metal and the gas. This subject has not yet received an exhaustive examination. For this purpose it would be necessary to know the composition of the iron or steel operated on in each case and make comparative tests on the different specimens. It is also probable that the method of melting employed has an effect on the result.

A detail of manipulation in the method of applying aluminum, especially in castings for steam and pump cylinders and other castings intended to resist high pressures, is reported in *Dingler's Journal* (Vol. 284, No. 11, p. 255). The addition is made by first forming a mixture of aluminum and iron, which is effected by placing the proper quantity of heated aluminum in the bottom of a small ladle, running some iron into the ladle from the furnace, and waiting until the mixture begins to stiffen. Then the iron to be operated on is run into a large ladle and the iron-aluminum mixture is poured into it, whereby an intimate mixture of the whole is effected. For 100 kilograms of iron to be operated on 200 grams of aluminum are used (= 0.20 per cent.) The iron is not poured at once from the large ladle, but is allowed to stand until it is orange-yellow and a thin film begins to form on the surface. As soon as this occurs the film is removed and the iron is poured. The mold should be kept full. No reason is assigned for this procedure, but it appears that iron containing aluminum is inclined to shrink excessively and that this tendency must be obviated by pouring as cold as possible.

According to a paper read by Mr. J. W. Langley, at the Glen Summit meeting of the American Institute of Mining Engineers, the practice in the United States in pouring ingots is as follows: The aluminum, in small pieces of ¼ or ½ pound weight, is thrown into the ladle during the tapping, shortly after a small quantity of steel has already entered it. The aluminum melts almost instantaneously and diffuses with great rapidity throughout the contents of the ladle. The diffusion seems to be complete, for the writer had never seen the slightest action indicating want of homogeneity of mixture, all of the ingots poured from one ladle being precisely alike so far as the specific action of the aluminum was concerned. The quantity of aluminum to be employed will vary slightly according to the kind of steel and the results to be attained. For open-hearth steel, containing less than 0.50 per cent. carbon, the amount will range from 5 to 10 ounces per ton of steel. For Bessemer steel the quantities should be slightly increased, viz., 7 to 16 ounces. For steel containing over 0.50 per cent. carbon, aluminum should be used cautiously; in general between 4 and 8 ounces to the ton. If these statements are put in the form of percentages, it will at once be seen how extremely minute is the quantity of aluminum which causes such marvelous results, for the numbers are:

4 ounces = 0.0125 per cent		= 1-8000
5 ounces = 0.0156 per cent		= 1-6500
8 ounces = 0.0250 per cent		= 1-4000
16 ounces = 0.0500 per cent		= 1-2000

Soldering.—From the articles which occasionally appear in the trade journals, both in this country and in Europe, and the patent list, it appears that the difficulties of soldering aluminum have not been overcome. Some of the new solders are introduced here without comment.

Chloride of silver has been recommended as a solder. It is to be finely powdered and spread along the junction to be soldered and melted with the blow-pipe. Mr. Joseph W. Richards makes an alloy of aluminum 1 part, zinc 8 parts, tin 32 parts, and phosphor-tin, containing 5 per cent. phosphorus, 1 part. The aluminum is first melted, then the zinc is added, and finally the tin, which has been melted separately and mixed with the phosphor-tin. The alloy is poured into small bars for use. The object is to provide in the phosphorus a powerful reducing agent to prevent the formation of the film of oxide which usually prevents the intimate contact of the opposed surfaces. (United States patent 407789, October 5, 1891.) Another formula is, cadmium 50 parts, zinc 20, tin 30. The zinc is first melted, then the cadmium is added, and finally the tin (*Dingler's Journal*, Vol. 284, No. 6, page 144.) Electroplating the surfaces with copper and then applying the solder was mentioned last year.

Other solders which have been used are composed of—

Composition of certain solders for aluminum.

	I.	II.	III.	IV.	V.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Aluminum	12	9	7	6	4
Copper	8	6	5	4	2
Zinc	80	85	88	90	94

In making these solders the copper should be melted first, the aluminum then added, and the zinc last. Stearin is used as a flux to prevent the rapid oxidation of the zinc. When the last metal is fused, which takes place very quickly, the operation should be finished as rapidly as possible by stirring the mass, and the alloy should then be poured into an ingot mold of iron, previously rubbed with fat. The pieces to be soldered should first be cleaned thoroughly and roughened with a file and the solder placed on the parts in small fragments, the pieces being supported on a piece of charcoal. The place of juncture should then be heated with the blast lamp. The union is facilitated by the use of a soldering tool of aluminum. This last is said to be essential to the success of the operation. Alloy I is recommended for small objects of jewelry; alloy IV is said to be best adapted for larger objects and for general work, and is that most generally used. The successful performance of the act of soldering appears to require skill and experience, but the results obtained are said to leave nothing to be desired. Soldering tools of copper or brass should be avoided, as they would form colored alloys with the aluminum and solder. The skillful use of the aluminum tool, however, requires some practice. At the instant of fusion the operator must apply some friction, and, as the solder melts very suddenly, the right moment for this manipulation may be lost unless the workman is experienced.

Alloys.—It is regretted that no statistics of the production of aluminum bronze and ferro-aluminum in this country can be given for 1891. Both of these valuable alloys have been produced by the Cowles Electric Smelting and Aluminum Company for a number of years, and have found their way into the market on a considerable scale. The ferro-aluminum made by this company was used as a vehicle for adding aluminum to iron and steel in making sound castings when that method was first introduced. Aluminum bronze is coming into use in Germany for torpedoes on account of its strength and noncorrodibility, and for telephone wires. It was estimated that 280,000 kilograms would be used during 1892. The 5 per cent. bronze has been used for some time for nozzles of gas motors on account of its nonoxidizable character, and the 12 per cent. bronze is used for the pins of needle guns, for which purpose it is said to be better than steel.

The number of patents which have been granted for aluminum alloys, either where that metal forms a minor ingredient or has small quantities of other metals added to it for special purposes, shows that experimenting in this direction is increasing. As yet much of this experimenting is done without definite knowledge or aim on the part of inventors. Doubtless, in time, valuable conclusions may be derived from this kind of work, after rigid experiments with a definite purpose or idea have been undertaken. Of alloys formed with a specific purpose in view, that containing a small quantity of titanium, and another containing silver, were described last year. Others are mentioned in a lecture by Mr. Hunt, president of the Pittsburg Reduction Company, whose statements are valuable because they are based on knowledge and experience. He says:

"The alloys of from 2½ to 12 per cent. aluminum with copper have so far achieved the greatest reputation. With the use of 8 per cent. to 12 per cent. aluminum in copper we obtain one of the most dense, finest-grained, and strongest metals known, having remarkable ductility as compared with its tensile strength. A 10 per cent. aluminum bronze can be made in forged bars with 100,000 pounds tensile strength, 60,000 pounds elastic limit, and with at least 10 per cent. in elongation in 8 inches. An aluminum bronze can be made to fill a specification of

130,000 pounds tensile strength and 5 per cent. elongation in 8 inches. Such bronzes have a specific gravity of about 7.50, and are of a light yellow color. For cylinders to withstand high pressures such bronze is probably the best metal yet known.

"The 5 to 7 per cent. aluminum bronzes have a specific gravity of 8.30 to 8, and are of a handsome yellow color, with a tensile strength of from 70,000 to 80,000 pounds per square inch, an elastic limit of 40,000 pounds per square inch. It will probably be bronzes of this latter character that will be most used, and the fact that such bronzes can be rolled and hammered at a red heat with proper precautions will add greatly to their use. Metal of this character can be worked in almost every way that steel can, and has for its advantages its greater strength and ductility, and greater power to withstand corrosion, besides its fine color. With the price of aluminum reduced only a very little from the present rates, there is a strong probability of aluminum bronze replacing brass very largely.

"A small percentage of aluminum added to Babbitt metal gives very superior results over the ordinary Babbitt metal. It has been found that the influence of the aluminum upon the ordinary tin-antimony-copper Babbitt is to very considerably increase the durability and wearing properties of the alloy. Under compressive strain aluminum Babbitt proves a little softer than the ordinary Babbitt. A sample 1½ inches in diameter by 1½ high began to lose shape at a pressure of 12,000 pounds. A similar sample of the same Babbitt metal without the addition of the aluminum (having a composition of 7.3 per cent. antimony, 3.7 per cent. copper, and 89 per cent. tin) did not begin to lose its shape until a compressive strain of 16,000 pounds had been applied. Both samples have stood an equal strain of 35,000 pounds. In comparative tests of the ordinary Babbitt metal and the aluminum Babbitt metal, the latter has given very satisfactory results.

"The following alloys have recently been found useful: Nickel-aluminum, composed of 20 parts nickel and 8 parts aluminum, used for decorative purposes; rosine, composed of 40 parts nickel, 10 parts of silver, 30 parts aluminum, and 20 parts tin, for jewelers' work; sun bronze, composed of 60 parts cobalt (or 40 parts cobalt), 10 parts aluminum, 40 (or 30) parts copper; metalline, composed of 35 parts cobalt, 25 parts aluminum, 10 parts iron, and 30 parts copper.

"Prof. Robert Austin has discovered a beautiful alloy containing 22 per cent. aluminum and 78 per cent. gold, having a rich purple color, with ruby tints.

"The addition of from 5 per cent. to 15 per cent. aluminum to type metal composed of 25 per cent. antimony and 75 per cent. lead makes a metal giving sharper castings and a much more durable type."

Mr. A. H. Cowles makes an alloy for electrical purposes consisting of manganese 18 parts, aluminum 1.2 parts, silicon 5 parts, zinc 13 parts, and copper 67.5 parts. This alloy has a tensile strength of 26,000 kilograms and 20 per cent. elongation. Its electric resistance is greater than that of "neusilber," and it is therefore especially applicable for rheostats. (*Chemiker-Zeitung*, March 12, 1892.)

Mr. C. C. Carroll makes an aluminum alloy for dentists' fillings, consisting of silver 42.3 per cent., tin 52 per cent., copper 4.7, and aluminum 1 per cent. It is reduced to powder and then forms an amalgam with mercury. (U. S. Patent 475382, May 24, 1892).

Mr. Chas. B. Miller has patented an antifriction alloy of lead 320 parts, antimony 64, tin 24, aluminum 2. (U. S. patent 456898, July 28, 1891.)

Mr. Thomas MacKellar has patented an alloy for type metal of lead 65 parts, antimony 20, and 10 parts of an alloy consisting of equal parts of tin, copper, and aluminum. The tin-copper-aluminum alloy is first melted, the antimony added to it, and the mixture is then added to the melted lead. (U. S. patent 463427, November 11, 1891.)

An aluminum bronze alloy contains aluminum 12 to 25 parts, manganese 2 to 5, copper 75 to 85. It is the product of John A. Jeançon. (U. S. patent 446351, February 10, 1891.)

The antifriction metal (Babbitt metal plus aluminum) contains antimony 7.3 parts, tin 89, copper 3.7, with from $\frac{1}{4}$ to 2.5 parts of aluminum. It is patented by Alexander W. Cadman. (U. S. patent 464147, December 1, 1891.)

Aluminum imported and entered for consumption in the United States from 1870 to 1891.

Years ending—	Quantity.	Value.	Years ending—	Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1870	....	$98	June 30, 1882	566.50	$6,459
1871	....	341	1883	426.25	5,079
1873	2.00	2	1884	595.00	8,416
1874	683.00	2,125	1885	439.00	4,736
1875	434.00	1,355	Dec. 31, 1886	452.10	5,369
1876	139.00	1,412	1887	1,260.00	12,119
1877	131.00	1,551	1888	1,348.53	14,086
1878	251.00	2,978	1889	998.00	4,840
1879	284.44	3,423	1890	2,051.00	7,062
1880	340.75	4,042	1891	3,906.00	6,263
1881	517.10	6,071			

TIN.

During 1891, 125,289 pounds of metallic tin were produced from the Temescal mines, near Riverside, California. This amount is valued at $27,564 at 20 cents per pound in New York. The mill began running in April, but only in a very small way. From January to July, 1892, the product amounted to 137,000 pounds, making the total commercial product 272,289 pounds, or 136 tons of metallic tin produced in the United States. up to July 1, 1892. Up to July, the latest date available, the production in 1892 averaged 14 tons per month. The most complete account of the occurrence of tin at this place is that by Mr. W. de L. Benedict, published in the *Engineering and Mining Journal* of October 18, 1890.

In South Dakota vigorous work was carried on by the Harney Peak company in the direction of deepening shafts on several of the mines to 600 feet and other development work designed to afford a large output when mining proper should be commenced. Early in 1892 the concentrating mill erected by Fraser & Chalmers was completed, and spurs are still being built from the tracks of the Burlington and Missouri River railroad to the principal openings. The company reports that it is not expected that the mill will be started for several months yet, until more railroad spurs are built, which were delayed by spring rains, and until larger pumps and other machinery are installed at some of the openings.

In Virginia operations came to a standstill at the Cash property, in Amherst county, because the company did not buy the mine, on which an option was held, and where about $50,000 in machinery had been placed in position. This machinery included a set of jigs and a Sturtevant mill.

The world's production of tin increased in 1891, and so did the consumptive demand, resulting altogether in a decided decrease in the stocks of tin. In spite of that, however, the prices ruled low, as shown in the table of prices on the following page.

World's supply of tin from 1880 to 1891.

Years.	English production.	Straits shipments to Europe and America.	Australian shipments to Europe and America.	Banca sales in Holland.	Billeton sales in Java.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1880	8,918	11,735	9,177	3,756	4,735	38,321
1881	8,615	11,400	10,100	4,548	4,740	39,403
1882	9,300	11,705	10,067	4,399	4,200	39,671
1883	9,307	16,958	11,121	4,203	4,157	45,746
1884	9,574	17,548	9,337	4,193	3,600	44,252
1885	9,331	17,320	9,088	4,200	3,760	43,699
1886	9,312	19,674	8,064	4,379	4,128	45,557
1887	9,282	23,977	7,750	4,384	4,978	50,371
1888	9,241	23,855	7,975	4,430	5,220	50,721
1889	8,912	28,295	6,800	4,114	4,857	52,978
1890	9,000	27,470	6,415	5,317	5,232	53,434
1891	9,354	31,457	5,991	5,350	5,753	57,905

According to Sargent's circular, from which most of the above figures have been taken, the tin industry was in striking contrast to the other larger metal industries. The increased total product came from greater activity in the Straits Settlements and the island of Banca, with a slight decline in Australia. It is probable that the influences which contributed toward an increased production in 1891 will lead to even more in 1892. The consumption increased by 1,708 tons, but was less than the production by 1,806 tons. The stocks at the close of 1891 were small and only sufficient for about five weeks' consumption. The fluctuations in London prices were small; the highest price was £93 4*s*. and the lowest £90 0*s*. 3*d*. The average price for the year was £91 3*s*. a decline of £3 from 1890.

Tin plates.—During nine months from July 1, 1891, to March 31, 1892, the newly established plants in the United States produced 1,468,056 pounds of tin plates; besides 3,772,774 pounds of terne (tin and lead) plates, according to the statistics collected by Special Agent Ira Ayer, of the Treasury Department. The above amounts do not include a larger product, estimated at 2,000,000 pounds, of tin-plated ware made by stamping block-steel plates into the form of various utensils, and then dipping them in tin with the same result as tinware made in the ordinary way.

Prices.—There have been no great fluctuations in prices in the past two years similar to those in 1888, due to the operations of the French copper syndicate. In 1889 the price was comparatively steady, fluctuating by fractions of a cent from 21 cents per pound. In 1890 the prices were not so steady, the principal feature being a rise in September to 25 cents per pound. This soon declined again to 21 cents, which was about the average for the year. The rise in price was due to a speculative movement, and the corner was aided by comparatively light stocks in New York and good consumptive demand. In 1891 the prices ruled slightly lower without great fluctuations, except a rise to 21½ cents in June. The prices for recent years are given below:

Prices of tin in New York, by months, from 1885 to 1891.

[Cents per pound.]

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1885....	16⅝	17.45	17⅜	17.80	18⅝	20⅜	22⅜	21¼	20.95	20.95	20.65	21.00
1886....	20⅝	20.70	20.80	20.85	21.30	22¾	22¼	21¾	22.20	22¼	22.40	22¼
1887....	20.30	22½	22.55	22½	22.95	23¼	23.35	23.30	23⅛	25⅛	31.05	36⅓
1888....	36.95	36.95	36.70	32.95	21.95	18.05	19¼	20¾	22.95	23.35	22.70	22.10
1889....	21⅞	21½	21.30	20⅞	20½	20.30	19⅞	20.20	21.30	20.80	21¾	21.30
1890....	20.95	20.87	20.39	20.13	21.52	21.53	21.17	21.62	24.00	22.60	21.07	21.21
1891....	20.20	19.90	19¾	19½	20.00	21.00	20.20	20.10	20¼	20.10	20.00	19.90

Imports and exports.—The following tables show the tin and tin plates imported and entered for consumption from 1867 to 1890; also the value of the exports of the manufactures of tin from 1826 to 1890:

Tin and tin plates imported and entered for consumption in the United States, 1867 to 1891.

Years ending—	In blocks, bars, or pigs, and grain tin.		Tin plates, sheets, etc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Cwts.		*Cwts.*		
June 30, 1867 ..	....	$1, 210, 354. 02	....	$6, 276, 136. 78	$7, 486, 490. 80
1868 ..	....	1, 454, 327. 36	....	6, 893, 072. 07	8, 347, 399. 43
1869 ..	80, 811	1, 709, 385. 00	1, 534, 324	8, 565, 432. 56	10, 274, 817. 56
1870 ..	81, 702	2, 042, 887. 71	1, 333, 150	7, 628, 871. 51	9, 671, 759. 22
1871 ..	106, 595	2, 938, 409. 82	1, 556, 023	9, 490, 778. 64	12, 429, 188. 46
1872 ..	102, 006	3, 033, 837. 45	1, 617, 627	10, 736, 906. 59	13, 770, 744. 04
1873 ..	130, 469	3, 938, 032. 25	1, 854, 956	15, 906, 446. 82	19, 844, 479. 07
1874 ..	116, 442	3, 199, 807. 07	1, 553, 860	13, 322, 976. 14	16, 522, 783. 21
1875 ..	102, 904	2, 329, 487. 96	1, 540, 600	12, 557, 630. 75	14, 887, 118. 71
1876 ..	93, 176	1, 816, 506. 00	1, 767, 210	10, 226, 802. 87	12, 043, 306. 87
1877 ..	98, 209	1, 783, 765. 00	1, 984, 893	9, 818, 069. 69	11, 601, 834. 69
1878 ..	128, 849	2, 167, 350. 00	2, 166, 489	9, 893, 639. 61	12, 060, 989. 61
1879 ..	142, 927	2, 301, 944. 00	2, 487, 007	10, 248, 720. 34	12, 550, 664. 34
1880 ..	290, 007	6, 153, 005. 68	3, 298, 534	16, 524, 590. 19	22, 677, 595. 87
1881 ..	171, 146	3, 971, 756. 67	3, 366, 720	14, 641, 057. 87	18, 612, 814. 54
1882 ..	197, 544	5, 204, 251. 68	3, 926, 311	16, 550, 834. 64	21, 755, 086. 32
1883 ..	237, 348	6, 106, 250. 37	4, 051, 108	16, 688, 276. 67	22, 794, 527. 04
1884 ..	(a) 26, 081, 992	5, 429, 184. 01	(a) 527, 881, 321	18, 931, 072. 70	24, 360, 256. 71
1885 ..	23, 947, 523	4, 263, 447. 00	505, 559, 076	16, 610, 104. 56	20, 873, 552. 00
Dec. 31, 1886 ..	27, 960, 761	5, 873, 773. 00	574, 098, 405	17, 719, 957. 12	23, 593, 730. 12
1887 ..	29, 645, 531	6, 927, 710. 00	570, 643, 389	16, 883, 813. 95	23, 811, 523. 95
1888 ..	31, 740, 583	8, 758, 562. 00	632, 224, 296	19, 034, 821. 03	27, 793, 383. 03
1889 ..	35, 177, 646	7, 045, 939. 00	734, 086, 964	20, 361, 564. 00	27, 407, 503. 00
1890 ..	33, 800, 729	6, 869, 645. 00	688, 247, 657	21, 923, 754. 00	28, 793, 399. 00
1891 ..	41, 146, 123	8, 091, 363. 00	734, 425, 267	25, 900, 305. 00	33, 991, 668. 00

a Pounds in 1884 and following years.

Value of tin manufactures exported from the United States (a).

[Fiscal year ending September 30 until 1843; ending June 30, from 1844 to 1886; calendar years since 1886.]

Years.	Value.	Years.	Value.	Years.	Value.
1826	$4, 515	1848	$12, 353	1870	$46, 607
1827	2, 967	1849	13, 143	1871	70, 366
1828	5, 049	1850	13, 590	1872	67, 244
1829	1, 757	1851	27, 823	1873	69, 865
1830	4, 497	1852	23, 420	1874	62, 973
1831	3, 909	1853	22, 988	1875	48, 194
1832	3, 157	1854	30, 698	1876	48, 144
1833	2, 928	1855	14, 279	1877	87, 057
1834	2, 230	1856	13, 610	1878	116, 274
1835	2, 545	1857	5, 622	1879	103, 467
1836	5, 604	1858	24, 186	1880	144, 185
1837	10, 892	1859	39, 289	1881	498, 524
1838	10, 179	1860	39, 064	1882	198, 608
1839	19, 981	1861	30, 229	1883	191, 947
1840	7, 501	1862	62, 286	1884	166, 819
1841	3, 751	1863	41, 558	1885	162, 304
1842	5, 682	1864	46, 968	1886	157, 724
1843 (nine months)	5, 026	1865	106, 244	1887	137, 551
1844	6, 421	1866	79, 461	1888	219, 000
1845	10, 114	1867	40, 642	1889	255, 100
1846	8, 902	1868	27, 110	1890	262, 343
1847	6, 363	1869	18, 994	1891	204, 429

a Classed as "tin, and manufactures of," from 1851.

NICKEL AND COBALT.

The supply of domestic nickel, nickel anodes, nickel salts, etc., is still obtained, as it has been for many years, from the same smelting works of Mr. Joseph Wharton, in Camden, New Jersey, and now some nickel material is also furnished by the Orford Copper Company, at Constable Hook, New Jersey. In regard to the sources of the ores, however, the industry has changed its character altogether. Many years ago Chatham, Connecticut, furnished a small amount of ore, but the dominant supply has been from the Lancaster Gap mine in Pennsylvania, with occasional contributions from Oregon and Nevada. Some years ago the lead works at Mine La Motte, Missouri, began separating the nickel and cobalt from their ores by converting it into a rich speiss, which has been sold to the usual nickel refiners. Since the beginning of 1889, however, nickel matte produced in Canada has been bought and smelted in the United States. At the end of 1891 this resulted in closing the Lancaster Gap mine. So that in 1892 the product of the nickel smelters will be all from Canada, except occasional small amounts from Mine La Motte, and from Nevada, Oregon, and the mines near Webster, North Carolina. Nickel and cobalt are by-products at Mine La Motte, and therefore the production will not change markedly. At the western localities the situation is radically different. There is no regular product, but in the process of deciding whether the deposits can support a profitable industry large, though irregular, amounts of ore are apt to be offered for sale at any time. Indeed there is a considerable accumulation of nickel and cobalt arsenide on the dumps at Lovelock Station, Nevada, and efforts are also being made to market the Oregon silicates.

Production.—The ores mined in the United States yielded 118,498 pounds of nickel, valued in Philadelphia at $76,024. In addition to this 2,000,000 pounds of nickel contained in Canadian matte was smelted in the United States. Not all of this, however, was contributed to the general market, for a considerable amount was contained in the matte purchased by the Navy Department and worked up by contract, the copper being taken out and the nickel and iron being left as oxide. It is delivered in this form to the steel works at Bethlehem and Homestead to furnish the nickel for armor plates. Some of this mixture of oxides of iron and nickel made from Canadian matte is exported for treatment abroad.

Nickel product of the United States, 1876 to 1890.

Years.	Metallic nickel	Nickel in matte.	Nickel in ore.	Nickel in nickelammonium sulphate.	Total.	Value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
1876					201,367	$523,554
1877					188,211	301,138
1878					150,890	165,979
1879					145,120	162,534
1880					233,893	257,282
1881					265,668	292,235
1882	277,034	4,582			281,616	309,777
1883	6,500	52,300			58,800	52,920
1884		64,550			64,550	48,412
1885	245,504	14,400	18,000		277,904	179,975
1886	182,345	20,000	5,600	7,047	214,992	127,157
1887	183,125	10,846		11,595	205,566	133,200
1888	190,637		1,000	12,691	204,328	127,632
1889	209,763	42,900			252,663	151,598
1890	223,488				223,488	134,092
1891	118,498				118,498	76,024

The total amount of Canadian nickel in matte produced is as follows:

Product of Canadian nickel.

Years.	Pounds.
1889	500,000
1890	1,435,742
1891	2,000,000

Prospecting has continued at the silicate mines near Webster, North Carolina, without any such decisive result as the production of ore for sale. The region has been well described lately in the *Engineering and Mining Journal.* Ore accumulated on the dump at Lovelock's, Nevada, but no shipments were made. A project is on foot to put up two 60-ton furnaces. In Oregon, the mines at Riddles were idle. They were sold during the year to a company with headquarters in Chicago. This company is now actively prosecuting work, and intend during the present year to erect works capable of treating 100 tons of of ore per day.

In the spring of 1891, Mr. William H. Hampton, of Portland, discovered a considerable number of pebbles in the placer ground of a stream in Josephine and Jackson counties, which lie south of Douglas county where the nickel-silicate mines are located. On analysis by Mr. W. H. Melville they were found to contain an alloy of iron with nickel in the proportion of 60.4 per cent. nickel to 23.06 iron. This is a different composition from the known natural alloys and therefore was named "Josephinite," from the county where it occurs. It seems that the alloy is not meteoric, although the dike from which it came has not been found.

In South Dakota nickeliferous pyrrhotite has been found, as noted in Mineral Resources of the United States, 1888. In 1891, Mr. Samuel Scott, of Rapid City, began development work on some pyrrhotite found adjacent to the Riverton, Buckhorn, Margaret, and Tin Hill tin claims.

Analyses showed from 0.32 to 5.26 per cent. of nickel in various samples; further development work is under way.

IMPORTS AND EXPORTS.

Nickel imported and entered for consumption in the United States, 1868 to 1891, inclusive.

Years ending—	Nickel.		Oxide and alloy of nickel with copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
June 30, 1868	....	$118, 058	....	....	$118, 058
1869	....	134, 327	....	....	134, 327
1870	....	99, 111	....	....	99, 111
1871	17, 701	48, 133	4, 438	$3, 911	52, 044
1872	26, 140	27, 144	....	....	27, 144
1873	2, 842	4, 717	....	....	4, 717
1874	3, 172	5, 883	....	....	5, 883
1875	1, 255	3, 157	12	36	3, 193
1876	....	....	156	10	10
1877	5, 978	9, 522	716	824	10, 346
1878	7, 486	8, 837	8, 518	7, 847	16, 684
1879	10, 496	7, 829	8, 314	5, 570	13, 399
1880	38, 276	25, 758	61, 869	40, 311	66, 069
1881	17, 933	14, 503	135, 744	107, 627	122, 130
1882	22, 906	17, 924	177, 822	125, 736	143, 660
1883	19, 015	13, 098	161, 159	119, 386	132, 484
1884	....	....	*a*194, 711	129, 733	129, 733
1885	....	....	105, 603	64, 166	64, 166
Dec. 31, 1886	....	....	277, 112	141, 546	*b*141, 546
1887	....	....	439, 037	205, 232	*c*205, 232
1888	....	....	316, 895	138, 290	*d*138, 290
1889	....	....	367, 288	156, 331	*e*156, 331
1890	*f*566, 571	260, 665	247, 299	115, 614	376, 279
1891	355, 455	172, 476	*g*10, 245, 200	148, 687	321, 163

a Including metallic nickel.
b Including $465 worth of manufactured nickel.
c Including $879 worth of manufactured nickel.
d Including $2,281 worth of manufactured nickel.
e Including $131 worth of manufactured nickel.
f Classified as nickel, nickel oxide, alloy of any kind in which nickel is the element or material of chief value.
g Classified as nickel and nickel matte.

Cobalt.—In connection with the nickel from Lancaster Gap, 7,200 pounds of cobalt oxide were produced in 1891, worth $18,000. The product in previous years is given below:

Production of cobalt oxide in the United States from 1869 to 1891.

Years.	Pounds.	Years.	Pounds.	Years.	Pounds.
1869	811	1877	7, 328	1885	8, 423
1870	3, 854	1878	4, 508	1886	8, 689
1871	5, 086	1879	4, 376	1887	5, 769
1872	5, 749	1880	7, 251	1888	7, 491
1873	5, 128	1881	8, 280	1889	12, 955
1874	4, 145	1882	11, 653	1890	6, 788
1875	3, 441	1883	1, 096	1891	7, 200
1876	5, 162	1884	2, 000		

Cobalt oxide imported and entered for consumption in the United States, 1868 to 1891.

Years ending—	Oxide.		Years ending—	Oxide.	
	Quantity.	Value.		Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1868	....	$7,208	June 30, 1880	9,819	$18,457
1869	....	2,330	1881	21,844	13,837
1870	....	5,019	1882	17,758	12,764
1871	....	2,766	1883	13,067	22,323
1872	....	1,920	1884	25,963	43,611
1873	1,480	4,714	1885	16,162	28,138
1874	1,404	5,500	Dec. 31, 1886	19,366	29,543
1875	678	2,604	1887	26,882	39,396
1876	4,440	11,180	1888	27,446	46,211
1877	19,752	11,056	1889	41,455	82,332
1878	2,860	8,693	1890	33,338	63,202
1879	7,531	15,208	1891	23,643	43,188

The imports of cobalt and cobalt ore during 1891 amounted to 2,377 pounds, worth $104.

CHROME IRON ORE.

As stated in the previous report, the domestic product of chrome iron ore comes from California. The industry of mining and shipping this product is still on the decline, owing to the facility with which it can be imported from Asia Minor. The product of the United States in 1891 was only 1,372 long tons, worth $20,580. This was about one-fourth of the total consumption in Baltimore and Philadelphia. As shown below, the domestic product was limited to Alameda, San Luis Obispo, and Tehama counties in California. The mines of Del Norte county were rendered unavailable by rains which washed out the roads.

Production of chromic iron ore in the United States.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Long tons.			*Long tons.*	
1880	2, 288	$27, 808	1886	2, 000	$30, 000
1881	2, 000	30, 000	1887	3, 000	40, 000
1882	2, 500	50, 000	1888	1, 500	20, 000
1883	3, 000	60, 000	1889	2, 000	30, 000
1884	2, 000	35, 000	1890	3, 599	53, 985
1885	2, 700	40, 000	1891	1, 372	20, 580

The production of chromic iron ore in California during 1890 and 1891 has been as follows:

Production of chromic iron ore in California in 1890 and 1891, by counties.

Counties.	1890.	1891.
	Long tons.	*Long tons.*
Alameda	355	229
San Luis Obispo	687	74
Tehama	2, 207	1, 069
Placer	150	....
Shasta	200	....
Total	3, 599	1, 372

Imports.—The following table shows the imports of chromate and bichromate of potash and chromic acid imported and entered for consumption into the United States from 1867 to 1891:

Chromate and bichromate of potash and chromic acid imported and entered for consumption in the United States, 1867 to 1891, inclusive.

Years ending—	Chromate and bichromate of potash.		Chromic acid.		Chrome ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Long tons.*		
June 30, 1867	875, 205	$88, 787					$88, 787
1868	777, 855	68, 634					68, 634
1869	877, 432	78, 288		$3			78, 291
1870	1, 235, 946	127, 333		8			127, 341
1871	2, 170, 473	223, 529		5			223, 534
1872	1, 174, 274	220, 111	514	49			220, 160
1873	1, 121, 357	178, 472	922	276			178, 748
1874	1, 387, 051	218, 517	44	13			218, 530
1875	1, 417, 812	183, 424	45	22			183, 446
1876	1, 665, 011	175, 795	120	45			175, 840
1877	2, 471, 669	264, 392	13	10			264, 402
1878	1, 929, 670	211, 136	32	35			211, 171
1879	2, 624, 403	221, 151					221, 151
1880	3, 505, 740	350, 279	5	3			350, 282
1881	4, 404, 237	402, 088	124	89			402, 177
1882	2, 449, 875	261, 006	52	42			261, 048
1883	1, 990, 140	208, 681	290	338			209, 019
1884	2, 593, 115	210, 677		120	2, 677	$73, 586	284, 383
1885	1, 448, 539	92, 556		39	12	239	92, 834
Dec. 31, 1886	1, 985, 809	139, 117		101	3, 356	43, 721	182, 949
1887	1, 722, 465	120, 305		5, 571	1, 404	20, 812	146, 668
1888	1, 755, 489	143, 312		281	4, 440	46, 735	190, 328
1889	1, 580, 385	137, 263		2, 974	5, 474	50, 782	191, 019
1890	1, 304, 185	113, 613		634	4, 353	57, 111	171, 358
1891	755, 254	55, 897		636	4, 459	108, 764	165, 297

Prices of bichromate of potash in the United States from 1845 to 1892.

Years.	Cents per pound.	Years.	Cents per pound.
1845	$19\frac{7}{8}$	1869	$16\frac{7}{8}$
1846	$18\frac{7}{8}$	1870	$14\frac{1}{8}$
1847	$17\frac{1}{2}$	1871	$16\frac{5}{8}$
1848	$16\frac{7}{8}$	1872	$20\frac{11}{16}$
1849	$20\frac{3}{4}$	1873	$20\frac{9}{16}$
1850	$22\frac{5}{8}$	1874	$18\frac{1}{8}$
1851	17	1875	$18\frac{5}{16}$
1852	$15\frac{5}{8}$	1876	$15\frac{5}{8}$
1853	15	1877	13
1854	$15\frac{1}{16}$	1878	$12\frac{7}{16}$
1855	$14\frac{11}{16}$	1879	$12\frac{7}{16}$
1856	$16\frac{1}{2}$	1880	$13\frac{7}{8}$
1857	$18\frac{3}{4}$	1881	$15\frac{3}{8}$
1858	$20\frac{3}{4}$	1882	$15\frac{1}{2}$
1859	19	1883	$14\frac{9}{16}$
1860	$20\frac{3}{4}$	1884	$11\frac{1}{8}$
1861	$20\frac{3}{4}$	1885	10
1862	$20\frac{7}{8}$	1886	$9\frac{7}{8}$
1863	$23\frac{1}{8}$	1887	10
1864	$26\frac{1}{4}$	1888	$10\frac{1}{2}$
1865	$25\frac{1}{2}$	1889	$11\frac{3}{8}$
1866	$23\frac{7}{8}$	1890	$10\frac{1}{2}$
1867	$19\frac{3}{8}$	1891	$9\frac{13}{16}$
1868	$18\frac{5}{8}$	1892	$10\frac{1}{2}$

ANTIMONY.

By E. W. Parker.

During 1891 more progress was made in the development of antimony properties in the United States than has been previously noted. In Nevada particularly has the work been prosecuted, and an industry which for a number of years has been one of a very desultory and unorganized character, gives promise of becoming of considerable importance. The properties near Antimony, Arkansas, were not operated during the year, the owners prefering to wait the completion of a railroad which is under construction, and which will enable them through adequate transportation facilities to compete with other producers. A small quantity of ore from this property produced in and carried over from 1890 was smelted in Philadelphia, yielding 2,578 pounds of metallic antimony. This was marketed during 1891, as was also something over 4,000 pounds of metal smelted from Arkansas ores in 1890.

Owing to litigation the mines near Pine Creek, Idaho, were not in operation during the year. Mr. Frank Roband, agent of the company owning the property, reports it is expected that operations will be begun in 1892 and prosecuted regularly. The Montana mines, located near Thompson Falls, were not operated on account of a disagreement among the owners. Operations are expected to be resumed during the present year (1892) and on a more extended scale.

The domestic production for the year was therefore limited to the State of Nevada. The product of ore (stibnite) amounted to 1,000 tons. Of this 300 tons were smelted in San Francisco, about 400 tons were shipped to Liverpool for smelting, and the remainder was carried over. In addition to this stock were 300 tons carried over from 1890, largely the result of development work, and for which no attempt was made to find a market. The value of the Nevada ores is quoted at from $65 to $75 per ton at San Francisco, and from $125 to $140 at Liverpool, England.

Among the localities where antimony is found should be mentioned the property on Coyote creek, Iron county, Utah. It is said that this property was worked about ten or twelve years ago, but on account of heavy transportation expenses the enterprise was not successful and was discontinued. It is claimed that with concessions in the way of freight rates, the working of these properties could be profitably carried on. During 1891 the discovery of a valuable body of antimony was reported in Inyo county, California. For a more extended discussion of the antimony localities of the United States the reader is referred to "Mineral Resources" for 1883–'84.

Including the antimony from the Arkansas ores sold in 1890, the amount of metal marketed in 1891 was 236,660 pounds, valued at $27,007. The ore sent to Liverpool for smelting may be safely valued at $20,000, making a total of $47,007, as against $40,756 in 1890 and $28,000 in 1889.

Prices.—The market quotations during 1891 showed a wide range. In New York quotations are made for foreign antimony, the prices for domestic metal being made at San Francisco. The Western market is largely influenced by New York quotations. In New York the market opened with Cookson's quoted at 18¾ to 19 cents, Hallett's at 16¼ to 16½. A gradual decline took place during the spring and summer, until in September it was quoted at 11⅝ cents for Cookson's and 10 cents for Hallett's. The decline had been caused by reports of large supplies of ores, which, however, were not forthcoming, and the market reacted during the last three months, closing in December at 16¼ cents for Cookson's and 12¾ cents for Hallett's. In San Francisco the year opened with local metal quoted at 24 to 25 cents. In sympathy with New York, the market fell off to 22 cents in April and continued to decline until October, when the quotations were as low as 13 cents. The reaction was not so marked as in the East, prices for December being from 14 to 15 cents.

Imports.—The imports continue to be largely in excess of domestic production, and the total quantity of antimony consumed in the United States is sufficient to warrant still more attention to our own properties and larger smelting facilities. The imports for a series of years have been as follows:

Antimony and antimony ore imported and entered for consumption in the United States, 1867 to 1891.

Years ending—	Crude and regulus.		Ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
June 30, 1867	....	$63, 919	....	....	$63, 919
1868	1, 033, 336	83, 822	....	....	83, 821
1869	1, 345, 921	129, 918	....	....	129, 918
1870	1, 227, 429	164, 179	....	....	164, 179
1871	1, 015, 039	148, 264	....	$2, 364	150, 628
1872	1, 933, 306	237, 536	....	3, 031	240, 567
1873	1, 166, 321	184, 498	....	2, 941	187, 439
1874	1, 253, 814	148, 409	....	203	148, 612
1875	1, 238, 223	131, 360	6, 460	609	131, 969
1876	946, 869	119, 441	8, 321	700	120, 141
1877	1, 115, 124	135, 317	20, 001	2, 314	137, 631
1878	1, 256, 624	130, 950	20, 351	1, 259	132, 209
1879	1, 380, 212	143, 099	34, 542	2, 341	145, 440
1880	2, 019, 389	265, 773	25, 150	2, 349	268, 122
1881	1, 808, 945	253, 054	841, 730	18, 199	271, 253
1882	2, 525, 838	294, 234	1, 114, 699	18, 019	312, 253
1883	3, 064, 050	286, 892	697, 244	11, 254	298, 146
1884	1, 779, 337	150, 435	231, 360	6, 489	156, 924
1885	2, 579, 840	207, 215	215, 913	7, 497	214, 712
Dec. 31, 1886	2, 997, 985	202, 563	218, 366	9, 761	212, 324
1887	2, 553, 284	169, 747	362, 761	8, 785	178, 532
1888	2, 814, 044	248, 015	68, 040	2, 178	250, 193
1889	2, 676, 130	304, 711	146, 309	5, 568	310, 279
1890	3, 315, 659	411, 960	611, 140	29, 878	441, 838
1891	2, 618, 941	327, 307	1, 433, 531	36, 232	363, 539

Principal foreign sources.—Great Britain obtains her supply of antimony and antimonial ores from her colonies in Canada, New South Wales, New Zealand, and Victoria. The Canadian properties are in New Brunswick and Nova Scotia, and produced in 1888, according to the Blue Book, 308 tons of antimony ore, valued at £739 at the mines. In the same year New South Wales exported 171 tons of ore and 19 tons of metal, with an aggregate value of £2,918; New Zealand produced 376 tons of ore, worth £6,246, and Victoria 2 tons, valued at £19. The European countries producing antimony are France, Spain, Portugal, Germany, Austria, and Italy. Borneo is an extensive producer, and some ore comes from Japan. It was the reported large production and heavy shipments from Japan that caused smelters to unload stocks during the spring and summer of 1891 and brought about the rapid decline of prices. The subsequent improvement was due to these reports being proved without foundation.

COAL.

By E. W. Parker.

INTRODUCTION.

The statistics of the production of bituminous coal in 1891 have been compiled almost entirely from direct returns of operators to the Geological Survey, with the exception of the States of Illinois and Colorado. As in previous volumes, the report on Illinois is obtained from that of Col. J. S. Lord, secretary of the bureau of labor statistics of that State. The amount of coal mined in Colorado has been reported by Mr. John McNeil, State Inspector of coal mines, in advance of his own publication. The report on Pennsylvania anthracite has been prepared by Mr. John H. Jones, of Philadelphia, Pennsylvania, who was the special agent of the Eleventh Census in charge of coal statistics, and who also compiled the report on Pennsylvania anthracite for the preceding volume of "Mineral Resources." Mr. Albert S. Bolles, chief of the bureau of industrial statistics of Pennsylvana, has rendered valuable assistance in furnishing information regarding the product of a number of Pennsylvania bituminous mines, from which no reports had been received by this office. Mr. John T. Stewart, State Inspector of mines of Kansas, has kindly furnished similar information for delinquent mines in his State, and access has been had to the reports of other State mine inspectors to substantiate returns made to the Survey and to furnish a basis of estimate for nonreporting mines. The number of mines from which direct returns were not received was, however, not more than 10 per cent. of the total number addressed. With the means adopted for estimating on the product of delinquent mines, it may be safely assumed that the average of error in the figures hereinafter submitted will not be more than 3 per cent. In some instances reports have been received from every known operator in the State, so they may be said to be substantially correct. As in the report for 1890, no attempt has been made to collect the statistics from country banks producing for small local trade.

Method of collecting information.—All of the information obtained from operators has been secured by correspondence. In order to reach all commercial mines, a directory of all that could be located from every available source was compiled for each state, by counties, and copies sent to operators or others likely to be able to give information, with the request that corrections and additions be noted and returned. This method has proved very satisfactory, and by its continuance each year a correct list of mines may be maintained.

THE COAL FIELDS OF THE UNITED STATES.

For convenience of description, the coal areas of the United States have been grouped into the Anthracite division and the Bituminous division.

The Anthracite division, in a commercial sense, may be said to include the anthracite districts of Pennsylvania alone, although small amounts of anthracite are mined in Colorado, Arkansas, and New Mexico. In the New England basin the original coal beds have been metamorphosed into graphite and graphitic coal, which have special uses, although not classified by the coal trade as anthracite.

The Bituminous division includes the following coal fields: (1) The Triassic field, embracing the coal beds of the Triassic or New Red sandstone formation in the Richmond basin in Virginia, and in the coal basins along the Deep and Dan rivers in North Carolina; (2) the Appalachian field, which extends from the state of New York on the north to the state of Alabama on the south, having a length northeast and southwest of over 900 miles and a width ranging from 30 to 180 miles; (3) the Northern field, which is confined exclusively to the central part of Michigan; (4) the Central field, embracing the coal areas in Indiana, Illinois, and western Kentucky; (5) the Western field, including the coal areas west of the Mississippi river, south of the forty-third parallel of north latitude and east of the Rocky mountains; (6) the Rocky Mountain field, containing the coal areas in the states and territories lying along the Rocky mountains; (7) the Pacific coast field, embracing the coal districts of Washington, Oregon, and California. (See Mineral Resources of the United States, 1886, for detailed descriptions.)

The following table contains the approximate areas of these coal fields, with the total product of each during 1887, 1888, 1889, 1890 and 1891:

Classification of the coal fields of the United States.

	Area.	Product in 1887.	Product in 1888.	Product in 1889.	Product in 1890.	Product in 1891.
Anthracite.						
	Sq. miles.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
New England (Rhode Island and Massachusetts)	500	6,000	4,000	2,000	....	500
Pennsylvania	470	39,506,255	43,922,897	45,544,970	46,468,641	50,665,431
Colorado and New Mexico	15	36,000	44,791	53,517	(*b*)	(*b*)
	985	39,548,255	43,971,688	45,600,487	46,468,641	50,665,931
Bituminous (*a*).						
Triassic:						
Virginia	180	30,000	33,000	49,411	19,346	17,290
North Carolina	2,700	....	....	222	10,262	20,355
Appalachian:						
Pennsylvania	9,000	30,866,602	30,796,727	36,174,089	42,302,173	42,788,490
Ohio	10,000	10,301,708	10,910,946	9,976,787	11,494,506	12,868,683
Maryland	550	3,278,023	3,479,470	2,939,715	3,357,813	3,820,239
Virginia	2,000	795,263	1,040,000	816,375	764,665	719,109
West Virginia	16,000	4,836,820	5,498,800	6,231,880	7,394,494	9,220,665
Kentucky	10,000	950,903	1,193,000	1,108,770	1,206,120	1,222,918
Tennessee	5,100	1,900,000	1,967,297	1,925,689	2,169,585	2,413,678
Georgia	200	313,715	180,000	225,934	228,337	171,000
Alabama	8,660	1,950,000	2,900,000	3,572,983	4,090,409	4,759,781
	64,395	55,193,034	60,966,240	62,972,222	73,008,102	77,984,563

a Including lignite, brown coal, and scattering lots of anthracite. *b* Included in bituminous product.

Classification of the coal fields of the United States—Continued.

	Area.	Product in 1887.	Product in 1888.	Product in 1889.	Product in 1890.	Product in 1891.
Bituminous—Continued.						
Northern:	*Sq. miles.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Michigan	6, 700	71, 461	81, 407	67, 431	74, 977	80, 073
Central:						
Indiana	6, 450	3, 217, 711	3, 140, 979	2, 845, 057	3, 305, 737	2, 973, 474
Kentucky	4, 000	982, 282	1, 377, 000	1, 290, 985	1, 495, 376	1, 693, 151
Illinois	36, 800	10, 278, 890	14, 655, 188	12, 104, 272	15, 292, 420	15, 660, 698
	47, 250	14, 478, 883	19, 173, 167	16, 240, 314	20, 093, 533	20, 327, 323
Western:						
Iowa	18, 000	4, 473, 828	4, 952, 440	4, 045, 358	4, 021, 739	3, 825, 495
Missouri	26, 700	3, 209, 916	3, 909, 967	2, 557, 823	2, 735, 221	2, 674, 606
Nebraska	3, 200	1, 500	1, 500	} 2, 222, 443	2, 259, 922	1, 500
Kansas	17, 000	1, 596, 879	1, 850, 000			2, 716, 705
Arkansas	9, 100	150, 000	276, 871	279, 584	399, 888	542, 379
Indian Territory	20, 000	685, 911	761, 986	752, 832	869, 229	1, 091, 032
Texas	4, 500	75, 000	90, 000	128, 216	184, 440	172, 100
	98, 500	10, 193, 034	11, 842, 764	10, 036, 256	10, 470, 439	11, 023, 817
Rocky Mountains, etc.:						
Dakota	....	21, 470	34, 000	28, 907	30, 000	30, 000
Montana	....	10, 202	41, 467	363, 301	517, 477	541, 861
Idaho	....	500	400	....	....	....
Wyoming	....	1, 170, 318	1, 481, 540	1, 388, 947	1, 870, 366	2, 327, 841
Utah	....	180, 021	258, 961	236, 651	318, 159	371, 045
Colorado	....	1, 755, 735	2, 140, 686	2, 544, 144	3, 094, 003	3, 512, 632
New Mexico	....	508, 034	626, 665	486, 463	375, 777	462, 328
	....	3, 646, 280	4, 583, 719	5, 048, 413	6, 205, 782	7, 245, 707
Pacific coast:						
Washington	....	772, 612	1, 215, 750	1, 030, 578	1, 263, 689	1, 056, 249
Oregon	....	31, 696	75, 000	64, 359	61, 514	51, 826
California	....	50, 000	95, 000	119, 820	110, 711	93, 301
	....	854, 308	1, 385, 750	1, 214, 757	1, 435, 914	1, 201, 376
Total product sold	....	124, 015, 255	142, 037, 735	....	....	....
Colliery consumption	....	5, 960, 302	6, 621, 667	....	....	....
Total product, including colliery consumption	....	129, 975, 557	148, 659, 402	141, 229, 513	157, 788, 656	168, 566, 669

PRODUCT.

The total product of all kinds of coal in 1891, including colliery consumption (*i. e.*, that portion of the product used at the mines in the work of operating, ventilating, etc., and sold or furnished to employés), was 150,505,954 long tons, or 168,566,669 short tons, valued at $191,133,135. Of this total 45,236,992 long tons, or 50,665,431 short tons, were Pennsylvania anthracite, worth $73,944,735 at the mines. The remainder of the product, 105,268,962 long tons, or 117,901,238 short tons, includes all the bituminous, semibituminous, brown, and lignite coals, and the anthracite product of Arkansas, Colorado, and Virginia, representing a total value at the mines of $117,188,400. The total product in 1891 was 9,623,225 long tons, or 10,778,013 short tons, in excess of the output of the preceding year, the increase in value being $14,328,562. The increase in Pennsylvania anthracite was 3,747,134 long tons, or 4,196,790 short tons, in quantity, and $7,560,963 in value. The increase in bituminous and other coals was 5,876,091 long tons, or 6,581,223 short tons; the value increasing $6,767,599. The average price per ton received for anthracite was $1.79 against $1,729 in 1890, The average price for bituminous was $0.994, against

$0.992 the previous year, an increase of two-tenths of a cent per ton. In obtaining these averages only the marketable product of anthracite—that is, the quantity shipped and sold to local trade and employés—is considered; the item of colliery consumption is not included in the valuation. In all other cases the estimate is based on the entire product of all grades, and includes the colliery consumption.

Including superintendents, mechanics, clerical force, etc., at the mines, as well as actual miners, laborers, and others engaged in the active operation of the bituminous collieries, the total number employed in the industry during the year was 205,372, against 192,204 in 1890. The average number of days worked in 1891 was 223, being equivalent to the employment of 45,797,956 men for one day; or, allowing for Sundays, holidays, etc., and assuming 300 days to be a full year's time, the number of men employed for a full year would have been 152,893. On the same basis for 1890, when 192,204 men made an average of 226 days, there was an equivalent 43,532,064 men for one day, or 145,107 men for a full year of 300 working days. The total number of tons mined per man employed in 1891 was 574, against 578 in 1890. As the number of persons employed includes everyone connected with the mines (except those at distant offices) these figures are not representative of the average work of a miner.

The total product, including colliery consumption, is shown in the following table, together with the distribution for market and the total value.

Bituminous coal product in the United States in 1891, by States.

States.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	2,822,813	91,456	100,160	1,745,352
Arkansas	518,120	8,909	15,350	....
California	86,783	3,424	3,094	....
Colorado (a)	2,934,332	70,000	50,000	458,300
Georgia	15,000	1,000	5,000	150,000
Illinois (a)	12,787,993	2,246,705	610,000	16,000
Indiana	2,689,780	211,854	63,152	8,688
Indian Territory	1,026,932	9,405	22,163	32,532
Iowa	3,363,347	373,025	88,966	157
Kansas	2,428,787	255,839	31,946	133
Kentucky	2,559,263	285,281	21,363	50,162
Maryland	3,771,584	36,959	11,696	....
Michigan	53,133	21,515	5,659	....
Missouri	2,350,707	265,595	58,304	....
Montana	501,503	5,395	6,438	28,525
Nebraska	....	1,500	....	....
New Mexico	448,612	3,471	6,245	4,000
North Carolina	18,780	600	975	....
North Dakota	....	30,000	....	....
Ohio	11,393,209	1,281,568	140,420	53,486
Oregon	47,541	4,285	....	....
Pennsylvania	29,976,914	2,007,348	321,225	10,483,003
Rhode Island	500	....	....	....
Tennessee	1,626,964	100,478	33,302	652,934
Texas	169,300	900	1,900	....
Utah	315,711	8,233	21,650	25,451
Virginia	583,082	16,685	3,178	133,454
Washington	1,008,496	12,025	20,428	15,300
West Virginia	6,887,151	429,878	47,163	1,856,473
Wyoming	2,229,401	33,558	60,392	4,490
Total	92,615,738	7,816,891	1,750,169	15,718,440

a The distribution of the product in Colorado and Illinois is estimated on the basis of the output in 1890.

Bituminous coal product in the United States in 1891, by States—Continued.

States.	Total amount produced.	Total value.	Number of days active.	Average number employed.	Average price per ton.
	Short tons.				
Alabama	4,759,781	$5,087,596	268	9,302	$1.07
Arkansas	542,379	647,560	214	1,317	1.19
California	93,301	204,902	222	256	2.20
Colorado	3,512,632	4,800,000	....	6,000	1.37
Georgia	171,000	256,500	312	850	1.50
Illinois	15,660,698	14,237,074	215½	32,951	.909
Indiana	2,973,474	3,070,918	190	5,879	1.03
Indian Territory	1,091,032	1,897,037	221½	2,891	1.74
Iowa	3,825,495	4,867,999	224	8,124	1.27
Kansas	2,716,705	3,557,303	222	6,201	1.31
Kentucky	2,916,069	2,715,600	225	6,355	.93
Maryland	3,820,239	3,082,515	244	3,891	.81
Michigan	80,307	133,387	205	223	1.66
Missouri	2,674,606	3,283,242	218	6,199	1.23
Montana	541,861	1,228,630	....	1,119	2.27
Nebraska	1,500	4,500	....	....	3.00
New Mexico	462,328	779,018	265	806	1.68
North Carolina	20,355	39,365	254	80	1.95
North Dakota	30,000	42,000	....	....	1.40
Ohio	12,868,683	12,106,115	206	22,182	.94
Oregon	51,826	155,478	125	100	3.00
Pennsylvania	42,788,490	37,271,053	223	63,661	.87
Rhode Island (*a*)	500	10,000	....	6	....
Tennessee	2,413,678	2,668,188	230	5,097	1.105
Texas	172,100	412,360	225	787	2.40
Utah	371,045	666,045	....	621	1.80
Virginia	736,399	611,654	246	820	.83
Washington	1,056,249	2,437,270	211	2,447	2.31
West Virginia	9,220,665	7,359,816	237	14,227	.80
Wyoming	2,327,841	3,555,275	....	3,411	1.53
Total	117,901,238	117,188,400	*b*223	205,803	.994

a Graphitic coal.
b General average obtained from the average days made in the different states, exclusive of Colorado, Montana, Utah, and Wyoming.

A study of the foregoing table shows that the steadiest employment was obtained at the mines in Georgia, where work was continuous throughout the year. Alabama comes next in the average activity, with 268 days. New Mexico reports an average of 265 days, and North Carolina 254. The least number of days was made in Oregon, the mines in that state being active only 125 days. Next to this comes Indiana, with an average of 190 days. The greater number averaged between 210 and 240 days, the general average being 223.

The average price of $3 per ton obtained in Nebraska and Oregon was the highest figure realized, except for the graphitic coal product of Rhode Island, and these states represented a comparatively small portion of the product. The smallest average price was obtained in West Virginia, with Maryland next at an advance of 1 cent per ton. Virginia's product brought an average of 83 cents per ton, and Pennsylvania's 87 cents. The general average for the United States was six-tenths of 1 cent less than $1 per ton.

IMPORTS AND EXPORTS.

The following tables have been compiled from official returns to the Bureau of Statistics of the Treasury Department, and show the imports and exports of coal from 1867 to 1890, inclusive. The values given in both cases are considerably higher than the average "spot" rates by which the values of the domestic production have been computed.

The tariff from 1824 to 1843 was 6 cents per bushel, or $1.68 per long ton; from 1843 to 1846, $1.75 per ton; 1846 to 1857, 30 per cent. ad valorem; 1857 to 1861, 24 per cent. ad valorem; 1861, bituminous and shale, $1 per ton; all other, 50 cents per ton; 1862 to 1864, bituminous and shale, $1.10 per ton; all other, 60 cents per ton; 1864 to 1872, bituminous and shale, $1.25 per ton; all other, 40 cents per ton; since August, 1872, bituminous coal and shale, 75 cents per ton; anthracite, free of duty. No change has been made in tariff rates since 1872, except for slack or culm, which, under act of March 3, 1883, was made 30 cents per ton. During the period from June, 1854, to March, 1866, the reciprocity was in force, and coal from the British possessions in North America was admitted into the United States duty free.

The exports consist both of anthracite and bituminous coal, the amount of anthracite being the greater. They are made principally by rail over the international bridges and by lake and sea to the Canadian provinces. Exports are also made by sea to the West Indies, to Central and South America, and elsewhere.

The imports are principally from Australia and British Columbia to San Francisco, from Great Britain to the Atlantic and Pacific coasts, and from Nova Scotia to Atlantic coast points.

Coal imported and entered for consumption in the United States, 1867 to 1891.

Years ending—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
June 30, 1867	....	....	509,802	$1,412,597
1868	....	....	394,021	1,250,513
1869	....	....	437,228	1,222,119
1870	....	....	415,729	1,103,965
1871	973	$4,177	430,508	1,121,914
1872	390	1,322	485,063	1,279,686
1873	2,221	10,764	460,028	1,548,208
1874	471	3,224	492,063	1,937,274
1875	138	963	436,714	1,791,601
1876	1,428	8,560	400,632	1,592,846
1877	630	2,220	495,816	1,782,941
1878	158	518	572,846	1,929,660
1879	488	721	486,501	1,716,209
1880	8	40	471,818	1,588,312
1881	1,207	2,628	652,963	1,988,199
1882	36	148	795,722	2,141,373
1883	507	1,172	645,924	2,013,555
1884	1,448	4,404	748,995	2,494,228
1885	4,976	15,848	768,477	2,548,432
Dec. 31, 1886	2,039	4,920	811,657	2,501,153
1887	14,181	42,983	819,242	2,609,311
1888	24,093	68,710	1,085,647	3,728,060
1889	20,652	117,434	1,001,374	3,425,347
1890	15,145	46,695	819,971	2,822,216
1891	37,607	112,722	1,362,387	4,557,932

Coal of domestic production exported from the United States, 1867 to 1891.

Years ending—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
June 30, 1867	192,912	$1,333,457	92,189	$512,742
1868	192,291	1,082,745	86,367	433,475
1869	283,783	1,553,115	.....	.....
1870	121,098	803,135	106,820	503,223
1871	134,571	805,169	133,380	564,067
1872	259,567	1,375,342	141,311	586,264
1873	342,180	1,827,822	242,453	1,086,253
1874	401,912	2,236,084	361,490	1,587,666
1875	316,157	1,791,626	203,189	828,943
1876	337,934	1,869,434	230,144	850,711
1877	418,791	1,891,351	321,665	1,024,711
1878	319,477	1,006,843	340,661	1,352,624
1879	386,916	1,427,886	276,000	891,512
1880	392,626	1,362,901	222,634	695,179
1881	462,208	2,091,928	191,038	739,532
1882	553,742	2,589,887	314,320	1,102,898
1883	557,813	2,648,033	463,051	1,593,214
1884	649,040	3,053,550	646,265	1,977,959
1885	588,461	2,586,421	683,481	1,989,541
Dec. 31, 1886	667,076	2,718,143	544,768	1,440,631
1887	825,486	3,469,166	706,364	2,001,966
1888	969,542	4,325,126	860,462	2,529,472
1889	857,633	3,636,347	935,151	2,783,592
1890	794,335	3,272,697	1,280,930	4,004,995
1891	861,251	3,577,610	1,615,869	5,104,850

WORLD'S PRODUCT OF COAL.

In the following table, the product of coal in the principal countries is given for the years nearest to the one under discussion for which figures are obtainable. In each instance the year for which the product is given is named. Long tons of 2,240 pounds are used in giving the product of Great Britain, net tons of 2,000 pounds for the United States, and metric tons of 2,204 pounds for all continental countries:

The world's product of coal.

Countries.	Tons.
Great Britain (1891)	185,479,126
United States (1891)	168,566,669
Germany (1891)	84,347,156
France (1891)	26,199,745
Belgium (1891)	19,865,345
Austria (1889)	8,592,873
Russia (1889)	6,207,800
Sweden (1888)	300,000
Spain (1891)	1,314,147
Italy (1889)	390,320
Total	501,316,681
Percentage of the United States	33.6

COAL TRADE REVIEW.

Including, in addition to shipments, the coal sold to local trade around the mines, the amount used for steam and heat in operating the collieries, and the amount made into coke, the total product in 1891 was 150,505,954 long tons, or 168,566,669 short tons, an increase over the product of 1890 of 9,623,225 long tons, or 10,778,013 short tons, or a little more than 6 per cent. The details of this increase are discussed under the head of "Product."

A retrospective view of the trade in 1891 reveals evidences of a fairly prosperous year, taken as a whole. In the anthracite business the year opened with a good demand for domestic consumption. This was due to the prevalence of cold weather. The strike in the coke regions in the early months of the year also caused a larger demand for anthracite coal, particularly of the large sizes. With the warmer weather and the end of the strike the demand for anthracite fell off, but until August and September little attempt was made to curtail production. The result of this was that the market became overcrowded and the restriction in production in the later months did not entirely relieve this condition. The circulars issued by the sales agents for the latter part of the year were merely nominal and subject very largely to the disposition of buyers.

In the bituminous industry an increase in business is noticed, though in seven States, namely, California, Indiana, Iowa, Missouri, Texas, Virginia, and Washington, there was a decreased product. Among those in which the product increased, West Virginia should be particularly mentioned. Owing to the wonderful development in the Flat Top region, as also to increased output in Fayette and Kanawha counties, the product of the State was nearly 2,000,000 tons more than in 1890, an increase of over 25 per cent. In the Indian Territory the product reached the million-ton mark for the first time, the actual product being 1,091,032 short tons, an increase of 221,803 short tons, or more than 25 per cent., over 1890. Sympathizing with the industry in the Territory, the output in Arkansas increased from 399,888 short tons in 1890 to 542,379 short tons in 1891, an increase of 142,481 short tons, or 26 per cent. The increases in the other bituminous States were not of special note. It is to be noted that in Pennsylvania the shipments were about 700,000 tons more than in the previous year, and an increase of more than half a million tons is observed in the amount sold to local trade, the latter being due doubtless to colder weather during the winter season; but a decrease of over 1,000,000 tons in the amount made into coke, caused by the prolonged strike in the Connellsville region, makes the total for the State but about 1 per cent. more than the product of 1890. A two months' strike in the Brazil district of Indiana caused a loss to the State not only during the continuance of the strike, but had an after effect in that the market which had been supplied by this coal offered inducements to operators in Ohio, Pennsylvania, and other States who were not slow to take advantage of it, and the outlet once secured to them was not to be easily taken away. The full results of the strike are seen in a decreased output of 332,463 tons. In Iowa operators suffered from the importation of coal from other States which low rates of transportation have brought into competition with the home product, and the output of the State fell off 196,244 short tons.

Missouri's product is also slightly decreased, due probably to the same cause, the proximity and accessibility of the Illinois fields being a principal factor.

During the latter part of the year the coal interests of Tennessee were disturbed by an outbreak on account of the convict-lease system. The Tennessee Coal, Iron and Railway Company, operating both coal and iron mines, in accordance with the laws of the Commonwealth employ the convicts under lease. Free labor is also employed, and the convict system has been the thorn in the flesh of the "honest labor." The dissatisfaction culiminated finally at Briceville in acts of lawlessness on the part of the free miners, during which the stockades were burned and a number of convicts released. These disturbances, however, occurred too late in the season to materially affect the industry of the State for the year.

The condition of the coal market can be appreciated by a statement of the ruling prices during the year at the various trade centers, and of the general movement of coal between the producing districts and the principal markets. The following market reports have been compiled for this volume from weekly trade reports published in the "Black Diamond," the "Coal Trade Journal," and from other technical periodicals, together with reports from boards of trade at some of the principal points:

New York, New York.—The year opened with circular prices for free-burning anthracite the same as for September 1890, and these were maintained until the close of March. These prices, which were, however, merely nominal, were—for broken, $3.65; egg, $3.90; stove, $4.15; chestnut, $3.75. On March 23, the spring schedule of prices went into effect and the circular made approximate to the prices which were actually being paid before: Broken, $3.50; egg, $3.60; stove, $3.75; chestnut, $3.50, with pea coal at $3. These prices were 15 cents in advance on broken and chestnut of those existing at the same period in 1890, and 25 cents advance each on egg and stove. They were not strictly maintained, however, during the summer months, as, in the addition to the usual dullness of that season, the market suffered considerably from overproduction (a condition which existed during nearly the entire year) and it was not possible to keep up the stiffened prices. In July the Reading issued a circular in which the following prices were quoted, free on board, at New York:

Circular prices for anthracite coal at New York, July, 1891.

Kinds of coal.	Broken.	Egg.	Stove.	Chestnut.
Hard white ash	$3.90	$4.00	$4.05	$3.75
Free white ash	3.80	3.85	4.05	3.75
North Franklin white ash	....	4.05	4.05	3.75
Shamokin, Schuylkill red ash, and Lorberry	....	4.05	4.30	3.90
Lykens Valley	4.50	4.90	5.15	4.35

But while the circular prices showed a sharp advance, they may be classed as nominal, and the majority of sales were made at shaved prices, notwithstanding efforts of the producing companies to restrict production and maintain prices.

The prices for free-burning white ash coal at the close of 1891 were as follows:

Broken	$3.75
Egg	4.10
Stove	4.40
Chestnut	3.95

Boston, Massachusetts.—The receipts of coal at the port of Boston for a series of years have been as follows:

Receipts of coal at Boston for nine years.

Years.	Anthracite.	Bituminous.	From Cape Breton.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
1883				2, 273, 068
1884				2, 225, 740
1885				2, 221, 220
1886				2, 500, 000
1887				2, 400, 000
1888	2, 057, 279	1, 004, 195		3, 061, 474
1889	1, 647, 348	914, 966	5, 538	2, 567, 852
1890	1, 740, 564	964, 857	14, 072	2, 719, 493
1891	2, 039, 443	1, 070, 088		3, 109, 531

The amounts here given do not represent the consumption of coal in the city of Boston, as a considerable portion of the coal received at the port is shipped to interior points, but it is not possible to determine the exact quantity.

Taken in its entirety the year 1891 was much more satisfactory than the preceding one. The receipts at the port were 290,038 long tons more than in 1890, and 48,057 tons more than in 1888, when the receipts were greater than in any year in the history of the coal trade in the city. Following a year of almost unprecedented dullness, 1891 opened in the anthracite trade with a dull market which continued during the spring, though prices were somewhat in advance of those ruling in the early part of 1890. Business showed an improvement in the summer and the better condition prevailed the greater part of the remainder of the year.

The trade in bituminous coal was good and dealers were well satisfied with the year's business.. One thing that helped to make the year a successful one was the low freight rates that ruled during the year. An unusually large supply of carriers were at the disposal of shippers, and charges were at times as low as 35 and 40 cents per ton from New York and 50 cents from Philadelphia and Baltimore.

Philadelphia, Pennsylvania.—The wholesale prices for anthracite coal, free on board at Port Richmond, averaged as follows for the past three years:

Average prices of anthracite coal at Port Richmond in 1889, 1890, and 1891.

Kinds of coal.	Broken.	Egg.	Stove.	Chestnut.	Pea.
1889.	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*	*Per ton.*
Hard white ash	3.70	3.85	4.05	3.80	2.10
Free-burning white ash	3.50	3.75	3.95	3.75	2.10
1890.					
Hard white ash	3.65	3.90	4.05	3.70	2.25
Free-burning white ash	3.50	3.75	4.05	3.70	2.25
1891.					
Hard white ash	3.75	3.90	4.05	3.75	2.25
Free-burning white ash	3.65	3.90	4.00	3.70	2.25

The contracts for supplying gas coal to the board of public works for 1892 are as follows:

Contracts for supplying gas coal to Philadelphia in 1892.

Companies.	Tons.	Price per ton.
Manor Gas Coal Co	5,000	$3.47
Penn Gas Coal Co	76,932	3.48
Westmoreland Coal Co	76,392	3.48
Newburg-Orrel Coal and Coke Co	15,000	3.49
Despard Coal Co	15,000	3.49
J. & W. Wood (cannel)	6,000	6.30
Montana Coal and Coke Co	15,000	3.49
Gaston Gas Coal Co	5,000	3.49

Compared with the prices bid for furnishing the supply in 1891, it will be seen that the coal for 1892 was obtained at much cheaper rates. The bids for 1891 were:

Bids for supplying gas coal to Philadelphia for 1891.

Companies.	Price per ton.
Montana Coal and Coke Co	$3.91
Gaston Coal Co	3.91
Despard Coal Co	3.91
Chesapeake and Ohio	3.94
Manor Gas Coal Co	3.98
Westmoreland Coal Co	3.99

The charges for coastwise freight from Philadelphia at the close of the year were as follows:

Coastwise freights from Philadelphia at the close of 1891.

To—	Rate per ton.	To—	Rate per ton.
Portland	$1.00	Baltimore	$0.60
Portsmouth	1.00	Washington	.85
Boston	$0.85- 1.00	Norfolk	.60
New Bedford	.75	Richmond	$0.60- .65
Providence	.75- .80	Charleston	.70
New York	.90	Savannah	.70

Baltimore, Maryland.—The coal received at Locust Point for the Baltimore market includes Cumberland, Georges Creek, Myersdale, and the gas coal from the West Virginia mines on the line of the Baltimore and Ohio railroad, and that from the Youghiogheny mines in Pennsylvania on the line of the same road, for local use and for northern shipment. Although the bulk of the coal received in Baltimore comes by the Baltimore and Ohio railroad, the receipts over the Northern Central are not inconsiderable. The receipts over the Baltimore and Ohio in 1891 were 2,296,735 tons, and by the Northern Central 916,086 tons. Of the latter about 300,000 tons is anthracite. In addition to the above about 250,000 tons of anthracite are received annually by the Susquehanna Canal, and a comparatively small amount of bituminous coal is received over the Baltimore and Potomac Railroad.

The three railroads have carried to Baltimore annually since 1883 the following quantities:

Coal receipts at Baltimore.

Years.	Via Baltimore and Ohio railroad.	Via Northern Central railroad.	Via Baltimore and Potomac railroad.
	Tons.	*Tons.*	*Tons.*
1883	1,618,416	693,494	....
1884	2,510,389	767,381	....
1885	2,238,097	850,303	....
1886	2,313,783	818,863	....
1887	2,167,007	765,082	15,338
1888	2,300,000	680,962	16,500
1889	2,000,000	666,972	7,139
1890	2,090,911	735,912	10,000
1891	2,296,735	916,086	....

Foreign shipments of coal from Baltimore.

Years.	Tons.	Years.	Tons.
1883	63,526	1888	33,386
1884	50,289	1889	27,750
1885	71,527	1890	37,190
1886	64,477	1891	122,818
1887	54,455		

Rates for anthracite coal in cars at Baltimore or via Canton pier at the close of 1891.

Sizes.	Hard white ash.	Shamokin.	Lykens Valley.	Bernice.
Broken	$4.35	$4.35	$4.65	$4.45
Egg	4.45	4.45	4.85	4.45
Stove	4.60	4.60	5.10	4.60
Chestnut	4.30	4.30	4.60	4.45
Pea	3.00	3.00	3.25	....

Bituminous coal was quoted at $2.60 per long ton free on board at Locust Point or Canton piers.

These prices show an advance over those at the same period in 1890, of 15 cents per ton on all sizes of hard white ash and Shamokin except chestnut and pea, which remain the same; 40 cents on the three larger sizes of Lykens Valley, and 25 cents on chestnut, and an advance of 15 cents on all sizes of Bernice.

Pittsburg, Pennsylvania.—The following prices were quoted at the close of 1891:

Pittsburg coal prices at the close of 1891.

River coal, on board (per bushel)	5 to 6 cents.
Railroad, at the mines (per ton)	$0.95 to $1.10

These prices are but a very slight advance on those at the close of 1890 and there were no noteworthy variations in the market during the year. The fluctuations in the price of Pittsburg coal at Cincinnati, Louisville, and New Orleans during 1891 may be seen from the following. The quotations are taken from market reports at the first of each month.

Prices of Pittsburg coal at Cincinnati, Louisville, and New Orleans (a).

Months.	Cincinnati.	Louisville.	New Orleans.
	Cts. per bushel.	*Cts. per bushel.*	*Cts. per barrel.*
January	5½ to 6¾	6½ to 7	28 to 30
February	6 6¾	6½ 7	28 30
March	6 6¾	7 7½	28 30
April	6½ 7	7 7½	28 30
May	7 7¼	7 7½	28 30
June	7 7½	7 7¾	30 33
July	7 8	7 8	33 35
August	7 7¾	7 8	33 35
September	7 7½	7 7½	33 35
October	7 8	7 8	33 35
November	7 8½	7 8½	34 36
December	7½ 8½	7½ 8½	35 37

a Rates at Cincinnati and Louisville are for bushels of 76 pounds; at New Orleans for barrels of 208 pounds.

The shipping trade of Pittsburg suffered seriously from strikes during the early part of the year, and when work was resumed the river mines were unable to ship any large amounts because of low water. It was not until June that sufficient water for shipping was in the river, and then large shipments were made. But, notwithstanding the loss of time by strikes and low water, the year's business was large. Much of this was due to the decreased consumption of natural gas, which caused a return to the use of coal.

Mr. Joseph D. Weeks, of Pittsburg, reports the amount of coal shipped from the several pools of the Monongahela slackwater during 1891 at 106,914,700 bushels, a decrease as compared with 1890 of 9,387,900 bushels. The total shipments for a period of nine years are given below:

Coal shipments by Ohio river for nine years.

Years.	Bushels.	Years.	Bushels.
1883	87,995,000	1888	109,572,000
1884	55,432,000	1889	79,578,100
1885	74,964,000	1890	116,302,600
1886	91,664,000	1891	106,914,700
1887	56,743,000		

Buffalo, New York.—The prices for anthracite coal, free on board, at the close of 1891 were as follows:

Prices for anthracite coal at Buffalo, New York.

Sizes.	Per short ton.	Sizes.	Per short ton.
Stove	$4.17	Grate	$4.08
Chestnut	4.17	Egg	4.17

For bituminous coal the quotations to consumers on railroad track were as follows, cartage extra:

Prices for bituminous coal at Buffalo at the close of 1891.

Kinds of coal.	Per ton.	Kinds of coal.	Per ton.
Brier Hill region:		Pittsburg region of Allegheny Valley railroad:	
No. 1 lump	$3.70	Screened lump	$2.60
No. 2 lump	3.45	Lump and nut, mixed	2.50
Cannel (Ohio):		Run of mines	2.35
No. 1	4.70	Mercer county region:	
Reynoldsville region:		Screened lump	2.25
Screened lump	2.45	Lump and nut, mixed	2.15
Lump and nut, mixed	2.35	Run of mines	2.00
Run of mines	2.20	Screened nut	2.00
Screened nut	2.20	Slack	1.50
Nut and slack, mixed	2.00	Allegheny Valley railroad River Division region:	
Slack	1.70	Screened lump	2.25
Low Grade division of Allegheny Valley railroad:		Screened lump and nut, mixed	2.15
Screened lump	2.25	Run of mines	2.00
Lump and nut, mixed	2.15	Nut and slack, mixed	1.80
Run of mines	2.00	Slack	1.50
Screened nut	2.00	Coke:	
Nut and slack, mixed	1.80	Connellsville coke	4.55
Slack	1.50	Reynoldsville coke	3.75

Anthracite prices were per net ton as below on cars:

Stove	$4.17
Chestnut	4.17
Grate	4.08
Egg	4.17

The following tables exhibit the receipts and shipments of anthracite, bituminous, and Blossburg (smithing) coal at Buffalo for a series or years:

Coal receipts at Buffalo for several years.

Years.	Anthracite.	Bituminous.	Blossburg.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*
1842				1,800
1852				57,560
1862				239,873
1872				790,876
1882				3,021,791
1886	2,673,778	1,420,956	30,000	4,124,734
1887	3,497,203	1,776,217	25,000	5,298,420
1888	4,549,015	1,892,823	22,500	6,464,338
1889	4,338,570	2,198,327	22,500	6,559,397
1890	4,500,000	2,200,000	25,500	6,725,500
1891	4,800,000	2,450,000	25,500	7,275,000

Lake shipments of anthracite coal from Buffalo.

Years.	Tons.	Years.	Tons.
1883	1,467,778	1888	2,514,906
1884	1,431,081	1889	2,151,670
1885	1,428,086	1890	2,157,810
1886	1,531,210	1891	2,365,895
1887	1,894,060		

Lake shipments of bituminous and Blossburg coal from Buffalo.

Years.	Bituminous.	Blossburg.
	Tons.	*Tons.*
1887	8,706	10,000
1888	7,452	5,000
1889	11,673	5,000
1890	25,372	5,000
1891	34,066	5,000

The principal points to which coal was shipped from Buffalo by lake during the past six years are shown in the following table, together with the tonnage for each year:

Clearances of coal at Buffalo for six years.

Destination.	1886.	1887.	1888.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Chicago	642,135	784,462	1,023,649	988,750	952,280	957,805
Milwaukee	376,615	376,876	549,831	497,895	451,550	508,140
Duluth	157,420	165,798	282,106	160,430	199,230	257,625
Superior	65,090	96,746	120,000	112,450	127,300	162,075
Toledo	55,290	84,563	83,850	52,725	96,230	64,620
Gladstone			39,575	36,520	30,215	35,170
Racine	25,263	16,565	29,695	33,410	29,130	30,510
Detroit	31,090	40,203	35,330	31,890	40,065	24,560
Green Bay	23,870	29,446	26,345	25,050	22,380	29,015
Other places	156,439	140,020	179,525	142,216	131,390	295,375
Total	1,531,212	1,734,479	2,369,906	2,081,336	2,079,770	2,365,895

Cleveland, Ohio.—The prices of anthracite and bituminous coals at the close of 1890 and 1891 were as follows:

Prices of coal at Cleveland, Ohio.

Kinds of coal.	1890.	1891.	Kinds of coal.	1890.	1891.
Bituminous:	*Per ton.*	*Per ton.*	Bituminous—cont'd:	*Per ton.*	*Per ton.*
Massillon	$2.40	$2.40	Coshocton	$2.20	$2.10
Palmyra	2.75	2.75	Hocking	2.00	1.90
Pittsburg	2.10	2.10	Anthracite:		
Salineville	1.70	1.70	Grate	5.00	5.25
Kentucky cannel	4.50	4.75	Egg	5.25	5.50
Goshen	1.75	1.85	Stove	5.25	5.50
Sherodsville	1.75	1.70	Chestnut	5.25	5.50
Osnaburg	1.85	1.80			

As will be seen above, the prices for bituminous coals, with the exception of Kentucky cannel, at the close of 1891 were only slightly different from those at the close of 1890. Kentucky cannel and all sizes of anthracite advanced 25 cents per ton.

The coal trade of Cleveland in 1891 was something phenomenal, the receipts, including coke, being nearly 60 per cent. more than in 1888, the largest previous year in the history of the city. The increase in receipts over 1890 was 1,269,562 tons, or 65 per cent. The shipments were 686,892 tons more than in 1890. Exclusive of coke, the difference between the receipts and shipments in 1891 was 539,039 tons, representing the consumption of the city during the year. The increased receipts were entirely of bituminous coal, anthracite and coke both falling off. The shipments of anthracite, however, increased 5,854 tons.

The coal and coke receipts and coal shipments at Cleveland for a series of years are shown in the following table:

Coal and coke receipts and shipments at Cleveland, Ohio, for the past six years.

	1886.	1887.	1888.	1889.	1890.	1891.
Receipts:	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Bituminous	1,412,535	1,454,744	1,737,781	1,600,000	1,560,208	2,838,586
Anthracite	144,826	176,769	181,551	160,000	205,856	201,927
Coke	117,372	114,924	124,827	150,000	194,527	189,640
Total	1,674,733	1,746,437	2,044,159	1,910,000	1,960,591	3,230,153
Shipments:						
Anthracite by rail	20,000	20,296	29,735	25,000	29,056	34,910
Bituminous by rail	120,000	294,453	677,733	600,000	785,526	941,564
Bituminous by lake	600,000	703,506	1,000,000	1,100,000	1,200,000	1,525,000
Total	740,000	1,018,255	1,707,468	1,725,000	1,814,582	2,501,474

From the Cuyahoga customs district, which embraces Cleveland, Ashtabula, Fairport, and Lorain, the clearances during the past six years have been as follows:

Clearances from the Cuyahoga (Ohio) district for six years.

Years.	Tons.	Years.	Tons.
1886	1,079,784	1889	2,020,996
1887	1,433,035	1890	2,328,663
1888	1,855,260	1891	2,635,461

Toledo, Ohio.—The receipts of coal of all kinds in 1891 were 2,754,943 tons, a decrease as compared with 1890 of 266,943 tons. Of the amount received 83,800 tons were anthracite by lake, a decrease from 1890 of a little more than 50,000 tons. The following table shows the total receipts of coal for six years and the railroads carrying the same:

Receipts of coal at Toledo, Ohio, for six years.

Received by—	1886.	1887.	1888.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Wabash Railway	12,598	9,634	10,375	7,586	3,620	600
Lake Shore and Michigan Southern Railroad	165,382	206,099	101,064	35,693	20,592	8,872
Cincinnati, Hamilton and Dayton Railroad	8,198	11,741	37,831	51,746	25,753	35,356
Pennsylvania Company's railroad	201,427	330,020	339,750	234,675	214,765	172,325
Michigan Central Railroad	9,594	13,864	16,504	19,935	3,152	544
Columbus, Hocking Valley and Toledo Railway	1,039,200	955,620	1,358,025	923,745	931,717	604,039
Toledo, Ann Arbor and North Michigan Railway	1,910	552	24,700	96		
Toledo, St. Louis and Kansas City Railroad	3,828		1,359	3,287	8,420	6,891
Toledo and Ohio Central Railway	404,684	590,000	637,000	706,950	826,049	800,429
Lake boats (*a*)	87,120	117,921	140,963	90,282	133,813	83,800
Wheeling and Lake Erie Railway	391,086	454,813	755,155	763,055	853,940	1,007,042
Toledo, Columbus and Southern Railway	15,832	5,446	1,014	1,210		35,065
Cincinnati, Jackson and Mackinaw Railroad			45	54	65	
Total	2,340,859	2,695,710	3,423,785	2,838,314	3,020,886	2,754,943

a Anthracite.

The following prices were quoted at the close of the year:

Prices of coal at Toledo, Ohio.

Kinds of coal.	Lump.	Run of mine.	Nut.
Hocking Valley	$2.50	$2.40	$2.10
Massillon	2.60		2.50
Jackson	2.70	2.40	2.20
Cannel	3.25		

Chicago, Illinois.—The following tables give the receipts of coal and coke at Chicago during 1891 and 1890 as collected and compiled by the bureau of coal statistics:

Coal receipts at Chicago in 1890 and 1891.

Months.	Anthracite.							
	By lake.		By rail.		Total.		1891.	
	1891.	1890.	1891.	1890.	1891.	1890.	Increase.	Decrease.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
January			24,943	9,299	24,943	9,299	15,644	
February			27,122	4,254	27,122	4,254	22,868	
March			16,889	4,736	16,889	4,736	12,153	
April	10,736	30,692	33,192	8,341	43,928	39,033	4,895	
May	173,288	106,850	26,971	15,632	200,259	122,482	77,777	
June	142,455	131,563	32,024	19,859	174,479	151,422	23,057	
July	175,826	129,073	43,794	29,798	219,620	158,871	60,749	
August	164,367	159,338	52,723	35,174	217,090	194,512	22,578	
September	149,983	168,465	70,844	62,061	220,827	230,526		9,699
October	155,805	243,078	77,314	60,149	233,119	303,227		70,108
November	193,107	198,089	68,394	43,418	261,501	241,507	19,994	
December	144,780	68,873	69,328	53,380	214,108	122,253	91,855	
Total	1,310,347	1,236,021	543,538	346,101	1,853,885	1,582,122	271,763	

Months.	Pennsylvania.				Ohio.			
	1891.	1890.	1891.		1891.	1890.	1891.	
			Increase.	Decrease.			Increase.	Decrease.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
January	17,309	19,342		2,033	27,698	26,009	1,689	
February	26,395	14,653	11,742		29,328	23,655	5,673	
March	25,459	18,954	6,505		30,012	31,629		1,617
April	26,595	19,900	6,695		30,822	28,313	2,509	
May	21,477	15,653	5,824		31,685	41,781		10,096
June	26,326	20,375	5,951		37,145	40,898		3,753
July	27,123	17,058	10,065		40,460	30,561	9,899	
August	24,079	21,621	2,458		30,134	25,801	4,333	
September	30,035	31,297		1,262	40,833	42,711		1,878
October	25,462	35,744		10,282	51,524	46,751	4,773	
November	52,729	32,540	20,189		81,725	53,629	28,096	
December	36,949	24,653	12,296		64,683	42,652	22,031	
Total	339,938	271,790	68,148		496,049	434,390	61,659	

Months.	West Virginia and Kentucky.				Illinois.			
	1891.	1890.	1891.		1891.	1890.	1891.	
			Increase.	Decrease.			Increase.	Decrease.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
January	10,277	6,902	3,375		136,786	159,400		22,614
February	9,758	7,541	2,217		135,505	150,537		15,032
March	10,076	8,829	1,247		166,086	162,167	3,919	
April	12,374	9,830	2,544		157,948	160,450		2,502
May	10,081	10,895		814	75,976	89,002		13,026
June	10,935	10,080	855		127,914	111,711	16,203	
July	8,704	7,113	1,591		96,546	118,368		21,822
August	9,472	10,826		1,354	103,921	118,337		14,416
September	8,173	12,304		4,131	137,547	155,984		18,437
October	10,300	14,159		3,859	184,976	174,264	10,712	
November	22,240	15,714	6,526		181,402	140,492	40,910	
December	18,439	13,819	4,620		190,011	168,656	21,355	
Total	140,829	128,012	12,817		1,694,618	1,709,368		14,750

Months.	Indiana.				Coke.			
	1891.	1890.	1891.		1891.	1890.	1891.	
			Increase.	Decrease.			Increase.	Decrease.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
January	118,614	109,723	8,891	....	64,207	87,241	....	24,034
February	113,705	92,361	21,344	....	47,118	103,825	....	56,707
March	157,541	123,761	28,780	....	46,770	70,732	....	23,962
April	164,652	128,697	40,955	....	27,181	56,831	....	29,650
May	55,213	87,564	....	32,351	31,143	55,804	....	24,661
June	133,090	107,034	26,056	....	49,318	59,038	....	9,720
July	101,872	116,393	....	14,520	49,365	55,465	....	6,100
August	132,730	108,043	24,687	....	56,184	76,098	....	19,914
September	139,640	135,299	4,341	....	72,096	88,460	....	16,364
October	130,427	140,549	....	10,122	74,637	90,389	....	15,752
November	25,595	83,293	....	57,698	87,993	81,112	6,881	....
December	32,040	149,179	....	117,139	86,319	80,498	5,821	....
Total	1,305,120	1,381,896	....	76,776	692,331	905,493	....	213,162

SHIPMENTS FROM CHICAGO.

Months.	Anthracite.				Bituminous coal and coke.			
	1891.	1890.	1891.		1891.	1890.	1891.	
			Increase.	Decrease.			Increase.	Decrease.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
January	29,784	29,114	670	....	76,193	74,911	1,282	....
February	19,014	16,233	2,781	....	39,243	76,149	....	36,906
March	32,994	21,063	11,931	....	50,012	69,481	....	19,469
April	18,732	12,719	6,003	....	73,119	56,407	16,712	....
May	9,728	19,601	....	9,873	32,212	37,415	....	5,203
June	40,741	47,944	....	7,203	53,914	56,309	....	2,395
July	49,334	58,007	....	8,673	64,274	69,453	....	5,179
August	81,247	79,484	1,763	....	64,896	67,111	....	2,215
September	93,827	98,441	....	4,614	74,012	76,209	....	2,197
October	98,773	87,619	11,154	....	86,327	94,071	....	7,744
November	81,218	42,661	38,557	....	62,739	67,818	....	5,079
December	51,327	40,359	10,968	....	60,405	79,015	....	18,610
Total	606,709	553,245	53,464	....	737,346	824,349	....	87,003

Milwaukee, Wisconsin.—The following review of the coal trade of Milwaukee in 1891, and the accompanying tables, have been kindly furnished by Mr. William J. Langson, secretary of the Chamber of Commerce:

"Receipts of coal at Milwaukee in 1891 exceeded the record of any preceding year. The total amount was 1,156,033 net tons, an increase of 160,375 tons over the total receipts of 1890, of which 1,006,656 tons arrived by lake and 149,377 by rail, the latter Illinois coal. The receipts consisted of—

		Tons.
Anthracite coal by lake		762,735
Bituminous coal by lake	243,921	
Bituminous coal by rail	149,377	
Total bituminous coal		393,298
Total anthracite and bituminous		1,156,033

"Shipments westward by railroad during the year amounted to 600,888 tons, an increase of 78,270 tons over the shipments of 1890, and as local stocks were nearly exhausted before the opening of the straits it is apparent that the local consumption exceeded 550,000 tons.

"In the tables comparing receipts and shipments with those of previous years, the receipts from each lake port are given separately as reported at the custom-house. The total of the custom-house figures shows a deficiency of 5,517 tons below the actual amount received by the consignees. This difference is probably accountable to the fact that some of the cargoes were reported at the custom-house in long tons in place of short tons.

"In the last table the annual receipts for thirty years are given, showing the coal trade of Milwaukee to have grown from 21,860 tons in 1862 to 1,156,033 tons in 1891.

"Prices of coal at Milwaukee were maintained without much variation during the year 1891, anthracite coal delivered ranging from $5 to $5.75 per ton, Briar Hill and Erie $4.80 to $5, and steam coal $2.25 to $2.40 for Illinois and $3.20 to $3.50 for Ohio.

Receipts of coal at Milwaukee for seven years.

	1885.	1886.	1887.	1888.	1889.	1890.	1891.
By lake from—	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Buffalo	392,003	395,971	464,972	631,263	542,167	510,598	659,388
Erie	50,915	41,847	61,222	74,610	47,862	46,378	55,202
Oswego	10,043	....	1,153	1,348	....	2,408	17,022
Cleveland	126,741	91,997	78,259	98,631	89,071	135,413	143,776
Ashtabula	35,360	11,096	38,881	23,105	48,599	24,671	22,726
Black River	5,549	....	....	....	....	....	....
Lorain	19,452	12,417	11,757	13,533	15,367	15,351	3,983
Sandusky	19,307	57,412	36,606	19,733	51,816	26,193	10,692
Toledo	31,875	69,079	14,115	38,452	71,516	59,305	53,644
Charlotte	19,491	31,744	2,781	14,292	22,526	6,120	10,013
Fairport	....	....	10,517	30,253	5,552	11,100	5,775
Ogdensburg	....	....	....	7,700	4,953	7,026	5,179
Huron, Ohio	....	....	....	8,244	7,726	9,720	12,307
Other ports	....	2,679	4,331	....	588	(*a*)49,375	(*a*)6,949
Total by lake	710,736	714,242	724,594	961,164	907,743	903,658	1,006,656
By railroad	65,014	45,439	118,385	161,079	72,935	92,999	149,377
Total receipts	775,750	759,681	842,979	1,122,243	980,678	996,657	1,156,033

a Including cargoes from all ports not reported at the custom-house.

Shipments of coal from Milwaukee for the past nine years.

Shipped by—	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Chicago, Milwaukee and St. Paul Ry	146,295	140,630	179,883	177,286	166,120	283,269	258,281	378,090	406,455
Chicago and Northwestern Ry	41,746	37,314	56,591	70,420	79,258	107,193	97,207	103,279	114,847
Wisconsin Central R. R.	6,725	7,469	8,943	11,745	18,953	12,624	11,727	15,929	14,449
Milwaukee, Lake Shore and Western Ry	30,575	11,757	12,804	13,072	13,886	16,146	25,413	5,884	7,998
Milwaukee and Northern R. R	10,075	7,556	10,872	12,011	15,627	34,480	20,556	19,386	26,723
Lake	355	335	184	269	1,595	125	224	50	416
Totals	235,771	205,061	269,277	284,803	295,439	453,837	413,408	522,618	600,888

Receipts of coal at Milwaukee by lake and rail annually for thirty years, from 1862 to 1891, inclusive.

Years.	Tons.	Years.	Tons.
1862	21, 860	1877	264, 784
1863	43, 215	1878	239, 667
1864	44, 503	1879	350, 840
1865	36, 369	1880	368, 568
1866	66, 616	1881	550, 027
1867	74, 568	1882	593, 842
1868	92, 992	1883	612, 584
1869	87, 690	1884	704, 166
1870	122, 865	1885	775, 750
1871	175, 526	1886	759, 681
1872	210, 194	1887	842, 979
1873	229, 784	1888	1, 122, 243
1874	177, 655	1889	980, 678
1875	228, 674	1890	996, 657
1876	188, 444	1891	1, 156, 033

Louisville, Kentucky.—Owing to the interruption of business at Pittsburg by strikes and low water, the receipts of coal from there during 1891 fell off 114,000 tons from those of 1890. The amount received from Kentucky increased 88,706 tons accordingly, and anthracite receipts increased 3,305 tons, or from 2,846 in 1890 to 6,151 tons in 1891. The total receipts of coal and coke were 21,989 tons less than in 1890.

The following table shows the consumption of coal in Louisville and vicinity during the past seven years. The amount used by railroads is not included:

Consumption of coal in the vicinity of Louisville, Kentucky, for seven years.

	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Pittsburg by river	539, 628	575, 000	646, 000	750, 000	800, 000	640, 000	526, 000
Ohio and Kanawha rivers	86, 348	90, 000	72, 800	95, 000	100, 000	120, 000	120, 000
Total coal by river	625, 976	665, 000	718, 800	845, 000	900, 000	760, 000	646, 000
Bituminous by rail	305, 960	200, 671	232, 107	341, 427	298, 118	304, 399	393, 105
Anthracite	9, 300	4, 341	4, 241	13, 377	6, 740	2, 846	6, 151
Coke	40, 306	50, 000	49, 688	65, 000	50, 000	50, 000	50, 000
Aggregate	981, 542	920, 012	1, 004, 836	1, 264, 804	1, 254, 858	1. 117, 245	1, 095, 256

Duluth, Minnesota, and Superior, Wisconsin.—The coal receipts at Duluth in 1891 were 636,000 tons, according to the custom-house reports, being nearly 100,000 tons less than in 1890. The receipts at Superior were 1,140,000 tons, or 95,000 tons more than in the preceding year. The aggregate receipts of the two cities were 1,776,000 tons, 4,995 tons less than in 1890. Freight rates from Buffalo ruled exceedingly low throughout the season.

The table below shows development of the coal trade at the head of the lakes since 1878, and will be found of interest:

Coal receipts at Duluth, Minnesota, and Superior, Wisconsin.

Years.	Tons.	Years.	Tons.
1878	31,000	1887	912,000
1881	163,000	1888	1,535,000
1882	260,000	1889	1,205,000
1883	420,000	1890	1,780,995
1885	595,000	1891	1,776,000
1886	736,000		

Saint Paul and Minneapolis, Minnesota.—No reliable information regarding the amount of coal received is obtainable. Wholesale prices at the close of 1891 were as follows:

Prices of coal at Saint Paul and Minneapolis, Minnesota, in December, 1891.

Kinds of coal.	Free on board cars at Duluth.	To dealers at St. Paul and Minneapolis.
Anthracite:		
Grate, egg, stove, and nut	$5.00 to $5.25	$6.50
Pea	3.75 to 4.00	4.75
Bituminous:		
Pittsburg	3.75	4.75
Youghiogheny	3.75	4.75
Kincaid	3.50	4.50
Mansfield	3.75	4.75
Hocking	3.50	4.50
Wheeling Creek	3.50	4.50
Smithing:		
Briar Hill	4.25	5.25
Cumberland	4.25	5.25
Blossburg	4.25	5.25

Cincinnati, Ohio.—Receipts of coal at Cincinnati in the past eleven years have been as follows. The years are the fiscal years adopted by the chamber of commerce and end August 31:

Coal receipts at Cincinnati, Ohio.

Years.	Tons.	Years.	Tons.
1881	1,492,817	1887	2,350,026
1882	2,197,407	1888	2,551,415
1883	2,025,859	1889	2,348,055
1884	2,092,551	1890	2,452,253
1885	2,008,850	1891	2,608,923
1886	2,130,354		

The Survey is indebted to Col. S. D. Maxwell, formerly superintendent of the Cincinnati Chamber of Commerce, for interesting information relating to coal receipts at Cincinnati prior to 1891. Mr. Charles B. Murray, the present superintendent, has kindly furnished the figures for 1891. The following table shows the annual receipts in bushels for the fiscal years ending August 31 from 1871 to 1891:

Receipts of coal at Cincinnati for twenty years.

Years.	Pittsburg (Youghiogheny).	Kanawha.	Ohio River.	Canal.	Anthracite.	Other kinds.	Total.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
1871-'72	19,254,716	....	*a*10,359,906	1,104,003	72,171	....	30,790,796
1872-'73	24,962,373	....	*a*11,075,072	1,162,052	75,000	....	37,274,497
1873-'74	24,014,681	....	*a*10,398,153	710,000	112,000	....	35,234,834
1874-'75	24,225,002	4,476,619	4,277,327	565,352	248,750	1,597,260	35,390,310
1875-'76	27,017,592	6,004,675	4,400,792	409,358	282,578	2,068,322	40,183,317
1876-'77	28,237,572	3,631,823	5,141,150	322,171	376,125	1,913,793	39,622,634
1877-'78	26,743,055	6,386,623	3,288,008	380,768	439,350	1,654,425	38,892,229
1878-'79	20,769,027	6,134,039	4,068,452	333,549	768,750	2,136,850	34,210,667
1879-'80	31,750,968	8,912,801	4,268,214	202,489	712,075	2,351,699	48,198,246
1880-'81	23,202,084	10,715,459	3,151,934	67,684	770,525	2,336,752	40,244,438
1881-'82	37,807,961	13,950,802	3,560,881	77,336	779,925	3,090,715	59,267,620
1882-'83	33,895,064	13,260,347	3,309,534	180,621	977,250	2,997,216	54,620,032
1883-'84	32,239,473	15,926,743	2,956,688	293,010	1,085,350	3,910,795	56,412,059
1884-'85	32,286,133	14,588,573	3,007,078	314,774	1,257,900	2,683,864	54,138,322
1885-'86	34,933,542	17,329,349	939,746	205,717	1,287,925	2,720,250	57,416,529
1886-'87	37,701,094	20,167,875	338,435	129,503	1,314,775	3,693,850	63,345,532
1887-'88	41,180,713	20,926,596	1,533,358	26,098	1,328,225	5,710,649	70,705,639
1888-'89	36,677,974	23,761,853	544,940	12,129	1,020,525	3,075,000	65,092,421
1889-'90	42,601,615	19,221,196	454,385	....	1,001,175	4,709,775	67,988,146
1890-'91	43,254,460	19,115,172	1,479,670	15,111	1,118,671	7,362,698	72,345,782

a Including Kanawha coal.

Saint Louis, Missouri.—The aggregate receipts of coal and coke in 1891 were 2,421,350 short tons, an increase compared with 1890 of 216,115 tons. The receipts of coke decreased 64,280 tons, or from 162,940 to 98,660 tons, the difference being nearly two-thirds of the receipts in 1891. The receipts of bituminous coal were 2,183,640 short tons, against 1,915,960 tons in 1890, an increase of 267,680 tons, and anthracite receipts increased from 124,335 to 139,050 short tons. The following table exhibits the receipts of coal and coke for the past six years:

Receipts of coal and coke at Saint Louis for six years.

Years.	Bituminous coal.	Anthracite coal.	Coke.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
1886	2,082,019	96,640	104,036	2,282,695
1887	2,321,814	131,600	175,550	2,628,964
1888	2,357,938	136,290	134,660	2,628,888
1889	1,909,227	121,530	147,750	2,178,507
1890	1,915,960	124,335	162,940	2,205,235
1891	2,183,640	139,050	98,660	2,421,350

According to the market reports of the *Age of Steel* the prices at the close of 1891 for coal in car lots at East Saint Louis were as follows:

Prices of coal at East Saint Louis at the close of 1891.

Kinds of coal.	Per ton.
Bituminous:	
Ava	$1.25
Percy	1.37½
Royal	1.50
Bryden steam	1.70
Bryden block	2.12½
Jupiter lump	1.80
Jupiter steam	1.60
Jupiter nut	1.10
Big Muddy lump	2.00
Big Muddy nut	1.37½
Illinois (standard)	1.17½
Anthracite, all sizes delivered	7.00
Piedmont, smithing (*a*)	4.50

a In car lots in Saint Louis.

Delivered prices for bituminous coal to steam users in Saint Louis were from $1.75 to $2.90 per ton, and to residences $2.50 per ton. Prices for coke in car lots at Saint Louis were quoted:

Prices for coke at Saint Louis at the close of 1891.

Kinds of coke.	Per ton.
Connellsville foundry	$5.65
New River	5.55

Kansas City, Missouri.—A decrease of 49,253 tons is noted in the receipts of coal at this point in 1891 compared with 1890, while the shipments increased 40,000 tons.

Coal receipts and shipments at Kansas City for six years.

Years.	Receipts.	Shipments.	Years.	Receipts.	Shipments.
	Tons.	*Tons.*		*Tons.*	*Tons.*
1885	533,262	199,476	1889	1,260,816	269,281
1886	562,540	160,233	1890	1,149,253	385,000
1887	752,354	134,559	1891	1,100,000	425,000
1888	935,735	174,197			

The quotations at the close of 1891 show an advance on nearly all kinds of bituminous coal of about 25 cents per ton. Cannel and smithing coals were 25 cents less per ton and anthracite from 25 to 50 cents more. Gas-house coke was 50 cents less and Connellsville 55 cents more per ton.

Prices of coal and coke at Kansas City at the close of 1891.

Kinds of coal	Per ton.	Kinds of coal.	Per ton.
Bituminous:		Bituminous—Continued:	
Farmers lump	$2.75	Wellington	$2.40
Wier City nut	2.25	Semi-anthracite	6.00 to 6.50
Oakdale nut	2.75	Anthracite:	
Rich Hill nut	2.00	Nut size	9.00
Higginsville lump	2.25	Egg size	9.00
Clinton lump	2.50	Stove size	9.00
Deepwater lump	2.50	Grate size	9.00
Cannel	4.50	Smithing coal:	
Illinois	3.00	Piedmont	6.00
Vernon	2.55	Blossburg	6.00
Wier City lump	2.50	Coke:	
Oakdale lump	2.75	Gas house	4.00
Rich Hill lump	2.55	Native	4.00
Lexington lump	2.40	Connellsville	7.55
Excelsior lump	2.75		
Foster lump	2.50		

Mobile, Alabama.—The receipts of coal at this port in 1891 amounted to 53,042 tons, of which 51,267 tons were from Alabama mines and 1,775 tons anthracite and English. Following are the annual receipts for a period of nine years:

Receipts of coal at Mobile, Alabama, for nine years.

Years.	Alabama coal.	Anthracite and English.	Total.
	Tons.	*Tons.*	*Tons.*
1883	25,304	1,229	26,533
1884	17,808	891	18,699
1885	40,301	775	41,076
1886	30,310	2,022	32,332
1887	39,232	910	40,142
1888	38,785	648	39,433
1889	43,620	1,454	45,074
1890	39,320	1,327	40,647
1891	51,267	1,775	53,042

Strenuous and praiseworthy efforts are being made to create a coal port at Mobile, and circumstances would seem to justify the expectations of those interested. Backed by the great coal fields of the state and with the growing necessities of the gulf trade such an establishment can not but prove successful.

Coal trade with Cuba, South America, and Mexico would be easily established while other markets on the Gulf coast of the United States are waiting for the cheaper fuel which could thus be obtained. A coal elevator has been recently erected at Velasco, Texas, and at this port and at Galveston transportation may be had to interior parts of Texas, which now depend upon the Indian Territory for their supply of coal. There is, it is claimed, plenty of water on the outer bar of the Mobile harbor, and proper facilities for docking and handling the coal seem to be the only things lacking to make Mobile an important shipping port.

New Orleans, Louisiana.—Coal is sold in New Orleans by the barrel, the weight of which seems to be an indefinite quantity. According to the *American Manufacturer and Iron World* of Pittsburg, reporting sales of Pittsburg coal, the weight of the barrel is 208 pounds, and the prices at the close of 1891 were from 35 to 37 cents per barrel. *The Coal Trade Journal* quotes the weight of the barrel at 180 pounds and the price per barrel at 28 cents. The latter journal reports the receipts of Pittsburg coal at New Orleans in 1891 at 4,900,000 barrels, an increase of 150,000 barrels over 1890, and more than any other previous year, with the exception of 1887, the banner year of the New Orleans coal trade. In the receipts at New Orleans the coal sent to planters below the city is included.

Consumption of Pittsburg coal at New Orleans, Louisiana, from 1883 to 1891.

Years.	Barrels.	Years.	Barrels.
1883	3,759,250	1888	4,500,000
1884	3,864,300	1889	4,846,500
1885	3,995,650	1890	4,750,000
1886	4,529,000	1891	4,900,000
1887	5,100,000		

San Francisco, California.—The following interesting review of the coal trade of San Francisco has been prepared by Mr. J. W. Harrison, of San Francisco, for the benefit of the trade:

"The most reliable assurance we can have of progress during the year 1891 is the increased consumption of fuel, as it infallibly demonstrates an enlargement of our factories, besides the marked increase of demand for domestic uses. Our imports this year are 498,278 tons greater than last, and are largely in excess of all former years. Consumers have been singularly fortunate in securing low-priced coal for the past six months, caused by the excessive importation of foreign grades, thereby necessitating severe losses to the importers. The leading brands are being offered to-day at $4 per ton less than they could be readily disposed of at this time last year; with a local consumption of 4,000 tons daily the benefits can readily be computed in favor of those industries, where fuel figures are the leading item of expense. By looking over the monthly quotations it will be seen that the decline has been steady, but it is generally believed that bedrock has been reached and that an early improvement must be developed. The present low rates of wheat freights can not induce ship owners to carry coal here, unless well paid to do so, and present values leave the carriers almost nothing.

"The following table of prices will show the monthly fluctuations of foreign coals for 'spot' cargoes—the average price is given for each month:

Monthly prices of coal at San Francisco in 1891.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Australian (gas)	$9.00	$8.25	$7.00	$7.25	$7.00	$6.87	$7.12	$7.25	$7.12	$6.87	$6.75	$6.75
English steam	9.00	8.25	7.25	7.12	6.50	6.62	6.87	7.00	7.00	6.87	6.75	6.75
Scotch splint	10.00	8.87	8.37	7.50	7.00	6.87	7.25	7.50	7.37	7.25	7.00	7.00
West Hartley	10.00	8.87	7.87	7.25	6.50	6.62	6.87	7.12	7.12	7.00	7.00	7.00

"The various sources from which we have derived our supplies are as follows:

Sources of coal consumed in California.

Sources.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*
British Columbia	417,904	441,759	652,657
Australia	408,032	194,725	321,197
English and Welsh	32,890	35,662	168,586
Scotch	12,727	1,610	31,840
Eastern (Cumberland and anthracite)	18,950	32,550	42,210
Franklin, Green River, and Cedar River	209,137	216,760	178,230
Carbon Hill and South Prairie	163,377	191,109	196,750
Mount Diablo and Coos Bay	87,600	74,210	90,684
Japan, etc	1,340	16,170	20,679
Total	1,351,957	1,204,555	1,702,833

"To insure a correct statement of the consumption of the State, I have included all the arrivals at San Pedro, 90,614 tons, and San Diego, 70,206 tons.

"We start the year with an excessive supply in yard, but when it is calculated all that can possibly arrive here within the next four months, against the amount that will be used in the same period, our yarded stock will then make a very meager showing; besides, our coast collieries can not profitably meet this market until our present supply is materially reduced, and quotations are improved. The importers of foreign grades are not soliciting contracts for future delivery, as sellers' and buyers' views are a long distance apart.

"The arrivals of foreign coke this year are 40,974 tons, being more than double the amount imported (18,309 tons) in 1890."

Total receipts of coal at San Francisco during the past vine years.

Years.	Tons.	Years.	Tons.
1883	869,615	1888	1,386,463
1884	987,151	1889	1,196,543
1885	959,246	1890	1,105,572
1886	1,011,867	1891	1,542,013
1887	1,154,993		

In the above table the receipts at San Pedro and San Diego are not included.

WAGES IN COAL MINING.

It is not proposed to discuss the question of labor and wages in this report, the scope of the investigation not permitting even a partial inquiry into that subject. It does not seem that any lasting agreement between the employer and the employed will be effected within the time estimated that will elapse before the exhaustion of the coal fields themselves. Not a year passes that some region is not crippled by disastrous strikes, in which the question of wages is usually, though not always, the cause of the trouble. The year 1891 began with a big strike on in Alabama, followed shortly by the notable one in the Connellsville coke region. Indiana suffered seriously from a strike in the Brazil district, which lasted for three months, from April 1 to July 1. In all of these the cause was, directly or indirectly, wages. The disturbances in Tennessee, however, in the latter part of the year were not due to this cause, but to the employment of convicts in competition with free labor, the free miners claiming principally that in dull seasons they were put on half time or laid off entirely, while the convicts were kept at work, thus depriving them of their livelihood. Notwithstanding the trouble with the miners in Tennessee, the State shows a substantial increase in product.

On February 15, 1891, a meeting of the United Mine Workers of the United States was held at Columbus, Ohio, at which the following scale of prices was adopted:

"District A: Anthracite region, Pennsylvania, an advance of 5 cents a ton over former scale.

"District 2, Central Pennsylvania, an advance of 5 cents.

"District 5, Monongahela river, 99 cents per ton for screened coal and 69 cents for run of mine.

"District 6, Hocking valley, 80 cents for screened coal; 60 cents for run of mine.

"District 11, Indiana, 85 cents for screened coal; 65 cents for run of mine, and 80 cents for cannel coal.

"District 12, Illinois, Braidwood, $1.02; Streator, 90 cents; La Salle, $1; Peoria, 85 cents; Stoneton and Mount Olive 65 cents; Belleville, 66½ cents; Harrisburg and Equality, 72½ cents; Spring Valley, $1; Springfield, 72½ cents; Wilmington (10 cents additional for dead work).

"Districts 13 and 14, Iowa, Missouri and Kansas, 16 cents advance over present prices.

"District 16, Maryland, 50 cents per net ton.

"District 17, West Virginia, Kanawha river 75 cents, Pomeroy, 57; Moundsville, 60; Flat Top 40 (run of mine); Fairmount and Coal Valley 50 (run of mine); Coal Valley, 62 (screened coal).

"District 18, Kentucky, 65 cents (run of mine).

"District 20, Alabama, Pratt and Wheeling mines 50 cents; Blue creek 45; Coalburg 50 to 60; Warwick 75.

"District 22—Indian Territory—Lehigh, Coalgate, Krebs, McAlester, Anderson, and Hartshorne 4⅘ cents per bushel for screened coal and 3.9 cents run of mine; Jenny Lind, Coalgate, and Lloydsville, 99 cents per ton. The committee recommends these prices for machine mining to be fixed at 12½ cents below price of pick mining. This scale is a general advance of about 10 cents in each district."

DETAILED STATISTICS BY STATES.

In the following pages the statistics of the coal product in the different States are given by counties for the year under review, together with a statement of the distribution of the product, *i. e.*, the quantity loaded at the mines for distant consumption, the amount sold to local trade and employés, and that used at the mines for heat and steam, and the quantity of coal coked. In the latter amount is included only that portion which the operators coke themselves, or which they know is to be made into coke at another point. A considerable quantity of coal is made into coke at places distant from the mines of which operators have no knowledge, and is therefore out of the scope of this investigation. The same may be said of coke made at gas works as a by product in the manufacture of illuminating gas.

In addition to the above comparative tables are given, showing the product of each State and county for all the years for which the figures are obtainable, and the names of transportation companies or water routes by which the product of each county reaches the market.

ALABAMA.

Total product in 1891, 4,759,781 short tons; spot value $5,087,596.

The coal product of Alabama in 1891 was 669,372 short tons, or 16 per cent. greater than in the preceding year, when the total output was 4,090,409 short tons. Considered by counties and the distribution of the product for consumption, the output of Alabama coal mines in 1891 was as follows:

Coal product of Alabama in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bibb	524, 738	1, 409	21, 133	72, 529	619, 809	$724, 094	$1.17	243	1, 175
Jefferson	1, 248, 716	68, 546	66, 810	1, 521, 271	2, 905, 343	3, 024, 723	1.04	274	5, 405
St. Clair	61, 795	200	1, 800	2, 301	66, 096	75, 423	1.14	242	180
Shelby	34, 130				34, 130	88, 678	2.60	265	200
Tuscaloosa	90, 046	4, 113	1, 334	46, 691	142, 184	147, 036	1.03	287	298
Walker	863, 388	5, 188	9, 083	102, 560	980, 219	1, 008, 642	1.03	219	2, 044
Small mines		12, 000			12, 000	19, 000			
Total	2, 822, 813	91, 456	100, 160	1, 745, 352	4, 759, 781	5, 087, 596	1.07	268	9, 302

In addition to the increased production of 669,372 short tons, the coal mining industry in Alabama during 1891 appears from other reasons to have been in a highly prosperous condition. The average price per ton realized for the coal is found to have been $1.07, against $1.03 in

1890, an advance of 4 cents per ton. This points to increased remuneration to the operating companies for their product. The statistics of labor employed shows that while the number of men decreased from 10,642 in 1890 to 9,302 in 1891, their working time increased from an average of 217 days to 268. The highest prices received for coal is reported from Shelby county at $2.60 per ton, while in Tuscaloosa and Walker counties the average was $1.03, and in Jefferson county, $1.04. The highest average number of days worked was in Tuscaloosa county, and the lowest number made was in Walker county.

The rapid progress made in the coal-mining industry of Alabama has been phenomenal. In 1870 the total output was given by the Ninth Census at 11,000 long tons, all of which was used for local consumption. In 1873 the product was estimated at 40,000 long tons. The annual production since 1870 (with the exception of 1871 and 1872, for which no figures have been published) has been as follows:

Annual coal product of Alabama since 1870.

Years.	Short tons.	Years.	Short tons.
1870	13, 200	1882	896, 000
1873	44, 800	1883	1, 568, 000
1874	50, 400	1884	2, 240, 000
1875	67, 200	1885	2, 492, 000
1876	112, 000	1886	1, 800, 000
1877	196, 000	1887	1, 950, 000
1878	224, 000	1888	2, 900, 000
1879	280, 000	1889	3, 572, 983
1880	380, 800	1890	4, 090, 469
1881	420, 000	1891	4, 759, 781

Bibb county.—Bibb county, with Shelby and a part of Jefferson counties, form what is known as the Cahaba coal field of Alabama. In producing importance it ranks third in the State, Jefferson and Walker counties being respectively first and second. The product of Bibb county in 1891 was 619,809 short tons, valued at the mines at $724,094, against 521,811 short tons in 1890, valued at $574,419, a gain in tonnage of 97,998 and in value of $149,675. Transportation is obtained over the Louisville and Nashville railroad.

Coal product of Bibb county, Alabama, for five years.

Years.	Short tons.	Years.	Short tons.
1886	199, 206	1889	500, 525
1887	230, 000	1890	521, 811
1888	(*a*)	1891	619, 809

a Not published by counties.

The coal mines of Bibb county gave employment in 1891 to 1,175 men, who made an average of 243 days, against 1,340 men for 250 days in 1890.

Jefferson county.—Jefferson county is by far the most important in coal production in the State, furnishing over 60 per cent. of the total product in 1890 and 1891. The greater portion of the product is coked for consumption in the furnaces at Birmingham and Bessemer. The total output of Jefferson county in 1891 was 2,905,343 tons, against 2,665,060 tons in 1890, an increase of 240,283 short tons. The value of the product increased from $2,669,226 in 1890 to $3,024,723 in 1891, a gain of $355,497. The product reaches the market over the Louisville and Nashville, the Georgia Pacific, and the Kansas City, Memphis and Birmingham railroads.

Coal product of Jefferson county, Alabama, for five years.

Years.	Short tons.	Years.	Short tons.
1886	1,238,114	1890	2,665,060
1887	1,384,000	1891	2,905,343
1889	2,437,446		

The total number of men employed in Jefferson county coal mines in 1891 was 5,405 who made an average of 274 days. The number of men includes convicts leased from the State, under contract.

Saint Clair county.—Total product in 1891, 66,096 short tons; spot value $75,423. This shows an increase in output over product of 1890 of 32,443 short tons or nearly 100 per cent. The increase in value was $35,568. Employés in and about the mines numbered 180 during the year who worked an average of 242 days. In 1890 the number employed was reported at 175 men for 188 days. The East and West railroad of Alabama carries the Saint Clair county product.

Coal product of Saint Clair county, Alabama, for five years.

Years.	Short tons.	Years.	Short tons.
1886	71,950	1890	33,653
1887	53,000	1891	66,096
1889	40,557		

Shelby county.—In 1891 the product of Shelby county was 34,130 short tons, valued at $88,678, as against 25,022 short tons, worth $62,550 in 1890, a gain of 9,108 tons in quantity and of $26,128 in value. The coal is shipped over the East Tennessee, Virginia and Georgia railroad.

Coal product of Shelby county, Alabama, for five years.

Years.	Short tons.	Years.	Short tons.
1886	52,000	1890	25,022
1887	54,153	1891	34,130
1889	24,873		

Shelby county, in 1891, gave employment to 200 men for an average of 265 days.

Tuscaloosa county.—Tuscaloosa county reports a very largely increased product in 1891, being 142,184 short tons, against 65,517 short tons in 1890, and 16,141 short tons in 1889. The value in 1891 was $147,036 against $68,795 the preceding year, showing a gain in output of 76,667 short tons, and in value of $78,241. Of the total product 90,046 tons were shipped over the Alabama Great Southern and the Birmingham Mineral railroads, 46,691 tons were coked, and the balance was sold or used about the mines. The number of employés is reported at 298, who worked an average 287 days.

Coal product of Tuscaloosa county, Alabama, for five years.

Years.	Short tons.	Years.	Short tons.
1886	7,363	1890	65,517
1887	9,000	1891	142,184
1889	16,141		

Walker county.—Walker county stands second in the State as a coal producer, having an output in 1891 of 980,219 short tons, valued at $1,008,642, against 767,346 short tons, valued at $768,624 in 1890. Until 1891 very little of the Walker county coal was coked, but during that year the amount so consumed was 102,560 short tons, all of which was made by the Lady Endsly Coal, Iron and Railway Company for its own furnaces. About 14,000 tons were used locally and the remainder was sent to market over the Kansas City, Memphis and Birmingham, the Georgia Pacific, the Richmond and Danville, and the Birmingham, Sheffield and Tennessee River railroads. Employment was given to 2,044 men for 219 days.

Coal product of Walker county, Alabama, for five years.

Years.	Short tons.	Years.	Short tons.
1886	179,350	1890	767,346
1887	222,000	1891	980,219
1889	488,226		

Alabama coal on the Gulf.—Mention has already been made in reviewing the coal trade of Mobile, of the possibilities of increasing the coal mining industry of Alabama by the establishment of suitable docking and shipping facilities at that port. Mr. J. R. Ryan, general manager of the Virginia and Alabama Coal Company operating large coal mines in Walker county, has not waited for such development, but through arrangements made with the Georgia Pacific railroad and connecting barge lines at Greenville, Mississippi, has been able to place Alabama coal at New Orleans in competition with Pittsburg coal. In addition to this it is reported that the Louisville and Nashville railroad has made satisfactory rates for the transportation of Alabama coal to New Orleans for reshipment by steamer to Corpus Christi, Texas, thence by the Texas Mexican railroad to Laredo, Texas, and interior points in Mexico.

ALASKA.(a)

At no place on the Pacific can the development of coal mines prove of greater importance than on the coast of this far Northwest Territory. The existence of coal in Alaska was known to the Russians for many years, before the purchase of the Territory by the United States, and one mine was opened by them on the shore of Coal Bay in Graham's Harbor, but as the operators (the Russian-American Company) followed the seam under the bay, and having cut into a stream of water the mine was flooded and abandoned. Later another mine was opened near the first and considerable coal was taken out, but with the transfer of the territory to the United States all operations ceased and until quite recently no further attempts at mining coal were made.

In the last few years attention has been again directed the these deposits, and indications point to the establishment of a flourishing industry at an early date. In the summer of 1891 a party of prospectors started from San Francisco for the purpose of examining deposits of coal on the Island of Ungah, one of the Shumagin group, at the southwest point of the Territory. The party of whom Mr. F. W. Worster and Col. S. Lucas were prominent members, returned to San Francisco in November. They report the existence of several veins, measuring from 5 to 6 feet in thickness and traceable for a distance of 2 miles. A tramway has been built from the mine to a bunker with a 350-ton capacity at tidewater.

Of more present interest, however, is the development of the coal mines on Kachemak Bay, Cooks Inlet. In January, 1889, the Pacific Coal and Commercial Company was organized in San Franciseo for the purpose of developing these mines. From the prospectus issued by this corporation, the following information has been obtained.

The company owned or held under lease seventeen claims of 160 acres each, making 2,720 acres of coal land, situated on the Kenai Peninsula, Cooks Inlet, capable of being easily worked, containing coal in large quantities, and with a harbor free from storms and ice throughout the year. The company also obtained by location and purchase five bunker and wharf sites on the Kenai Peninsula spit, having a first-class water front, 42 feet of water at low tide, and a good bottom for anchorage.

The estimate made at the time of issuing the prospectus put the cost of mining at $1.60 per ton, at which coal could be put in San Francisco at $3.50 per ton and pay a profit of 10 per cent.

The prospectus also contains a report by Mr. William H. H. Hart of an expedition sent by him in August, 1888, to examine and report upon this property. Mr. Thomas W. Nowlin, having the expedition in charge, reported that they arrived at Kachemak bay on August 17 and remained until September 3, locating claims and securing a cargo of 111½

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a For valuable information regarding the developments of coal property in Alaska, and for access to papers and maps, the Survey is indebted to Hon. Levi Maish, of Washington, D. C.

tons of coal, 38¾ tons of which were placed in the bunkers of the steamer and 72¾ were transported to San Francisco. Photographs taken at this time show exposures of seams of coal on the coast bluffs, the thickest of the seams being about 6 feet, with a parting of fire clay in the middle.

The prospectus contains also a number of tests made of the coal by steam users in San Francisco with very satisfactory results. Among these is that of Capt. J. S. Higgins, agent of the company furnishing the steamer carrying the expedition.

He is quoted as saying, "I am delighted with it. I own an interest in fourteen steam schooners, and if you will put this Alaska coal on the market I will buy it for use on all my schooners in preference to all other coals. My reasons for saying this are that the coal has no soot or dust, the decks and sails are always clean when using this coal; it burns so freely and even that little draft is required, and thus all the heat strikes the tubes of the boilers instead of a large portion being carried off through the smokestack. The coal is so hard that it is easily handled without breaking; the ash is small compared with other coals, and having no soot or clinkers the tubes are always clean and free from soot."

The following analysis of coal from Cooks Inlet has been reported by Prof. F. W. Clarke, chief chemist of the Geological Survey:

Analysis of coal from Cooks Inlet, Alaska.

	Per cent.
Moisture	9.31
Volatile matter	46.14
Fixed carbon	40.85
Ash	3.70
Total	100.00

The coal makes a brownish red ash, and will not coke.

ARKANSAS.

Total product in 1891, 542,379 short tons; spot value, $647,560.

Compared with the product of 1890, the output in 1891 shows a gain of 142,491 tons and an increase of value of $132,965, the product in the former year being 399,888 short tons, worth $514,595. The increased product is due to the opening of new mines by the Kansas and Texas Coal Company, and more extensive operations by the Western Coal and Mining Company, the mines of both of which are located in Sebastian county. The output of the other two producing counties was not materially changed. The total number of men employed in 1891 was 1,317, who worked an average of 214 days, against 938 men for the same number of days in 1890. The increased production, however, was attended by a decline in the average price per ton, from $1.29 in 1890 to $1.19 in 1891.

Coal product of Arkansas in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Johnson	78, 223	1, 100	677	80, 000	$112, 000	$1. 40	193	185
Pope	4, 850	50	100	5, 000	15, 000	3. 00	100	40
Sebastian	435, 047	1, 759	14, 573	451, 379	508, 560	1. 13	222	1, 092
Small mines	....	6, 000	....	6, 000	12, 000	....	....	....
Total	518, 120	8, 909	15, 350	542, 379	647, 560	1. 19	214	1, 317

The annual production of coal in Arkansas since 1882 has been as follows:

Product of coal in Arkansas from 1882 to 1891.

Years.	Short tons.	Years.	Short tons.
1882	5, 000	1887	129, 600
1883	50, 000	1888	276, 871
1884	75, 000	1889	279, 584
1885	100, 000	1890	399, 888
1886	125, 000	1891	542, 379

Johnson county.—The product in 1891 decreased 9,000 tons compared with 1890, the difference in value being $18,927. The mines gave employment to 185 men in 1891 against 215 men the previous year. The coal is shipped from the collieries at Coal Hill over the Little Rock and Fort Smith railroad. The annual product of this county since 1887 has been as follows:

Coal product of Johnson county, Arkansas, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	71, 900	1890	89, 000
1888	106, 037	1891	80, 000
1889	105, 998		

Pope county.—The output in 1891 was 5,000 tons, valued at $15,000, an increase of 1,000 tons over the product of 1890. The coal is classed as a semi-anthracite and is consumed chiefly in Little Rock and Fort Smith for domestic purposes, being shipped over the Little Rock and Fort Smith railroad to those cities.

Coal product of Pope county, Arkansas, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	8, 200	1890	4, 000
1888	10, 240	1891	5, 000
1889	6, 014		

Sebastian county.—Sebastian county in 1891 produced 83 per cent. of the total output of the state, with 451,379 short tons valued at $508,560. The Kansas and Texas Coal Company, and the Western Coal and Mining Company, both of Saint Louis, are the principal operators, the former shipping its product from Huntington over the Saint Louis and San Francisco railroad, and the latter from Jenny Lind over the Saint Louis, Iron Mountain and Southern railroad. The output of the county in 1891 was 50 per cent. greater than the preceding year, being 451,379 short tons, against 300,888 short tons. The value did not increase as much in proportion, being 40 per cent. more than in 1890, or $508,560, as against $363,668. The Sebastian county mines gave employment to 1,092 men for an average of 222 days. In 1890 the number of men employed was 683 for 214 days.

Coal product of Sebastian county, Arkansas, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	39,500	1890	300,888
1888	160,594	1891	451,379
1889	165,884		

CALIFORNIA.

Total product in 1891, 93,301 short tons; spot value, $204,902.

The product in 1891 was 17,410 short tons less than that of 1890, the value decreasing $78,117. The lessened production was due to large importations, the Southern Pacific railroad finding it sometimes advantageous to buy instead of mining it. The total number of men employed was 256, who worked an average of 222 days. The production by counties was as follows:

Coal product of California in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Amador	27,952	500	1,050	29,502	$48,803	$1.65	284	34
Contra Costa	54,231	60	2,044	56,335	136,600	2.42	260	162
Fresno		180		180	360	2.00	90	18
Monterey	1,000			1,000	5,000	5.00	50	30
San Bernardino	3,600	2,684		6,284	14,139	2.25	240	12
Total	86,783	3,424	3,094	93,301	204,902	2.20	222	256

Coal product of California from 1883 to 1891.

Years.	Short tons.	Years.	Short tons.
1883	76,162	1888	95,000
1884	77,485	1889	121,820
1885	71,615	1890	110,711
1886	100,000	1891	93,301
1887	50,000		

Nearly all of the coal of California is lignite, that from Monterey county alone being classed as bituminous, and as the bulk of the supply has to be drawn from European and Australian mines an attempt has been made to have the State refund to importers the import duty on coal from those continents, it being argued that this would induce more vessels into the trade, and have the effect of giving a greater outlet for wheat as return freight.

Although the product in 1891 is from five counties only, a number of others are laying claim to the discoveries of fine beds of coal within their boundaries. Among these may be mentioned Alameda, Humboldt, Marin, Los Angeles, and Shasta, as noted in the following discussion of the counties' outputs:

Alameda county.—Some development work has been done on the coal deposits at Livermore, in this county, but no coal had been mined for shipment at the close of 1891.

Amador county.—The total product in 1891 was 29,502 short tons, worth $48,803, against 33,610 short tons, valued at $55,215 in 1890, a loss in tonnage of 4,108 and in value of $6,412. The coal is shipped over and to some extent used by the Southern Pacific railroad. The output of the county for the past three years has been as follows:

Coal product of Amador county, California, for three years.

Years.	Short tons.	Years.	Short tons.
1889	40,900	1891	29,502
1890	33,610		

The total number of employés is reported at 34, making an average of 284 days' time.

Contra Costa county.—A total of 162 men working an average of 253 days, produced 56,335 short tons, valued at $136,600 at the mines. This shows a falling off of 10,639 tons in quantity, and of $57,204 in value from 1890, when the product was 66,974 short tons, worth $193,804. The coal is shipped to market over the Southern Pacific railroad.

Coal product of Contra Costa county, California, for three years.

Years.	Short tons.	Years.	Short tons.
1889	64,945	1891	56,335
1890	66,974		

Fresno county.—The total product in 1891 was 180 short tons taken out in opening up the mines at Coalingo. It was sold at $2 per ton to local trade at the mines. Speaking of the Fresno county deposits, the *Fresno Expositor* says they are in the foothills of the coast range, about 40 miles from Fresno in a direct line and 89 miles by rail. The vein is 4 feet thick, and by outcroppings can be traced for many miles north and south. The mines are on the Hanford branch of the Southern Pacific railroad.

Humboldt county.—A discovery of coal is reported to have been made on the property of Mrs. S. J. Preston, 15 miles east of Eureka, and a force of men have been put to work sinking a shaft. The work was begun near the close of the year and no coal had been taken out except for specimens.

Los Angeles county.—Coal is reported to have been found 3 miles west of the city limits of Los Angeles. The coal is claimed to be of a bituminous nature and suitable for blacksmith work.

Marin county.—Specimens of coal have been shown in San Francisco from the banks of Pine Gulch creek near Bolinas, Marin county, but no work on the property is reported.

Monterey county.—The total product in 1891 was 1,000 tons, valued at $5,000. The coal of Monterey county is superior to that of any other in the state, being a good quality of bituminous and worth $5 per ton at the mines. The mines are just beginning to assume commercial importance, and give promise of increased production in the near future. Transportation is obtained over the Southern Pacific Railroad.

Coal product of Monterey county, California, for three years.

Years.	Short tons.	Years.	Short tons.
1889	672	1891	1,000
1890	125		

San Bernardino county.—The product in 1891 was 6,284 short tons against 5,000 tons in 1890, a gain of 1,284 tons. The value of the product increased only $1,139, or from $13,000 to $14,139, the price per ton falling from $2.60 in 1890 to $2.25 in 1891. Of the product in 1891, 3,600 tons were shipped over the Southern California railroad for distant consumption, and 2,684 tons were sold to local trade and employés about the mine.

Shasta county.—*The Mining and Scientific Press* of San Francisco, is authority for the following statement regarding coal in Shasta county:

"The latest addition to the museum of the State Mining Bureau has been contributed by Mr. Oscar Schulze in the shape of a specimen of fine lignite coal from section 12, township 33, range 2 west, 25 miles northeast of Redding. The analysis of the coal shows up well, and as the vein is said to be easily accessible by a short line from Redding, the California coal problem seems nearer solution than at any previous period. The analysis gives the following figures:

Analysis of Shasta county, California, coal.

	Per cent.
Water	9.50
Volatile carbonaceous matter	37.50
Fixed carbon	46.25
Ash	6.75
Total	100.00

"The great trouble with all the California coal deposits is that the seams or veins are thin and of limited area, except in the Mount Diablo field, which has been nearly worked out. In many of the coal basins so far located the veins do not exceed 1 or 2 feet in thickness, and when they do there is such an admixture of slate as to render the product almost worthless on the market. Another difficulty has been that most of the coal deposits lie at a considerable distance from existing lines of railroad.

"In 1874 a coal bed 12 feet in thickness was exposed in Shasta county, not more than 1½ miles from the location of the present find. The deposit did not consist, however, of solid coal, but of alternate layers of coal and slate, the thickest coal seam being only 22 inches. Previous to the present discovery numerous coal croppings had been exposed in this part of Shasta county, but none of them justified working on commercial principles.

"In Shasta county generally the coal deposits lie in the foothills, where the volcanic materials which cap the mountain spurs and ridges are generally underlaid by a body of coal-bearing strata of recent origin. These strata consist of soft and unaltered shales and sandstones, and they are spread out unconformably over the upturned edges of the metamorphic gold-bearing slates which form so large a portion of the mass of the Sierra. Their general position is not far from horizontal, and the aggregate thickness of the coal-bearing strata is not more than 150 feet. They belong to the geological period which immediately preceded the commencement of volcanic activity in the Shasta region."

COLORADO.

Total product in 1891, 3,512,632 short tons; spot value, $4,800,000.

The figures relating to coal production of Colorado in 1891 have been furnished this office by Mr. John McNeil, State inspector of coal mines. Special acknowledgment is due to Mr. McNeil, as the statements are given the Survey in advance of the publication of his report, which will not be ready for distribution until 1893.

The statistics for 1890 were collected for the Survey by Mr. F. F. Chisolm, of Denver, Colorado. According to Mr. Chisolm's report the output for that year was 3,094,003 short tons. Mr. McNeil gives 3,075,781 short tons as the product during the same period. The variance is inconsiderable, and, in order to preserve the uniformity of this series, Mr.

Chisolm's figures are used in this report when reference is made to the output of 1890.

Distributed by counties, the product in 1891 is shown in the following table:

Coal product of Colorado in 1891, by counties.

Counties.	Short tons.	Counties.	Short tons.
Arapahoe	1,273	Las Animas	1,219,224
Boulder	498,494	La Plata	72,471
Dolores	3,475	Mesa	5,000
El Paso	34,364	Park	52,626
Fremont	545,789	Pitkin	91,642
Gunnison	261,350	Weld	22,554
Garfield	191,994		
Huerfano	494,466	Total	3,512,632
Jefferson	17,910		

From the above table it is seen that Las Animas county is by far the most important in point of production, having more than twice as much as Fremont, which comes second, and nearly one-third the entire product of the state. Boulder county is third, with Huerfano closely following. These four counties produced 80 per cent. of the total output.

The following table exhibits the production by counties since 1886, with the increases and decreases in 1891 as compared with 1890:

Coal product of Colorado since 1886, by counties.

Counties.	1886.	1887.	1888.	1889.	1890.	1891.	Increases in 1891.	Decreases in 1891.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Arapahoe	11,000	16,000	1,700	823	700	1,273	573	....
Boulder	220,287	297,338	315,155	323,096	425,704	498,494	72,790	....
Dolores	....	1,000	200	....	800	3,475	2,675	....
El Paso	53,000	47,517	44,114	54,212	25,617	34,364	8,747	....
Fremont	332,024	417,326	438,789	274,029	397,418	545,789	148,371	....
Garfield	....	30,000	115,000	239,292	183,884	191,994	8,110	....
Gunnison	159,951	243,122	258,374	252,442	229,212	261,350	32,138	....
Huerfano	89,913	131,810	159,610	333,717	427,832	494,466	66,634	....
Jefferson	9,928	12,000	9,000	10,790	10,984	17,910	6,926	....
Las Animas	429,706	506,540	706,455	993,534	1,154,668	1,219,224	64,556	....
La Plata	18,166	22,880	33,625	34,971	43,193	72,471	29,278	....
Mesa	....	....	300	1,100	1,000	5,000	4,000	....
Park	23,823	23,421	46,588	41,823	49,594	52,626	3,032	....
Pitkin	....	4,000	28,113	....	74,362	91,642	17,280	....
Weld	20,450	39,281	28,054	28,628	46,417	22,554	....	23,863
Routt	....	....	....	1,491	705	....	....	705
Larimer	....	....	....	100	1,500	....	....	1,500
Douglas	....	3,500	400	260	700	....	....	700
San Miguel	....	....	....	1,800	1,500	....	....	1,500
Delta	....	....	....	1,357	775	....	....	775
Montezuma	....	....	....	816	238	....	....	238
Rio Blanco	....	....	....	2,900	200	....	....	200
Total	1,368,248	1,795,735	2,185,477	2,597,181	3,077,003	3,512,632	*a*435,629	....

a Net increase.

The State is divided for sake of convenience into four geographical divisions, known respectively as the Northern, Central, Southern and Western. The first mentioned contains the counties of Arapahoe, Boulder, Jefferson, Larimer, Routt and Weld. The Central division embraces Douglas, El Paso, Fremont and Park counties. The Southern division contains the counties of Dolores, Huerfano, La Plata and Las Animas, while Delta, Garfield, Gunnison, Mesa, Montezuma, Pitkin, Rio Blanco and San Miguel counties lie in the Western district.

The following table shows the annual product of coal in Colorado since 1864, that for the years previous to 1877 being given by counties and subsequent to 1878 by districts:

Coal product of Colorado from 1864 to 1891.

Years.	Localities.	Product.	
		Short tons.	
1864	Jefferson and Boulder counties		500
1865	do		1,200
1866	do		6,400
1867	do		17,000
1868	do		10,500
1869	do		8,000
1870	do		13,500
1871	do		15,600
1872	do	14,200	
	Weld county	54,340	
			68,540
1873	Jefferson and Boulder counties	14,000	
	Weld county	43,790	
	Las Animas and Fremont counties	12,187	
			69,977
1874	Jefferson and Boulder counties	15,000	
	Weld county	44,280	
	Las Animas and Fremont counties	18,092	
			77,372
1875	Jefferson and Boulder counties	23,700	
	Weld county	59,860	
	Las Animas and Fremont counties	15,278	
			98,838
1876	Jefferson and Boulder counties	28,750	
	Weld county	68,600	
	Las Animas and Fremont counties	20,316	
			117,666
1877			160,000
1878	Northern division	87,825	
	Central division	73,137	
	Southern division	39,668	
			200,630
1879	Northern division	182,630	
	Central division	70,647	
	Southern division	69,455	
			322,732
1880	Northern division	123,518	
	Central division	136,020	
	Southern division	126,403	
	Northwestern division	1,064	
	Unreported mines	50,000	
			437,005
1881	Northern division	156,126	
	Central division	174,882	
	Southern division	269,045	
	Northwestern division	6,691	
	Unreported mines	100,000	
			706,744
1882	Northern division	300,000	
	Central division	243,694	
	Southern division	474,285	
	Northwestern division	43,500	
			1,061,479
1883	Northern division	243,903	
	Central division	396,401	
	Southern division	501,307	
	Northwestern division	87,982	
			1,229,593
1884	Northern division	253,282	
	Central division	296,188	
	Southern division	483,865	
	Northwestern division	96,689	
			1,130,024
1885	Northern division	242,846	
	Central division	416,373	
	Southern division	571,684	
	Northwestern division	125,159	
			1,356,062
1886	Northern division	260,145	
	Central division	408,857	
	Southern division	537,785	
	Northwestern division	161,551	
			1,368,338

Coal product of Colorado from 1861 to 1898—Continued.

Years.	Localities.	Product.	
		Short tons.	
1887	Northern division	364, 619	
	Central division	491, 764	
	Southern division	662, 230	
	Western division	273, 122	
			1, 791, 735
1888	Northern division	353, 909	
	Central division	529, 891	
	Southern division	899, 690	
	Western division	401, 987	
			2, 185, 477
1889	Northern division	364, 928	
	Central division	370, 324	
	Southern division	1, 362, 222	
	Western division	499, 707	
			2, 597, 181
1890	Northern division	486, 010	
	Central division	473, 329	
	Southern division	1, 626, 493	
	Western division	491, 171	
			3, 077, 003
1891	Northern division	540, 231	
	Central division	632, 779	
	Southern division	1, 789, 636	
	Western division	549, 986	
			3, 512, 632

GEORGIA.

Total product in 1891, 171,000 short tons; spot value, $256,500.

The product in 1891, as in previous years, was exclusively from Dade county. Development work on the Walker county properties continued, but the anticipations of a product in 1891 were not realized. The following table shows the total product during the past three years with the distribution and value:

Coal product of Georgia in 1889, 1890 and 1891 by counties.

Years.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	
1889	46, 131	158	15, 000	164, 645	225, 934	$338, 901
1890	57, 949			170, 388	228, 337	238, 315
1891	15, 000	1, 000	5, 000	150, 000	171, 000	256, 500

Coal product of Georgia from 1884 to 1891.

Years.	Short tons.	Years.	Short tons.
1884	150, 000	1888	180, 000
1885	150, 000	1889	225, 934
1886	223, 000	1890	228, 337
1887	313, 715	1891	171, 000

ILLINOIS.(a)

Total product in 1891, 15,660,698 short tons; spot value, $14,237,074.

As compared with the output of 1890 the record for 1891 shows an increase of 368,278 short tons in quantity and of $65,844 in value. In addition to the above the following differences are presented:

Coal is reported from the same number of counties as in 1890, in which year several counties were added to the list as a result of the discovery of a number of remote and insignificant openings on the borders of counties not before reported as producing coal.

The whole number of mining places reported in 1891 is somewhat less than in 1890, owing to the suspension of a number of small country banks.

The output for the year is greater than that of any preceding year by 321,860 tons of lump coal. The apparent increase is much more, owing to the fact that the statistics for this year cover not only the tons of lump coal, which is the standard market grade, but also the tons of nut, pea, and slack, or whatever other grades are produced by dumping over screens in order to clean it. In the aggregate the tonnage of the inferior grades is considerable and, added to the product in lump, raises the actual output of all kinds of fuel to 15,660,698 tons.

The average value of coal per ton at the mines, as computed for all mines in all parts of the State, is found to be substantially the same as for 1890, the decimal of difference being a decline of 1.09 cents per ton.

The number of employés engaged in this industry during the year has increased in somewhat greater ratio than the output, and the average of all prices paid per ton for hand mining shows an increase of 3.2 cents over 1890, though the present average is still 1.6 cents less per ton than the average of 1889.

Mining machines.—There are 241 mining machines in use in the State, which is 25 less than the number reported at the close of the preceding year. Less than one-fifth, or 18.7 per cent., of the total product is mined by the mechanical process. Taking the State at large, the machine has not gained materially on the hand miner during recent years. The percentage of total product mined by machines for four years are as follows: For 1891, 18.7 per cent.; 1890, 22.8 per cent.; for 1889, 20.2 per cent., and for 1888, 18.9 per cent.

There have been 91 new mines opened during the year, and 104 old mines have been suspended or abandoned. The number of new mines is smaller than usual, and the number closed about the same as formerly.

Strikes.—An unusual amount of readjustment in the terms of employment was made necessary by recent legislation affecting the relations

a From the report of Col. J. S. Lord, secretary of the bureau of labor statistics of the State of Illinois.

of owners and men; but, on the whole, the friction arising from this source has been less, and compliance with the new laws has been more universal than was anticipated. During the month of May, however, suspensions were very general, and in some fields work was not resumed for several months. The longest and most serious interruption of business occurred in the Du Quoin field, where the men were idle from May to September. Some impairment of the output of the State for the year has doubtless resulted from the delays occasioned by the change in the wage basis, but, taking the year as a whole, the industry has been fairly active and without violent disturbance. The average number of days of active operations has been 215.6, which is more days and represents a steadier business than we have had since 1888.

Number and character of mines.—The statement that there are 918 coal mines in the State may convey an erroneous impression unless there is some further characterization of these various mining places. In fact by far the greater number of these so-called mines, or openings from which coal is taken, are of insignificant proportions and product as compared with the total product. They represent but little capital or labor and are chiefly interesting as disclosing the presence of the mineral, usually in outcrops among the hills, and chiefly useful as a source of fuel to the neighborhood in which each is situated.

On the other hand the mining establishments of the first class, while of large capacity and costly equipment, are relatively few in number.

An analysis of the mines of the State on the basis of their annual output in lump coal separates them into the following classes:

Classification of Illinois coal mines by output and districts.

Districts.	Number of mines producing.					Total number of mines.
	Less than 1,000 tons.	From 1,000 to 10,000 tons.	From 10,000 to 50,000 tons.	From 50,000 to 100,000 tons.	Over 100,000 tons.	
First	13	19	17	12	9	70
Second	169	76	13	2	4	264
Third	125	91	45	9	3	273
Fourth	39	34	26	16	11	126
Fifth	59	43	61	18	4	185
The State	405	263	164	55	31	918

The total number is thus reduced by 405 mining places of small consequence and by 263 more of minor importance, leaving only 250 with a product of 10,000 tons or more, and only 86 producing over 50,000 tons a year.

A similar grouping of the existing mines reported for a series of years gives the following results:

Classification of Illinois coal mines by annual output for nine years.

Years.	Number of mines producing— Less than 1,000 tons.	From 1,000 to 10,000 tons.	From 10,000 to 50,000 tons.	From 50,000 to 100,000 tons.	Over 100,000 tons.	Total number of mines.
1883	209	233	133	39	25	639
1884	262	273	148	38	20	741
1885	286	290	143	40	19	778
1886	316	280	135	44	14	789
1887	320	278	141	42	20	801
1888	327	271	152	47	25	822
1889	321	316	139	55	23	854
1890	398	301	155	54	28	936
1891	405	263	164	55	31	918
Increase	196	30	31	16	6	279

These figures show that the proportion of mines in each class varies but little from year to year, and that for every new mine of importance there are usually about the same number of minor places opened.

Divided into two classes, those which have produced more and those which have produced less than 50,000 tons for a series of years, the mines of the State are found in the following numbers and the tonnage in the following proportions in each class:

Annual output of Illinois mines producing more and less than 50,000 tons.

Years.	Mines producing over 50,000 tons lump coal.			Mines producing less than 50,000 tons lump coal.		
	Number.	Tons lump coal.	Per cent. of total.	Number.	Tons lump coal.	Per cent. of total.
1887	62	5,949,894	57.9	739	4,328,996	42.1
1888	72	7,188,507	60.64	750	4,666,681	39.36
1889	78	7,235,577	62.39	776	4,362,386	37.61
1890	81	8,011,777	63.39	854	4,626,587	36.61
1891	86	8,109,485	62.57	832	4,850,739	37.43

The output for the year.—The coal product for the State for the year is 15,660,698 tons, and is greater by 321,860 tons of lump coal than in 1890. This increase arises from gains to the amount of 611,609 tons in the first and second districts, reduced by losses to the amount of 289,749 tons in the third, fourth, and fifth districts. This is a reversal of the situation of last year, and represents the natural reaction from the effects of the recent strikes in the northern field. The following table shows the output, by districts, for three years, and in the columns for gains and losses illustrates the shifting activities from one part of the State to the other during that period:

Annual output of lump coal for three years by districts.

Districts.	Output of lump coal by districts.			Gains and losses.			
				1889–1890.		1890–1891.	
	1889.	1890.	1891.	Gain.	Loss.	Gain.	Loss.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
First	2, 530, 453	2, 303, 326	2, 701, 652	....	227, 127	398, 326	....
Second	1, 087, 848	1, 002, 600	1, 215, 883	....	85, 248	213, 283	....
Third	2, 050, 349	2, 375, 970	2, 336, 500	325, 621	....	....	39, 470
Fourth	3, 164, 835	3, 716, 464	3, 532, 233	551, 629	....	....	184, 231
Fifth	2, 764, 478	3, 240, 004	3, 173, 956	475, 526	....	....	66, 048
The State	11, 597, 963	12, 638, 364	12, 960, 224	1, 352, 776	321, 375	611, 609	289, 749
Net gain	....	....	....	1, 040, 401	....	321, 860	....

The remarkable gain of over a million tons made by the last three districts in 1890 is by no means canceled by a corresponding falling off during the year last passed, but the decline in product is something over a quarter of a million in three districts, while the gain in the first two is more than twice as much. Other agencies, however, than the suspension of the strike have contributed to this result, notably the scarcity of water for boiler use at a number of the principal collieries in the southern field, and the suspension of operations at No. 7, Staunton, for the greater part of the year.

The relative amount of this product depends somewhat on the character and condition of the coal as it comes from the mine, and somewhat on the system by which it is worked, but chiefly on the sort of screens used. These vary in dimensions and in the spaces between the bars, and the result of all these conditions is that the proportion of coal which passes through the screens is highly variable in individual cases, and in some degree these differences characterize the several districts. An illustration of this is found in the following statement of the total product of each district, with percentages of the lump and other grades:

Percentages of lump and other grades of coal produced in the several districts.

Districts.	Total product, 1891.	Percentage of—	
		Lump coal.	Other grades.
	Tons.	*Tons.*	*Tons.*
First	3, 082, 915	87. 63	12. 37
Second	1, 440, 266	82. 73	17. 27
Third	2, 794, 004	83. 54	16. 46
Fourth	4, 428, 109	79. 61	20. 40
Fifth	3, 915, 404	81. 06	18. 94
The State	15, 660, 698	82. 76	17. 24

By the application of the ratio thus developed for the State at large to the product of lump coal reported in former years, the following results are obtained as the presumptive fuel product derived from the coal mines of the state for ten years:

Annual output for ten years.

Years.	Whole number of mines.	Total product.	Lump coal.	Other grades.
		Tons.	*Tons.*	*Tons.*
1882	704	11,017,069	9,115,563	1,901,506
1883	639	12,123,456	10,030,991	2,092,465
1884	741	12,208,075	10,101,005	2,107,070
1885	778	11,834,459	9,791,874	2,042,585
1886	787	11,175,241	9,246,435	1,928,806
1887	801	12,423,066	10,278,890	2,144,176
1888	822	14,328,181	11,855,188	2,472,993
1889	854	14,017,298	11,597,963	2,419,335
1890	936	15,274,727	12,638,364	2,636,363
1891	918	15,660,698	12,960,224	2,700,474
Total		130,062,270	107,616,497	22,445,773

This statement illustrates very forcibly the growth of coal mining in Illinois during the last decade, and suggests the importance which this industry is destined to attain in the future. It is a feature of the present situation that a number of enterprises are now on foot contemplating further development of the more prolific seams, and the tendency is to an enlargement of capacity among existing mines in favored localities.

The relative importance of counties as the sources of coal is indicated by the general statement that 21 of the 57 counties reported have produced a total of 13,938,667 tons, or 89 per cent. of the whole; these have all produced over 200,000 tons each; four of them have produced over 1,000,000 tons each; eight have a tonnage of more than half a million and less than a million, and nine show an output of from 200,000 to 500,000 tons. The list of these counties is given below in the order of their rank, and with the tonnage of each county is given the percentage of other grades embraced in each total.

Counties which have produced more than 200,000 tons.

Names.	Rank.	Total product.	Other grades.	Names.	Rank.	Total product.	Other grades.
		Tons.	*Per cent.*			*Tons.*	*Per cent.*
St. Clair	1	1,595,839	12.93	Fulton	13	484,117	19.09
Macoupin	2	1,461,344	21.35	Livingston	14	458,329	22.37
Lasalle	3	1,378,168	14.74	Marion	15	321,652	21.88
Sangamon	4	1,051,604	13.21	Mercer	16	314,360	29.30
Grundy	5	921,907	6.55	Will	17	233,603	3.86
Vermilion	6	880,466	17.30	McLean	18	230,129	19.77
Madison	7	719,308	16.55	Macon	19	207,286	38.94
Christian	8	718,326	28.54	Williamson	20	206,452	22.26
Bureau	9	701,064	12.66	Menard	21	204,583	16.03
Jackson	10	681,859	30.00				
Perry	11	604,152	24.29	Total		13,938,667	17.89
Peoria	12	564,119	11.61				

The relative productiveness of all counties for the five years last past is given in the following statement, on the basis of the tons of lump coal. This is supplemented, however, for the present year, with the totals for all kinds of coal, showing the increment derived from tons of the minor grades:

Output by counties for five years.

Districts.	Output of lump coal.					1891, output, all grades.
	1887.	1888.	1889.	1890.	1891.	
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
First district	2, 686, 829	2, 877, 794	2, 530, 453	2, 303, 326	2, 701, 652	3, 082, 915
Counties:						
Grundy	792, 954	862, 866	698, 033	654, 017	861, 507	921, 907
Kankakee	97, 000	82, 000	67, 380	62, 460	84, 808	90, 908
Lasalle	1, 125, 235	1, 090, 435	1, 039, 703	926, 214	1, 174, 961	1, 378, 168
Livingston	387, 600	495, 388	382, 965	372, 504	355, 800	458, 329
Will	284, 040	347, 105	342, 372	288, 131	224, 576	233, 603
Second district	1, 069, 027	1, 293, 187	1, 087, 848	1, 002, 600	1, 215, 883	1, 440, 266
Counties:						
Bureau	429, 580	635, 097	493, 730	372, 701	612, 292	701, 064
Hancock	6, 208	6, 515	6, 028	6, 948	6, 740	6, 740
Henry	117, 533	108, 831	101, 716	98, 734	116, 173	131, 986
Knox	64, 324	57, 013	57, 588	51, 653	44, 974	44, 974
Marshall	73, 928	87, 013	59, 784	56, 574	53, 319	65, 219
McDonough	110, 103	104, 274	98, 386	83, 401	73, 596	81, 732
Mercer	127, 708	167, 931	175, 690	238, 290	222, 237	314, 360
Rock Island	85, 282	57, 872	47, 363	39, 696	38, 654	41, 540
Schuyler	22, 686	34, 403	16, 243	21, 836	15, 369	20, 122
Stark	17, 865	18, 690	19, 171	18, 672	20, 157	20, 157
Warren	13, 810	15, 518	12, 149	14, 095	12, 372	12, 372
Third district	1, 781, 395	2, 192, 121	2, 050, 349	2, 375, 970	2, 336, 500	2, 794, 004
Counties:						
Cass	2, 325	7, 300	4, 414	4, 650	5, 680	6, 466
Fulton	337, 215	461, 589	366, 577	404, 417	391, 721	484, 117
Logan	159, 000	174, 330	138, 700	164, 650	155, 048	176, 052
McLean	141, 700	117, 110	129, 322	173, 492	184, 629	230, 129
Menard	155, 621	181, 075	181, 621	230, 662	171, 784	204, 583
Peoria	452, 123	533, 817	454, 731	482, 725	498, 601	564, 119
Tazewell	51, 847	59, 324	67, 973	81, 141	85, 692	107, 252
Vermilion	359, 119	499, 076	537, 411	704, 509	728, 156	880, 465
Woodford	122, 445	158, 500	169, 600	129, 724	115, 189	140, 820
Fourth district	2, 568, 291	2, 854, 540	3, 164, 835	3, 716, 464	3, 532, 233	4, 428, 109
Counties:						
Bond	36, 076	38, 200	59, 724	66, 746	76, 067	102, 535
Calhoun	....	1, 036	1, 078	1, 468	2, 773	2, 773
Christian	149, 973	147, 030	249, 774	439, 451	513, 315	718, 326
Coles	34, 612	27, 210	....	....	....	....
Effingham	....	....	....	796	(a)487	(a)487
Green	12, 578	14, 494	19, 048	11, 714	16, 442	16, 442
Jasper	....	....	....	152	(b)	(b)
Jersey	2, 684	3, 949	4, 040	7, 500	4, 252	4, 252
Macon	118, 183	280, 805	233, 309	179, 050	126, 569	207, 286
Macoupin	926, 588	1, 016, 624	1, 202, 187	1, 369, 919	1, 149, 380	1, 461, 344
Madison	521, 705	512, 948	490, 181	646, 228	600, 294	719, 308
Montgomery	10, 220	14, 295	24, 425	58, 617	94, 975	107, 190
Morgan	6, 669	12, 545	13, 019	16, 601	6, 584	7, 610
Pike	....	....	....	135	(b)	(b)
Richland	....	....	....	154	(b)	(b)
Sangamon	730, 391	764, 970	846, 012	879, 888	912, 643	1, 051, 604
Scott	9, 802	12, 491	15, 028	20, 022	14, 255	14, 755
Shelby	8, 810	7, 943	7, 010	18, 023	14, 197	14, 197
Fifth district	2, 173, 348	2, 637, 546	2, 764, 478	3, 240, 004	3, 173, 956	3, 915, 404
Counties:						
Clinton	55, 238	66, 463	121, 557	170, 416	146, 903	174, 166
Franklin	....	....	....	700	200	200
Gallatin	31, 437	45, 374	30, 044	52, 383	31, 119	34, 462
Hardin	....	....	....	40	24	24
Hamilton	....	....	....	450	280	280
Johnson	28, 000	28, 210	3, 000	12, 110	424	424
Jackson	375, 718	445, 575	477, 474	580, 521	477, 330	681, 859
Jefferson	....	....	....	2, 100	1, 104	1, 104
Marion	98, 915	156, 975	180, 777	218, 499	251, 283	321, 652
Perry	319, 552	306, 235	381, 347	497, 768	457, 431	604, 152
Randolph	74, 263	167, 321	98, 202	134, 699	162, 717	172, 321
Saline	19, 518	32, 550	35, 496	45, 845	38, 729	54, 269
St. Clair	1, 018, 149	1, 184, 579	1, 198, 100	1, 332, 978	1, 389, 429	1, 595, 839
Washington	40, 220	43, 600	36, 220	25, 160	56, 500	68, 200
Williamson	112, 338	160, 664	202, 261	166, 335	160, 483	206, 452
State totals	10, 278, 890	11, 855, 188	11, 597, 963	12, 638, 364	12, 960, 224	15, 660, 698

a Includes Jasper, Pike, and Richland counties. *b* Included in Effingham county.

Number of employés.—The average number of men employed throughout the year was 27,266, and the greatest number employed at any one time was 32,951. Although these totals are neither of them the result of an exact enumeration at any one time, they are, for the most part, made up from the pay-rolls and truly represent the general facts. It should not be understood that all of these have been continuously employed, nor that the larger number represents all the individuals who have really been at work in the industry.

The increase in the number of employés reported this year is distributed among the districts in the ratio of about 1,000 to each, except in the fourth, in which the gain is only 200. Some of this apparent gain is doubtless due to the fact that heretofore the number reported has been the average for the winter, or busiest months, which would ordinarily be somewhat less than the maximum. The number of employés reported annually since 1880 is shown in the following table:

Employés in Illinois coal mines for eleven years.

Years.	Miners.	Others.	Total.
1880			16,301
1882			20,290
1883	20,839	3,100	23,939
1884	20,610	4,965	25,575
1885	20,772	5,174	25,946
1886	20,973	4,873	25,846
1887	21,158	5,646	26,804
1888	23,649	5,762	29,410
1889	23,583	6,493	30,076
1890	20,106	8,468	28,574
1891	26,059	6,892	32,951

Days of active operations.—The average running time of the mines which have been in operation continuously, or as steadily as the market or other conditions permitted throughout the year, is found to have been 215.6 days. Of course some mines were running more, and some fewer than the average number of days. This average is obtained merely as a measure of the activity of the industry as a whole. In 1890, the average running time was 203.5 days, and the difference represents the loss of time by strikes.

Number of operating days in Illinois coal mines for 1888, 1889, 1890, and 1891.

Districts.	1888.	1889.	1890.	1891.
First	216	188	178	207.6
Second	219	198	182	214.9
Third	219	203	193	193.2
Fourth	230	240.3	243	238.8
Fifth	219	235	232	225
The State	220.6	211.5	203.5	215.6

Value of coal at the mines.—The average spot value of all the coal mined in the State during 1891, as computed on the basis of the number of tons at each reported valuation was $1.0084 per ton. This is the mean between the maximum $1.426 per ton in the second district and the minimum 75.7 cents per ton in the fifth. For each of the past ten years, with one slight exception, the average value of coal has declined somewhat from that of the preceding year. From 1882 to 1886 the decline was 41 cents a ton, and from 1886 to 1891 10 cents a ton. During 1891 the decline was 1.1 cents a ton. This rule has been almost equally uniform for each district. The one exceptional year was 1888, when values showed an advance in all the districts and resulted in an increase in the State average of 3.7 cents. Sine then the decline has been slight but continuous. These values are those given by the mine owners as averages for the year of the sales made of lump coal. The value of the screenings is not included in these estimates. Following is a statement of the averages computed for each of ten years for districts and the State:

Average value of Illinois coal per ton at the mines during eight years.

Districts.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
First	$1.75	$1.59	$1.49	$1.41	$1.32	$1.32	$1.37	$1.36	$1.30	$1.298
Second	1.87	1.97	1.79	1.71	1.57	1.50	1.47	1.43	1.48	1.426
Third	1.43	1.45	1.31	1.25	1.16	1.10	1.14	1.10	1.06	1.032
Fourth	1.33	1.32	1.09	.985	.97	.89	.95	.97	.87	.853
Fifth	1.31	1.26	.96	.894	.86	.82	.86	.88	.81	.757
The State	1.51	1.48	1.26	1.17	1.10	1.09	1.12	1.08	1.02	1.0084

INDIANA.

Total product in 1891, 2,973,474 short tons; spot value, $3,070,918.

Compared with the output of 1890 the product of the Indiana coal mines in 1891 shows a decrease of 332,463 short tons and a loss in value of $188,315. The decreased output is largely due to the three months' strike in the Brazil region, but whether this would account for so great a falling off is to be doubted. Every effort possible with the means at hand has been made to secure reports from all mines of commercial importance in the State, but at the time of going to press quite a number of the larger producers have failed to respond to frequent inquiries and the output of such collieries has been estimated upon the best information obtainable. That such estimates may, in the aggregate, have been lower than the actual output is very possible, and may account for a showing necessarily unsatisfactory to the producers of the State. While this is to be regretted, it is not a cause for apology on the part of the Survey. In accordance with the foregoing, the product of the State in 1891, by counties, is shown to have been as follows:

Coal product of Indiana in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Clay	944,365	8,782	27,774	....	980,921	$1,124,459	$1.15	181	2,346
Daviess	150,008	3,250	2,100	....	155,358	174,701	1.12	217	359
Dubois	7,200	300	200	....	7,700	10,010	1.30	250	13
Fountain	23,250	50	400	....	23,700	23,400	.99	252	40
Greene	142,965	18,000	4,000	....	164,965	150,000	.91	154	300
Owen	12,000	300	300	....	12,600	15,750	1.25	275	30
Parke	303,382	....	4,000	....	307,382	347,707	1.13	255	510
Perry	29,125	5,800	475	....	35,400	38,975	1.10	190	95
Pike	111,763	198	1,417	8,688	122,066	110,159	.90	198½	230
Spencer	13,240	1,800	300	....	15,340	13,525	.88	204	46
Sullivan	163,974	8,700	8,760	....	181,434	184,115	1.01	130½	544
Vanderburg	83,982	111,109	10,640	....	205,731	224,032	1.09	228½	338
Vermillion	228,488	....	....	....	228,488	224,159	.98	147	380
Vigo	392,428	7,125	702	....	400,255	320,056	.80	244	487
Warrick	83,610	10,440	2,084	....	96,134	73,870	.77	199	161
Small mines	....	36,000	....	....	36,000	36,000	1.00	....	....
Total	2,689,780	211,854	63,152	8,688	2,973,474	3,070,918	1.03	190	5,879

The highest average price obtained was in Dubois county and the lowest in Warrick county. The general average for the State was $1.03 per ton, an advance over that of 1890 of 4 cents per ton.

The following table shows the annual coal output of Indiana for the past nineteen years:

Product of coal in Indiana from 1873 to 1891.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1873	1,000,000	1880	1,500,000	1887	3,217,711
1874	812,000	1881	1,771,536	1888	3,140,979
1875	800,000	1882	1,976,470	1889	2,845,057
1876	950,000	1883	2,560,000	1890	3,305,737
1877	1,000,000	1884	2,260,000	1891	2,973,474
1878	1,000,000	1885	2,375,000		
1879	1,196,490	1886	3,000,000		

Clay county.—In rank of producing importance, as well as alphabetically, Clay county comes first in the State, having about one-third the total product. Its output in 1891 was 980,921 short tons, 180,809 tons less than in 1890, when the product was 161,730 tons in excess of a million. The value fell off $53,207, or from $1,177,666 to $1,124,459. The mines of Clay county gave employment in 1891 to 2,346 men for an average of 180 days. In 1890 2,179 men averaged 218 days.

The coal of Clay county is sent to market over the Terre Haute and Indianapolis; Cleveland, Cincinnati, Chicago and Saint Louis; Chicago and Eastern Illinois; Louisville, New Albany and Chicago, and the

Chicago and Indiana Coal railroads. The annual output of Clay county for three years has been as follows:

Coal product of Clay county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	695, 649	1891	980, 921
1890	1, 161, 730		

Daviess county.—The product in 1891 was 155,358 short tons, worth $174,701, against 189,696 tons, valued at $197,696, in 1890, a decrease of 34,338 tons in quantity and $22,995 in value. The mines gave employment to 359 men for 217 days. Transportation is obtained over the Ohio and Mississippi and the Evansville and Indianapolis railroads.

Coal product of Daviess county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	191, 585	1891	155, 358
1890	189, 696		

Dubois county.—One of the two mines of Dubois county was abandoned in 1890, and no returns have been received from the other. The product has been estimated on the output of previous years at 7,700 short tons. As this represents the total production of the county there is a decrease from 1890 of 6,224 short tons. The Louisville, Evansville and Saint Louis railroad transports the product.

Coal product of Dubois county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	15, 848	1891	7, 700
1890	13, 994		

Fountain county.—Fountain county in 1891 produced 23,700 short tons of coal, worth $23,400, against 24,000 short tons, valued at $24,000, in 1890, a loss of 300 tons in output and $600 in value. The coal is shipped over the Toledo, Saint Louis and Kansas City railroad.

Coal product of Fountain county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	41, 141	1891	23, 700
1890	24, 000		

Greene county.—The product in 1891 shows a decrease of 32,373 short tons, or a little more than 16 per cent., compared with 1890. The value of the product decreased $36,294, or something over 19 per cent. An aggregate of 300 men made an average of 154 days, but little more than half time. The coal is sent to market over the Indianapolis and Vincennes railroad.

Coal product of Greene county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	185,849	1891	164,965
1890	197,338		

Owen county.—Until 1891 the product of Owen county was limited to a small amount used principally for local consumption, and as such did not appear in the returns for 1890. An output of 12,600 short tons is, however, reported in 1891, 12,000 tons of which were shipped over the Evansville and Indianapolis railroad to distant markets. The total value is given at $15,750. In 1889, according to the Eleventh Census, the product of Owen county was 3,958 short tons, worth $4,292.

Parke county.—Parke county ranks third in the state in the amount of coal produced, being led in this respect by Clay and Vigo counties. The product of Parke county in 1891 was 307,382 short tons, valued at $347,707, a decrease of 38,078 short tons and $30,326, as compared with 1890, when the output was 345,460 short tons, worth $378,033. The mines employed in 1891 510 men for an average of 255 days. The coal is forwarded over the Chicago and Indiana Coal railroad.

Coal product of Parke county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	357,434	1891	307,382
1890	345,460		

Perry county.—The amount of coal produced in Perry county in 1891 was 35,400 short tons, worth at the mines $38,975, against 40,201 short tons, valued at $42,201 in 1890, a decrease of 4,801 tons in quantity and $3,226 in value, showing the average price per ton to have slightly increased in spite of the lessened product. The greater portion of the product is shipped by the Ohio river, though a small amount is sent out over the Louisville, Evansville and Saint Louis railroad.

Coal product of Perry county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	40,050	1891	35,400
1890	40,201		

Pike county.—Pike county is one of the five counties of the State from which an increased product is reported in 1891 compared with the preceding year. The output in 1890 was 115,836 short tons, worth $113,000, and in 1891 122,066 short tons, worth $110,159, a gain of 6,230 tons and a decrease in value of $2,841. The coal produced in this county is forwarded over the Evansville and Terre Haute, and the Louisville, Evansville and Saint Louis railroads.

Coal product of Pike county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	154, 524	1891	122, 066
1890	115, 836		

Spencer county.—With a total product 15,340 short tons in 1891, Spencer county exceeded its output in 1890 by 3,684 short tons, the gain in value being $2,409, showing a slight decrease in the average price per ton received by the operators. The increased business, however, did not put the product up to that of 1889, when the county was credited with 18,456 tons, worth $21,207. The tonnage for 1889, 1890, and 1891 was as follows:

Coal product of Spencer county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	18, 456	1891	15, 340
1890	11, 650		

The product of Spencer county reaches the market over the Louisville and Evansville railroad.

Sullivan county.—A fire occurring in the mines of the largest operator in the county early in 1891, stopped their productiveness for about eleven months, and a probable loss to the county of from 90,000 to 100,000 tons was entailed from this cause alone. The actual decrease in the county's product, according to reports made to the Survey, was 104,889 short tons, and in value, $84,410. But for the loss of time occasioned by the fire, the product would, in all probability, have been equal to, if not larger than that of the preceding year.

The Terre Haute and Indianapolis and the Indiana and Illinois Southern railroads afford transportation facilities for the coal of Sullivan county. The mines gave employment to 544 men for an average of 130½ days, against 588 men for 181 days in 1890.

Coal product of Sullivan county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	317, 252	1891	181, 434
1890	286, 323		

Vanderburg county.—The coal product of Vanderburg county in 1890 was 192,284 short tons, valued at $197,224, and in 1891 205,731 short tons, valued at $224,032, a gain of 13,447 short tons, and $26,808. In the mines of this county 338 men were employed for 228½ days, compared to 307 men for 244 days in 1890. The railroads furnishing transportation are the Evansville and Terre Haute; Louisville and Nashville, and the Peoria, Decatur and Evansville. A portion of the product is also shipped by the Ohio river.

Coal product of Vanderburg, county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	183,942	1891	205,731
1890	192,284		

Vermillion county.—Vermillion county jumps from eighth place in rank of producing importance in 1890 to fourth place in 1891, the output increasing from 173,000 tons in 1890 to 228,488 in 1891, a gain of 55,488 short tons. The value of the product increased from $203,000 to $224,159, a gain in actual value of $21,159, but a decrease in the average price per ton from $1.17 to 98 cents. The mines were active an average of 147 days, and gave employment to 380 men. During the preceding year an average of 161 days' employment to 280 men was reported. The Chicago and Eastern Illinois railroad transports the entire product.

Coal product of Vermillion county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	187,651	1891	228,488
1890	173,000		

Vigo county.—This county ranks second in the State as a coal producer, having a product in 1891 of 400,255 short tons, valued at $320,056. This shows a decrease compared with 1890, when the product was 429,160 tons, worth $341,998, of 28,905 short tons and of $21,942 in value. Most of the coal of this county is shipped via the Chicago and Eastern Illinois, though the Chicago and Indiana Coal, the Evansville and Terre Haute, and the Terre Haute and Indianapolis railroads handle a portion of the traffic. Employment was given in 1891 to 487 men for 244 days, against 454 men for 262 days in 1890.

Coal product of Vigo county, Indiana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	371,903	1891	400,255
1890	429,160		

Warrick county.—The coal output of Warrick county shows an annual increase for the past three years. The product in 1890 was 89,059 short tons, worth $66,424, an increase of 22,421 tons and $16,124 over 1889. In 1891 the product was 96,134 short tons, worth $73,870, being 7,075 short tons and $7,446 in excess of 1890.

A small portion of the product goes to market over the Evansville, Suburban and Newburg railroad and by the Ohio river, the remainder going over the Louisville, Evansville and Saint Louis railroad.

Coal product of Warrick county, Indiana, for three years.

Years.	Short tons.
1889	66, 638
1890	89, 059
1891	96, 134

INDIAN TERRITORY.

Total product in 1891, 1,091,032 short tons; spot value, $1,897,037.

The output of the Indian Territory in 1891 exceeded that of any previous year, and reached for the first time a total of a million tons. The product of 1891 exceeded that of 1890 by 221,803 tons, or a little more than 25 per cent. The value of the product increased $317,849, or about 20 per cent. The distribution of the output in 1891 was as follows:

Coal product of the Indian Territory in 1891.

Distribution.	Short tons.
Loaded at mines for shipment	1, 026, 932
Sold to local trade and used by employés	9, 405
Used at mines for steam and heat	22, 163
Made into coke	32, 532
Total	1, 091, 032
Total value	$1, 897, 037
Total number of employês	2, 891
Average number of days worked	222

All of the coal mines of the Indian Territory are in the Choctaw Nation, and are controlled by five companies, operating under franchises from the Indian government. The Atoka Coal and Mining Company's mines at Lehigh ship over the Missouri, Kansas and Texas railroad, which also transports the product of the Osage Coal and Mining Company from McAlester and Krebs, and a portion of the output of the Southwest Coal and Improvement Company at Coalgate, the remainder of the latter going over the Denison and Washita Valley railroad. The mines of the Kansas and Texas Coal Company at Braidwood and Bryan ship over the Saint Louis and San Francisco railroad. The coal mines of the Choctaw Coal and Railway Company are at Alderson and Hartshorne, the company transporting its output.

No record of the production of the Indian Territory coal fields was made prior to 1885. Since that date the product has been as follows:

Product of coal in the Indian Territory from 1885 to 1891, inclusive.

Years.	Short tons.	Years.	Short tons.
1885	500,000	1889	752,832
1886	534,580	1890	869,229
1887	685,911	1891	1,091,032
1888	761,986		

IOWA.

Total product in 1891, 3,825,495 short tons; total value, $4,867,999.

Before entering into any discussion of the returns for Iowa, as received by the Survey, it will be found of interest to make a comparison of the total product as obtained by the Survey and that compiled by the mine inspectors of the three State inspection districts. These reports are of biennial publication, the latest one covering the fiscal years ending June 30, 1890 and 1891. According to the inspectors' reports the product of the State for the two fiscal years aggregated 7,702,483 short tons, and for the two calendar years, according to the returns to the Survey, 7,847,234 short tons, a difference of only 144,751 tons, or a little less than 2 per cent. A greater difference is noted in the valuations reported, that according to the inspectors being $10,809,007, and according to the Survey $9,918,568. It will be interesting to note also that both reports show a decreased product in 1891, the State reports showing a product of 3,980,492 tons in 1890 and of 3,721,991 in 1891, a decrease of 258,501 tons. According to the Survey the output fell from 4,021,739 tons to 3,825,495 tons, a loss of 196,244 tons. The decreased production in 1891 was due in part to strikes, but chiefly to the importation of coal from other States, particularly Illinois, which, owing to favorable river freight rates, could find a market in Iowa cheaper than her own coal could be brought by rail.

From the returns made to the Survey the distribution of the product in 1891 is found to have been as follows:

Coal product of Iowa in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Appanoose	388, 846	13, 964	6, 915	....	409, 725	$569, 296	$1.39	207	1, 419
Boone	121, 875	26, 467	3, 317	....	151, 659	282, 651	1.86	196	484
Dallas	41, 349	4, 161	3, 200	....	48, 710	77, 847	1.60	210	140
Greene	52, 345	870	....	....	53, 215	74, 725	1.40	185	120
Jasper	250, 761	4, 841	11, 600	....	267, 202	385, 268	1.44	256	416
Jefferson	600	200	....	....	800	1, 200	1.50	100	6
Keokuk	285, 573	19, 505	11, 225	....	316, 303	417, 395	1.32	204	795
Mahaska	1, 178, 009	18, 591	34, 805	....	1, 231, 405	1, 306, 579	1.06	263	1, 815
Marion	155, 277	8, 564	1, 869	157	165, 867	192, 288	1.16	222	394
Monroe	381, 294	6, 776	5, 157	....	393, 227	474, 744	1.21	203	806
Polk	206, 016	97, 317	6, 134	....	309, 467	464, 315	1.50	239	779
Taylor	9, 200	1, 300	....	....	10, 500	22, 620	2.15	241	35
Van Buren	27, 792	7, 916	458	....	36, 166	46. 728	1.29	207	85
Wapello	158, 715	3, 660	3, 452	....	165, 827	206, 129	1.24	214	421
Warren	....	2, 000	....	....	2, 000	3, 500	1.75	166	6
Wayne	31, 427	13, 533	440	....	45, 400	68, 967	1.52	205	130
Webster	74, 268	3, 360	394	....	78, 022	133, 747	1.71	182	273
Small mines	....	140, 000	....	....	140, 000	140, 000	....	....	....
Total	3, 263, 347	373, 025	88, 966	157	3, 825, 495	4, 867, 999	1.27	224	8, 124

The average price per ton obtained for all the coal produced in the State was $1.27, an advance of 5 cents per ton over 1890. The lowest average price obtained in any county was $1.06, in Mahaska county, and Taylor county reported the highest, $2.15

The State is divided into three inspection districts, known respectively as the Southern or first district, the Northeastern or second district, and the Northwestern or third district. In previous volumes of "Mineral Resources" the annual production of the State since 1883 has been given by districts, and for the sake of comparison the tables are carried up to 1891.

Total production of coal in Iowa, by districts, from 1883 to 1891, inclusive.

Districts.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
First	1, 099, 503	1, 040, 895	1, 156, 224	1, 264, 433	1, 426, 841
Second	1, 477, 024	1, 413, 811	1, 231, 963	1, 688, 200	1, 775, 978
Third	1, 403, 419	1, 447, 585	1, 194, 469	900, 741	791, 671
Small mines	....	....	....	....	....
Total	3, 979, 946	3, 902, 291	3, 582, 656	3, 853, 374	3, 994, 490

Districts.	1888.	1889.	1890.	1891.
	Long tons.	*Short tons.*	*Short tons.*	*Short tons.*
First	1, 528, 967	1, 497, 685	1, 536, 978	1, 229, 512
Second	1, 974, 352	1, 720, 727	1, 626, 193	1, 814, 910
Third	918, 503	876, 946	718. 568	641, 073
Small mines	....	....	140, 000	140, 000
Total	4, 421, 822	4, 095, 358	4, 021, 739	3, 825, 495

Product of coal in the first inspection district of Iowa from 1883 to 1891, inclusive.

Counties.	1883	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Appanoose	128, 896	158, 986	245, 896	150, 000	160, 351
Adams	3, 891	3, 981	3, 896	9, 581	19, 851
Cass	....	....	....	....	....
Davis	527	1, 207	33, 655	1, 000	1, 800
Jefferson	38, 887	8, 172	1, 116	1, 083	10, 397
Lucas	487, 821	410, 729	439, 956	530, 759	472, 998
Marion	90, 985	97, 085	100, 011	141, 694	212, 695
Monroe	93, 435	98, 427	101, 517	117, 700	183, 505
Montgomery	....	....	....	....	....
Page	748	1, 009	1, 819	1, 550	1, 780
Taylor	94	127	617	8, 585	12, 180
Van Buren	1, 678	1, 778	1, 193	8, 038	26, 331
Wapello	237, 821	240, 720	187, 911	237, 111	272, 073
Warren	12, 828	13, 727	12, 825	23, 332	24, 796
Wayne	1, 892	4, 947	25, 812	34, 000	28, 084
Total	1, 099, 503	1, 040, 895	1, 156, 224	1, 264, 433	1, 426, 841

Counties.	1888.	1889.	1890.	1891.
	Long tons.	*Short tons.*	*Short tons.*	*Short tons.*
Appanoose	210, 263	285, 194	284, 560	409, 725
Adams	18, 817	13, 457	(*a*)	(*a*)
Cass	....	280	(*a*)	(*a*)
Davis	1, 800	3, 825	(*a*)	(*a*)
Jefferson	9, 387	8, 123	} 351, 600	800
Lucas	364, 969	339, 229		
Marion	230, 652	145, 180	153, 506	165, 867
Monroe	233, 896	258, 401	324, 031	393, 227
Montgomery	....	1, 040	(*a*)	(*a*)
Page	3, 430	2, 768	(*a*)	(*a*)
Taylor	8, 002	9, 736	(*a*)	10, 500
Van Buren	25, 960	39, 258	47, 464	36, 166
Wapello	380, 395	359, 199	341, 932	165, 827
Warren	17, 103	14, 515	8, 470	2, 000
Wayne	24, 293	17, 480	25, 415	45, 400
Total	1, 528, 967	1, 497, 685	(*b*) 1, 536, 978	(*b*) 1, 229, 512

a Included in product of small mines. *b* Exclusive of product of small mines.

Product of coal in the second inspection district of Iowa from 1883 to 1891.

Counties.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Mahaska	927, 387	932, 714	762, 785	851, 362	1, 025, 548
Keokuk	500, 040	430, 940	372, 816	545, 304	599, 007
Jasper	45, 883	46, 336	90, 425	286, 034	142, 039
Scott	3, 714	3, 821	5, 937	3, 000	8, 634
Marshall	....	....	....	400	200
Hardin	....	....	....	2, 000	450
Muscatine	....	....	....	100	100
Total	1, 477, 024	1, 413, 811	1, 231, 963	1, 688, 200	1, 775, 978

Counties.	1888.	1889.	1890.	1891.
	Long tons.	*Short tons.*	*Short tons.*	*Short tons.*
Mahaska	835, 981	1, 056, 477	1, 103, 831	1, 231, 405
Keokuk	541, 966	455, 162	349, 318	316, 303
Jasper	275, 179	199, 152	173, 044	267, 202
Scott	9, 080	9, 446	(*a*)	(*a*)
Marshall	....	....	....	....
Hardin	1, 000	490	(*a*)	(*a*)
Muscatine	....	....	....	....
Total	1, 663, 206	1, 720, 727	(*b*) 1, 626, 193	(*b*) 1, 814, 910

a Included in product of small mines. *b* Exclusive of product of small mines.

Product of coal in the third inspection district of Iowa from 1883 to 1891.

Counties.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Boone	466, 981	473, 073	458, 191	294, 970	167, 068	140, 142	174, 392	153, 229	151, 659
Dallas	38, 208	37, 185	32, 986	21, 986	40, 420	48, 622	67, 055	33, 466	48, 710
Greene	88, 851	96, 327	89, 587	117, 538	105, 894	106, 042	51, 438	45, 192	53, 215
Guthrie		5, 187	4, 596	17, 194	18, 305	18, 680	12, 275	(*a*)	(*a*)
Hamilton	1, 998	1, 878	918	3, 312	6, 669	6, 480			
Polk	558, 821	619, 921	462, 895	337, 964	305, 094	300, 669	434, 047	367, 852	309, 467
Webster	248, 560	214, 014	145, 296	107, 777	146, 221	159, 715	137, 739	118, 829	78, 022
Story					2, 000	2, 000			
Total	1, 403, 419	1, 447, 585	1, 194, 469	900, 741	791, 671	785, 350	876, 946	(*b*)718, 568	(*b*)641, 073

a Included in product of small mines. *b* Exclusive of product of small mines.

Résumé.—In the foregoing tables the product for the years previous to 1889 has been given in long tons, while that of 1889, 1890, and 1891 is given in short tons. In the following table the product for all the years from 1883 to 1891 is given in short tons:

Product of coal in Iowa from 1883 to 1891.

Years.	Short tons.	Years.	Short tons.
1883	4, 457, 540	1888	4, 952, 440
1884	4, 370, 566	1889	4, 095, 358
1885	4, 012. 575	1890	4, 021, 739
1886	4, 315, 781	1891	3, 825, 495
1887	4, 473. 829		

PRODUCTION BY COUNTIES.

There are thirteen counties in the State whose coal product is entirely from country banks, and which, therefore, do not come within the scope of this report. These counties are Adams, Cass, Davis, Montgomery, Page, Scott, Marshall, Hardin, Muscatine, Guthrie, Hamilton, and Story. For convenience of comparison in the tables showing the production in previous years the amounts have been reduced to short tons.

Appanoose county.—The product increased from 284,560 short tons in 1890 to 409,725 short tons in 1891, a gain of 125,165 short tons. The value increased $177,243, or from $392,053 to $569,296. In 1891 employment was given to 1,419 men for 207 days, against 1,080 men for 165 days in 1890.

The railroads transporting the coal of Appanoose county are the Keokuk and Western; Chicago, Burlington and Kansas City; Chicago, Minneapolis and Saint Paul; Chicago, Rock Island and Pacific, and Iowa Central.

Coal product of Appanoose county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	144,364	1888	235,495
1884	178,064	1889	285,194
1885	275,403	1890	284,560
1886	168,000	1891	409,725
1887	179,593		

Boone county.—Against 153,229 short tons in 1890, worth $279,192, the output in 1891 was 151,659 short tons, valued at $282,651, a loss of 1,570 short tons in amount produced, and a gain of $3,459 in value. Employment was given to 484 men for 196 days. The product is shipped over the Chicago and Northwestern railroad.

Coal product of Boone county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	523,019	1888	156,959
1884	529,842	1889	174,392
1885	513,174	1890	153,229
1886	330,366	1891	151,659
1887	187,116		

Dallas county.—The product of Dallas county in 1890 was 33,466 short tons, valued at $57,059, increasing in 1891 to 48,710 short tons, valued at $77,847, a gain of 15,244 short tons, and $20,788.

Coal product of Dallas county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	42,793	1888	54,457
1884	41,647	1889	67,055
1885	36,944	1890	33,466
1886	24,614	1891	48,710
1887	45,270		

The coal mines of Dallas county in 1891 employed a total of 140 men for 210 days. The coal reaches market over the Chicago, Rock Island and Pacific railroad.

Greene county.—Against a product of 45,192 short tons, valued at $73,674 in 1890, the output in 1891 was 53,215 short tons, valued at $74,725, an increase of 8,023 short tons, and $1,051. The Chicago, Rock Island and Pacific and the Minneapolis and Saint Louis railroads furnish transportation facilities.

Coal product of Greene county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	99,513	1888	118,767
1884	107,886	1889	51,438
1885	100,337	1890	45,192
1886	131,643	1891	53,215
1887	118,601		

Jasper county.—Jasper county increased its coal product from 173,044 short tons in 1890 to 267,202 short tons in 1891, a gain of 94,158 short tons. The value increased $193,493, or from $191,775 to $385,268 in 1891. The annual production of the county since 1883 is shown in the following table:

Coal product of Jasper county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	51,389	1888	318,200
1884	51,996	1889	199,152
1885	101,276	1890	173,044
1886	320,358	1891	267,202
1887	159,084		

The railroads over which the product of Jasper county is shipped are the Chicago, Rock Island and Pacific and the Chicago, Burlington and Kansas City. The mines gave employment to 416 men for an average of 256 days in 1891 against 335 men for 246 days in 1890.

Jefferson county.—Only one mine in Jefferson county is considered of commercial importance (the bulk of the county's output being from country banks), and the product of this mine fell from 1,600 tons in 1890 to 800 tons in 1891. The value decreased proportionately from $2,400 to $1,200. The annual output since 1883 has been as follows:

Coal product of Jefferson county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	43,553	1888	10,513
1884	9,153	1889	8,123
1885	1,250	1890	1,600
1886	1,213	1891	800
1887	11,645		

Jefferson county coal is forwarded over the Chicago, Fort Madison and Des Moines railroad.

Keokuk county.—In 1891 employment was given to 795 men for an average of 204 days in the production of 316,303 short tons of coal, the value of which was $417,305. This shows a decrease compared with 1890 of 33,015 short tons, and $41,213. Coal production in Keokuk county reached its highest point in 1887 with a total of 599,007 long tons, or 670,888 short tons. Since that time the production has decreased steadily, the output in 1891 being 19,141 tons less than one-half the product of 1887. The annual production of the county since 1883 is exhibited in the following table:

Coal product of Keokuk county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	560,040	1888	607,002
1884	482,653	1889	455,162
1885	417,554	1890	349,318
1886	610,740	1891	316,303
1887	670,888		

Transportation for Keokuk county coal is furnished by the Chicago, Rock Island and Pacific, the Burlington, Cedar Rapids and Northern, and the Chicago and Northwestern railroads.

Lucas county.—The only commercial coal mines of Lucas county, at Cleveland, were not operated in 1891.

The annual production of Lucas county since 1883 has been as follows:

Coal product of Lucas county, Iowa, for eight years.

Years.	Short tons.	Years.	Short tons.
1883	546,360	1887	529,758
1884	460,016	1888	408,765
1885	492,751	1889	339,229
1886	594,450	1890	(*a*) 350,000

a Estimated.

Mahaska county.—As a coal producer Mahaska county ranks first in the state, contributing 26.5 per cent. of the total product in 1890, and a little over 32 per cent. of the total product in 1891. The output of the county in 1891 was 1,231,405 short tons against 1,103,831 short tons in 1890, an increase of 127,574 short tons. The value of the product increased $140,718, or from $1,165,861 to $1,306,579. The following table shows the annual production of the county since 1883:

Coal product of Mahaska county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	1,038,673	1888	936,299
1884	1,044,640	1889	1,056,477
1885	854,319	1890	1,103,831
1886	953,525	1891	1,231,405
1887	1,148,614		

The coal mines of Mahaska county gave employment in 1891 to 1,815 men for an average of 263 days. The Iowa Central and the Chicago, Rock Island and Pacific railroads transport the product to market.

Marion county.—Total product in 1891, 165,867 short tons; spot value, $192,288. The output in 1891 was 12,361 short tons more than in 1890, while the value decreased $426. In 1888 the production in Marion county reached its highest figure, with an output of 230,652 long tons, or 258,330 short tons, falling off to 145,180 short tons in 1889. A slight increase (8,326 short tons) was noted in 1890, the product being 153,506 short tons. The output since 1883 has been as follows:

Coal product of Marion county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	101, 903	1888	258, 330
1884	108, 735	1889	145, 180
1885	112, 012	1890	153, 506
1886	158, 697	1891	165, 867
1887	238, 218		

The number of men employed in the coal mines of Marion county in 1891 was 394, averaging 222 days per man. The product is shipped over the Chicago, Burlington and Quincy railroad.

Monroe county.—Coal mining in Monroe county has been a steadily increasing industry since 1883. The product in 1891 was 393,227 short tons, valued at $474,744, being 69,196 short tons and $83,775 in excess of the product in 1890. The largely increased production in 1891 was due chiefly to the operations of the Wapello Coal Company, which abandoned its old mines in Wapello county and increased the output of its Monroe county collieries. Since 1883 the annual production of Monroe county has been as follows:

Coal product of Monroe county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	104, 647	1888	261, 964
1884	110, 238	1889	258, 401
1885	113, 699	1890	324, 031
1886	131, 824	1891	393, 227
1887	207, 526		

In 1891 the mines of Monroe county gave employment to 806 men for 203 days, against 735 men for 197 days in 1890. The Chicago, Milwaukee and Saint Paul and the Chicago, Burlington and Quincy railroads are the principal carriers.

Polk county.—The year of largest coal production in Polk county was in 1884, when a total of 619,921 long tons, or 694,312 short tons, was obtained. The annual output then gradually decreased until 1888, when the amount produced was 300,669 long tons, or 333,749 short tons, In 1889 it increased a little more than 100,000 tons, the product being 434,047 short tons. In 1890 the output decreased again to 367,852 short tons, and still further in 1891 to 309,467 short tons. The value of the product in 1891 was $464,315. A total of 779 men were engaged for 239 days in 1891, against 700 men for 243 days in the preceding year.

Coal product of Polk county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	625,880	1888	333,749
1884	695,312	1889	434,047
1885	518,442	1890	367,852
1886	378,520	1891	309,467
1887	341,605		

Polk county coal is forwarded over the Des Moines and Kansas City; the Chicago, Saint Paul and Kansas City; the Chicago, Rock Island and Pacific; the Chicago and Northwestern; the Chicago, Milwaukee and Saint Paul; the Des Moines and Northern; the Des Moines and Northwestern, and the Wabash railroads.

Taylor county.—The following table shows the annual production of Taylor county since 1883:

Coal product of Taylor county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	105	1888	8,962
1884	142	1889	9,736
1885	691	1890	(*a*) 10,000
1886	9,615	1891	10,500
1887	13,642		

a Estimated.

The Humeston and Shenandoah railroad transports the comparatively small coal product of Taylor county.

Van Buren county.—The total product in 1890 was 47,464 short tons, valued at $61,180, and in 1891, 36,166 short tons, valued at $46,728, a decrease of 11,298 short tons in quantity and of $14,452 in value. The total number of employés reported for 1891 was 85, working an average of 207 days, against 108 men for 280 days the preceding year. The coal is shipped over the Chicago, Rock Island and Pacific, and the Chicago, Burlington and Kansas City railroads.

Coal product of Van Buren county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	1,879	1888	29,065
1884	1,991	1889	39,258
1885	1,336	1890	47,464
1886	9,002	1891	36,166
1887	29,591		

Wapello county.—The coal production for 1891 shows a considerable decrease compared with previous years, due to the abandonment of the Wapello Coal Company's mines at Kirkville. The total output in 1891 was 165,827 short tons, valued at $206,129, in the production of which

421 men were employed for an average of 214 days. The railroads transporting the product are the Chicago, Milwaukee and Saint Paul, the Chicago, Burlington and Quincy, and the Chicago, Rock Island and Pacific.

Coal product of Wapello county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	266, 360	1888	426, 042
1884	269, 606	1889	359, 199
1885	210, 460	1890	341, 932
1886	263, 193	1891	165, 827
1887	304, 722		

Warren county.—Owing to the temporary suspension of operations at the most important colliery, the product in 1891 was only 2,000 tons all of which was sold to local trade at the mines. The value of this product was $3,500. The annual output of the county since 1883 is shown in the following table:

Coal product of Warren county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	14, 367	1888	19, 155
1884	15, 374	1889	14, 515
1885	13, 364	1890	8, 470
1886	26, 132	1891	2, 000
1887	27, 772		

Wayne county.—The coal product of Wayne county in 1891 exceeded that of any previous year for which there are any records, the total output being 45,400 short tons, valued at $68,967. The nearest approach to this product was in 1886, when a total of 38,080 short tons was reported. Compared with 1890 the output increased nearly 20,000 short tons, the increase in value being $37,198. One hundred and thirty men were employed for 205 days against 60 men for 180 days, in 1890. About 30 per cent. of the product of Wayne county is sold to local trade at the mines, the remainder being shipped over the Chicago, Rock Island and Pacific and the Chicago, Milwaukee and Saint Paul railroads.

Coal product of Wayne county, Iowa, for nine years.

Years.	Short tons.	Years.	Short tons.
1883	2, 119	1888	27, 208
1884	5, 541	1889	17, 480
1885	28, 909	1890	25, 415
1886	38, 080	1891	45, 400
1887	31, 454		

Webster county.—The output in 1891 was 78,022 short tons, valued at $133,747. In the table below it will be observed that the largest year's business was in 1883, when a product of 278,387 short tons was obtained. It decreased annually until 1887 and 1888, when the industry recovered somewhat, but since 1888 has again decreased each year, the product for 1891 being 40,807 short tons less than in 1890, and the smallest output recorded for any one year.

Coal product of Webster county, Iowa, for nine years.

Years.	Short tons,	Years.	Short tons.
1883	278,387	1888	178,881
1884	239,696	1889	137,739
1885	162,732	1890	118,829
1886	120,710	1891	78,022
1887	163,768		

KANSAS.

Total product in 1891, 2,716,705 short tons; spot value, $3,557,305.

The coal product in 1891 was 456,783 short tons greater than in 1890, while the value increased $609,788. The four principal producing counties, Cherokee, Crawford, Leavenworth, and Osage, are each credited with increased output, Osage county having the largest increase and taking third position in rank of producing importance, changing places with Leavenworth county. Crawford county remains, as in 1890, at the head, with Cherokee second. Of the less important counties, four only come within the scope of this report, and of these Coffey, Labette, and Franklin have decreased outputs, while Linn reports an increase. During 1891, the total number of men employed in and about the mines was 6,201, who made an average of 222 days. This would be an equivalent of 4,585 men for 300 days. In 1890 the mines gave employment to 4,523 men for 210 days, equivalent to 3,166 men for a year of 300 days, the difference between 1890 and 1891 being 1,357 men for 300 days in favor of the latter. The explanation for this great difference is to be found in the returns for Osage county, which reports 1,581 men employed for 270 days in the production of 355,286 tons, considerably less than one ton of coal per day per man. This condition is due to the large number of small mines in the county the product of each of which was less than 1,000 tons. The following table shows the product of coal in Kansas in 1891, by counties, with the distribution and value:

Coal products of Kansas in 1891, by counties.

Counties.	Loaded at mines for shipments.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Cherokee	812, 723	10, 058	9, 508		832, 289	$989, 785	$1.19	180	1, 609
Coffey	404	814			1, 218	2, 638	2.16	133	6
Crawford	978, 729	10, 864	8, 166		997, 759	1, 090, 540	1.09	202	1, 785
Franklin	7, 600	2, 652	25		10, 277	19, 528	1.90	207	48
Labette		800			800	2, 000	2.50	100	5
Leavenworth	267, 634	99, 349	13, 026	133	380, 142	530, 681	1.40	245	1, 073
Linn	36, 322	2, 107	505		38, 934	47, 901	1.23	236	94
Osage	325, 375	29, 195	716		355, 286	724, 232	2.04	270	1, 581
Small mines		100, 000			100, 000	150, 000			
Total	2, 428, 787	255, 839	31, 946	133	2, 716, 705	3, 557, 305	1.31	222	6, 201

It will be seen from the foregoing table that the average prices per ton for coal sold varied from $1.09 in Crawford county, and $1.16 in Cherokee county, to $2.16 in Coffey county, and $2.50 in Labette county. In Osage county an average of $2.04 was realized. The mines of Crawford and Cherokee counties are operated on a large scale and nearly all of the product is shipped to distant points. Coffey and Labette counties produce coal chiefly for a local demand, and, while the prices realized were higher, the small amount of product makes little effect on the general average. The average for the state was $1.31, about the same as was realized in 1890, the difference being only a fraction of a cent.

In the following table is shown the total product and value for a series of years, and the fluctuations in the average price per ton realized each year since 1885:

Amount and value of coal product of Kansas for thirteen years.

Years.	Short tons.	Value.	Average price per ton.
1869	32, 938		
1880	550, 000		
1881	750, 000		
1882	750, 000		
1883	900, 000		
1884	1, 100, 000		
1885	1, 037, 234	$1, 200, 651	$1.16
1886	1, 400, 000	1, 680, 000	1.20
1887	1, 596, 879	2, 235, 631	1.40
1888	1, 850, 000	2, 775, 000	1.50
1889	2, 221, 043	3, 296, 888	1.48
1890	2, 259, 922	2, 947, 517	1.30
1891	2, 716, 705	3, 557, 305	1.31

From the foregoing table it will be seen that coal production in Kansas has, with the exception of 1885, increased each year since 1880. In collecting the statistics for 1891, valuable assistance has been rendered by Mr. John T. Stewart, State Inspector of coal mines, in furnishing information regarding the operations of collieries from which no returns had been received by the Survey.

THE PRODUCT BY COUNTIES.

Cherokee county—Cherokee county ranks second in the state in the amount of coal produced, having a product in 1891 of 832,289 short tons, valued at $989,785, an increase over the product of 1890 of 105,428 short tons and $107,599. The persons employed in and about the mines in 1891 numbered 1,609 who worked an average of 180 days, against 1,413 men for 186 days in 1890. Since 1885 the annual product of Cherokee county has been as follows:

Coal product of Cherokee county, Kansas, for seven years.

Years.	Short tons.	Years.	Short tons.
1885	371,930	1889	549,873
1886	(a) 375,000	1890	724,861
1887	385,262	1891	832,289
1888	(a) 450,000		

a Estimated.

The railroads transporting the coal of Cherokee county are the Kansas City, Fort Scott and Memphis, the Saint Louis and San Francisco, and the Atchison, Topeka and Santa Fe.

Crawford county.—Since 1889 Crawford county has held first place in importance of coal production, having superseded Cherokee county. In 1891 the output of Crawford county was 997,759 short tons, valued at $1,090,540, against 900,464 short tons, having a value of $1,114,701 in 1890, an increase of 97,295 short tons, but a decrease in value of $24,161. The number of persons employed in coal mining in 1891 was 1,785 for 202 days compared with 1,447 men for 198 days in 1890. Below is exhibited in short tons the annual output of Crawford county since 1885.

Coal product of Crawford county, Kansas, for seven years.

Years.	Short tons.	Years.	Short tons.
1885	221,741	1889	827,159
1886	(a) 250,000	1890	900,464
1887	298,049	1891	997,759
1888	(a) 425,000		

a Estimated.

The Missouri Pacific, the Kansas City, Fort Scott and Memphis, the Atchison, Topeka and Santa Fe, and the Saint Louis and San Francisco railroads are the transporting lines for Crawford county coal.

Coffey county.—The product of Coffey county in 1891 was small, and used chiefly for local consumption in and about the town of Lebo. A small amount was shipped over the Atchison, Topeka and Santa Fé railroad.

Franklin county.—The output in Franklin county in 1891 was 8,225 short tons, a decrease as compared with 1890 of 820 short tons. The value fell off $1,680, or from $18,130 in 1890 to $16,450 in 1891. The coal of Franklin county is shipped over the Atchison, Topeka and Santa Fé and the Kansas Southern railroads.

Coal product of Franklin county, Kansas, for seven years.

Years.	Short tons.	Years.	Short tons.
1885	14, 518	1889	37, 771
1886	(a) 15, 000	1890	9, 045
1887	18, 080	1891	8, 225
1888	(a) 25, 000		

a Estimated.

Labette county.—The total product in 1891 was 800 short tons, which supplied a local demand at Oswego. The value of the output was $2,000.

Leavenworth county.—Against a product of 319,866 short tons, valued at $490,224, in 1890, the output of Leavenworth county in 1891 was 340,419 short tons, worth $466,131, an increase in quantity of 20,553 short tons, but a decrease in value of $24,093. The number of employés in 1891 was 993, who worked an average of 245 days, against 745 men for 273 days in 1890. The annual output of Leavenworth county since 1885 is shown in the following table:

Coal product of Leavenworth county, Kansas, for seven years.

Years.	Short tons.	Years.	Short tons.
1885	120, 561	1889	245, 616
1886	(a) 160, 000	1890	319, 866
1887	195, 480	1891	340, 419
1888	(a) 210, 000		

a Estimated.

The following railroads furnish transportation facilities for the coal mines of Leavenworth county: Missouri Pacific; Union Pacific; Atchison, Topeka and Santa Fe; Chicago, Rock Island and Pacific; Saint Paul and Kansas City; Kansas City, Wyandotte and Northwestern. A portion of the product is shipped by boats on the Missouri river.

Linn county.—The coal product of Linn county increased from 10,474 short tons in 1890 to 38,934 short tons in 1891, a gain of 28,460 tons or nearly 280 per cent. The value increased from $14,078 in 1890 to $47,901 in 1891. The number of employés increased from 60 to 96 and the number of working days from 164 to 236. The Missouri Pacific, the Kansas City, Fort Scott and Memphis, and the Saint Louis and Emporia railroads carry the product to market.

Coal product of Linn county, Kansas, for seven years.

Years.	Short tons.	Years.	Short tons.
1885	5,556	1889	25,345
1886	(a) 8,900	1890	10,474
1887	12,400	1891	38,934
1888	(a) 17,500		

a Estimated.

Osage county.—Owing to incomplete returns in 1890 the product reported was probably underestimated in that year, the output being given at 179,012 short tons. This was 267,006 short tons less than in 1889, while with more complete returns for 1891 the product increases 186,274 short tons, the output in the latter year being 355,286 short tons, valued at $724,232. There are as many mines in Osage county as in all the other counties combined, but the most of them are of minor importance, only nine reporting a product of 10,000 tons or over in 1891. The number of men employed in 1891 was 1,581, who averaged 270 working days, against 804 men for 209 days in 1890.

Coal product of Osage county, Kansas, for seven years.

Years.	Short tons.	Years.	Short tons.
1885	370,552	1889	446,018
1886	(a) 380,000	1890	179,012
1887	393,608	1891	355,286
1888	(a) 415,000		

a Estimated.

Osage county coal is forwarded over the following lines of railway: Atchison, Topeka and Santa Fe; Missouri Pacific; Kansas City, Wyandotte and Northwestern.

KENTUCKY.

Total product in 1891, 2,916,069 short tons; spot value, $2,715,600. The product of coal in 1891 was 214,573 short tons more than in 1890, the percentage of increase being 7.9. The value increased $243,481, or 9.8 per cent. In 1889, according to the Eleventh Census, the number of country banks in Kentucky was 1,762, which produced 170,862 tons of coal, an average of not quite 100 tons each. The output of these mines for 1891 is estimated at 180,000 tons.

Attention is directed to a comparison of the statistics of coal production in Kentucky, as prepared by Mr. C. J. Norwood, State Mine Inspector, and as obtained by the Geological Survey. Mr. Norwood states the total product to be 2,879,082 short tons. The returns to the Survey show a product of 2,916,069 short tons, a difference of only 36,987 tons, or 1.3 per cent. According to Mr. Norwood's report, the output of cannel coal in Kentucky was 42,870 short tons, while the reports to the Survey indicate a product of 42,793, a difference of but 77 tons, or 0.18 per cent.

In the production of the 2,916,069 tons of coal reported to the Survey a total average of 6,355 men were employed, the mines being operated an average of 225 days. For the purpose of comparison this is reduced to the number of men that could have been employed for a year of 300 days and is found to be 4,764 men. In 1890 the total number of employés averaged 5,259 for 219 days, or, say, 3,839 men for 300 days. The result shows the practical employment of 925 men more in 1891 than in 1890, for an uninterrupted year. Below is shown the product of coal in Kentucky in 1891, by counties, with the distribution and value:

Coal product of Kentucky in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.	Average price per ton.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Bell	2,668	100	100	12,825	15,693	$19,616	130	75	$1.25
Boyd	177,710	1,440	200	....	179,350	145,112	287	300	.81
Carter	144,469	1,418	50	....	145,937	151,406	227½	437	1.04
Christian	33,055	405	600	....	34,060	39,373	187	125	1.13
Daviess	....	6,611	100	....	6,711	7,149	264	[illegible]	1.07
Hancock	16,815	....	....	....	16,815	31,008	80	[illegible]	1.84
Henderson	119,000	4,121	900	....	124,021	114,535	249	231	.92
Hopkins	614,982	17,157	10,910	37,337	680,386	494,939	244	1,203	.73
Johnson	21,042	480	....	....	21,522	49,250	280	153	2.33
Knox	60,000	40,000	....	....	100,000	100,000	200	215	1.00
Laurel	304,723	1,783	1,736	....	308,242	308,019	233	798	1.00
Lawrence	78,023	1,000	1,825	....	80,848	80,818	289	300	1.00
McLean	25,000	....	....	....	25,000	31,250	200	40	1.25
Muhlenburg	251,760	7,655	900	....	260,315	219,695	215	586	.84
Ohio	315,011	5,020	2,380	....	322,411	253,378	225	625	.79
Pulaski	15,810	....	....	....	15,810	21,948	170	74	1.39
Union	76,891	9,452	335	....	86,678	109,598	161	289	1.26
Webster	30,677	2,966	240	....	33,883	29,670	226	67	.88
Whitley	263,046	1,383	1,087	....	265,516	315,235	190	680	1.19
Butler	8,581	4,290	....	....	12,871	12,871	200	45	1.00
Small mines	....	180,000	....	....	180,000	180,000	....	....	....
	2,559,263	285,281	21,363	50,162	2,916,069	2,715,600	225	6,355	.93

The range in the average price per ton realized for coal sold was from 81 cents in Boyd county, to $2.33 in Johnson county, the unusually high prices obtained in the latter being for its product of cannel coal. The general average for the state was 93 cents per ton against 91½ cents in 1890.

The following table exhibits the annual coal product of Kentucky since 1873:

Annual coal product of Kentucky since 1873.

Years.	Short tons.	Years.	Short tons.
1873	300,000	1883	1,650,000
1874	360,000	1884	1,550,000
1875	500,000	1885	1,600,000
1876	650,000	1886	1,550,000
1877	850,000	1887	1,933,185
1878	900,000	1888	2,570,000
1879	1,000,000	1889	2,399,755
1880	1,000,000	1890	2,701,496
1881	1,100,000	1891	2,916,069
1882	1,300,000		

Bell county.—In 1889, according to the census returns, the product of Bell county was 20,095 short tons, of which 12,700 tons was from country banks, leaving 7,395 tons as the output of the commercial mines. In 1890 no commercial product was reported, but in 1891 operations were resumed and a total of 15,693 tons was obtained, valued at $19,616. Of the product 12,825 tons was made into coke. It is reported that extensive preparations are being made to develop the coal mines of Bell county on a large scale, and that a number of companies with ample capital have been organized for the purpose. The coal beds of Log and Pine mountains are located in Bell county, extending over the state line into Claiborne county, Tennessee. They are said to be very valuable, but seem to have been hitherto overlooked, as no product is reported prior to 1889. The Louisville and Nashville railroad runs through Bell county and will furnish transportation facilities.

Boyd county.—The amount of coal produced in Boyd county in 1891 varied very little compared with that of 1890, the product in 1891 being 179,350 short tons, and in 1890 179,600 tons, a decrease of only 250 tons. The value, however, fell off more in proportion, being $151,176 in 1890 and $145,112 in 1891, a decrease of three cents per ton in the price realized by the operators. The Ashland Coal and Iron railroad carries the coal of Boyd county to Ashland and Denton, where connections are made with the Chesapeake and Ohio and the Newport News and Mississippi Valley routes, respectively.

Coal product of Boyd county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	145,945	1890	179,600
1888	(a)	1891	179,350
1889	163,124		

a Not reported.

Butler county.—The Eleventh Census gives the product of coal in Butler county at 6,489 tons in 1889, all of which was from country banks and supplied a purely local demand. In 1890 no commercial product was reported, but during 1891 an output of 12,871 short tons was obtained, one-third of which was sold to local trade and used by employés and two-thirds shipped by boats on Green river. The mines are not located on the line of any railroad.

Carter county.—The total product in 1891 was 145,937 short tons, valued at $151,406, a decrease as compared with 1890 of 33,442 short, tons and $45,623. Of the product in 1891, 4,926 tons were cannel coal, valued at $15,112 at the mines. During the year the mines gave employment to 437 men for 227½ days. The coal is shipped over the Newport News and Mississippi Valley, the Elizabethtown, Lexington and Big Sandy, the Ashland Coal and Iron, and the Eastern Kentucky railroads.

Coal product of Carter county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	158,021	1890	179,379
1888	(a)	1891	145,937
1889	172,776		

a Not reported.

Christian county.—Total product in 1891, 34,060 short tons; spot value, $39,373.

The output of Christian county was 1,279 tons less than in 1890, but the value was $9,102 more. There is but one mine of commercial importance in the county, and the product of this is shipped over the Louisville and Nashville railroad. The output of the county since 1887 has been as follows:

Coal product of Christian county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	24,507	1890	35,339
1888	(a)	1891	34,060
1889	27,281		

a Not reported.

Crittenden county.—No product has been reported for 1891, the one mine which produced coal commercially having been abandoned in 1890.

Daviess county.—The total output in 1891 was 6,711 short tons, all of which, with the exception of 100 tons used at the mines, was consumed by the local trade of Owensboro. This product, of course, does not include that of country banks, of which there are quite a number in the county, and which produced about 25,000 tons in 1889. This omission must be taken into consideration in comparing the product of 1890 and 1891, in the following table, with that of 1887 and 1889:

Coal product of Daviess county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	15,243	1890	5,616
1888	(a)	1891	6,711
1889	30,870		

a Not reported.

Hancock county.—Total product, 16,815 short tons; spot value, $31,008.

The principal product of Hancock county is cannel coal of good quality, with some bituminous from country banks. The first production of the county is reported by the census of 1889, when 21,588 short tons were obtained, 13,110 tons of which were cannel coal. The output in

1890 is estimated at 14,400 tons. It was shipped to market over the Louisville, Saint Louis and Texas railroad.

Henderson county.—Total product in 1891, 124,021 short tons; spot value, $114,535.

The product of Henderson county in 1891 exceeds that of 1890 by 36,781 short tons. The gain is due to the opening up of a new mine at Baskitt station, unrecorded in previous reports, and having an output of 50,000 tons in 1891. One mine of the county ships its coal over the Ohio Valley railroad, the product of the others going over the Louisville, Saint Louis and Texas. A total of 231 men was given employment for an average of 249 days.

Coal product of Henderson county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	50,912	1890	87,240
1888	(*a*)	1891	124,021
1889	65,682		

a Not reported.

Hopkins county.—In point of coal production Hopkins county is the banner county of the state, having more than double the output of Ohio county, which comes second, and nearly 25 per cent. of the total product of the state. Its output of coal in 1891 was 680,386 short tons, an increase as compared with 1890 of 76,079 short tons. The increase in value was $33,762. The amount and value of the product in 1891 were in excess of any previous year. The number of men employed in 1891 was 1,203, who worked an average of 244 days, against 1,104 men for 231 days in 1890. The Louisville and Nashville railroad carries the entire product of the county.

Coal product of Hopkins county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	487,916	1890	604,307
1888	(*a*)	1891	680,386
1889	555,119		

a Not reported.

Johnson county.—The product in 1891 was 21,522 short tons of cannel coal, worth $49,950 at the mines. This was an increase over 1890 of 300 tons in quantity and $4,716 in value. The coal is shipped over the Charleston, Cincinnati and Chicago, and the Ohio and Big Sandy railroads. Considerable attention has been directed towards the cannel coals of Johnson county during the past year, and it is very probable that future reports will show much larger production. One hundred and fifty-three men found employment for an average of 283 days in 1891.

Coal product of Johnson county, Kentucky, since 1889.

Years.	Short tons.	Years.	Short tons.
1889	(a) 32,347	1891	21,522
1890	21,222		

a Includes 7,555 tons produced from country banks.

Knox county.—Coal produced in 1891, 100,000 short tons; spot value, $100,000.

No product from Knox county has been reported prior to 1889. In that year the output was 47,503 tons, valued at $41,000. It increased to 90,000 tons, worth $69,600 in 1890, and added 10,000 more tons in 1891. The Louisville and Nashville railroad handles the output.

Laurel county.—Coal produced in 1891, 308,242 short tons; spot value, $308,019.

Notwithstanding an increased product of 17,064 tons over 1890, Laurel county drops from second place in producing importance to third, changing positions with Ohio county. The value of the product, however, is greater by $54,631 than that of Ohio county, but still does not take second place in this regard, owing to an advance in the prices obtained by operators in Whitley county, which puts the value of their product second in the State. In the production of the 308,242 tons in 1891, 798 men were engaged for an average of 233 days, against 680 men for 225 days in producing 291,178 tons in 1890. The following table shows the annual production in Laurel county since 1887:

Coal product of Laurel county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	226,617	1890	291,178
1888	(a)	1891	308,242
1889	280,451		

a Not reported.

Lawrence county.—Coal produced in 1891, 80,848 short tons; spot value, $80,848.

The output was 19,352 tons less than in 1890, but greater than that of 1887 or 1889, the only other previous years for which the report of output is obtainable. The mines are in the southeastern corner of the county, on the line of the Ohio and Big Sandy railroad, over which the coal is shipped.

Coal product of Lawrence county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	46,598	1890	100,200
1888	(a)	1891	80,848
1889	79,787		

a Not reported.

McLean county.—The returns for McLean county in 1890 and 1891 are incomplete. The product is estimated at 25,000 short tons for each year. The output in 1889 was 35,177, and in 1887, 13,653 short tons.

Muhlenburg county.—Coal produced in 1891, 260,315 short tons; spot value, $219,695.

Muhlenburg county holds fifth place among the coal-producing counties of the State, but is only 5,201 short tons behind Whitley county in the number of tons produced in 1891. The product of Muhlenburg county in 1891 was 19,332 more than in 1890, the value increasing $26,365. The coal is shipped over the Newport News and Mississippi Valley, the Owensboro and Nashville, the Louisville and Nashville railroads and by the Green river boats. The number of men employed in 1891 was 586 for an average of 215 days against 495 men for 213 days in 1890.

Coal product of Muhlenburg county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	189,511	1890	240,983
1888	(a)	1891	260,315
1889	206,855		

a Not reported.

Ohio county.—Coal produced in 1891, 322,411 short tons; spot value, $253,378.

In 1891 Ohio county took second place in importance of coal production, superseding Laurel county. In the value of the product, however, Ohio county still retains third place, being outclassed by Whitley county in this respect. The output in 1891 was 54,675 short tons in excess of 1890, the increase in value being $45,306. All of the product sent to a distance is shipped over the Newport News and Mississippi Valley railroad. In 1891 employment was given to 625 men for an average of 225 days against 520 men for 236 days in 1890.

Coal product of Ohio county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	150,578	1890	267,736
1888	(a)	1891	322,411
1889	246,253		

a Not reported.

Pulaski county.—Coal produced in 1891, 15,810 short tons; spot value, $21,948.

In 1887 four mines reported a product of 148,385 short tons. In 1889 three mines produced 82,278 tons, the output of country banks increasing the total to 84,363 tons. The output in 1890 was estimated at 12,000 short tons, the product, as in 1891, being reported from only one mine.

Union county.—Coal produced in 1891, 86,678 short tons; spot value, $109,598.

The amount of coal taken from Union county mines in 1891 was 18,915 short tons more than the product of 1890, the value increasing $36,599. The coal is shipped by rail over the Ohio Valley railroad, and by boats on the Ohio river.

Coal product of Union county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	47,130	1890	67,763
1888	(*a*)	1891	86,678
1889	56,556		

a Not reported.

Webster county.—Coal produced in 1891, 33,883 short tons; spot value, $29,670.

In 1890 the product of Webster county was 38,016 short tons, valued at $24,860, showing an increase in 1891 of 867 short tons, and a gain in value of $4,810. Only one mine reports shipments to distant markets, the Louisville and Nashville railroad transporting the product.

Coal product of Webster county, Kentucky, for three years.

Years.	Short tons.	Years.	Short tons.
1889	32,729	1891	33,883
1890	33,016		

Whitley county.—Coal produced in 1891, 265,516 short tons; spot value, $315,235.

Whitley county in 1891 comes fourth in the state in the amount of coal produced, and second in value of the output. The product during the year was 2,975 short tons more than in 1890, and greater than that of any previous year.

The mines gave employment to 680 men for an average of 190 days in 1891 against 625 men for 204 days in 1890. The product is shipped over the Louisville and Nashville and the East Tennessee, Virginia and Georgia railroads.

Coal product of Whitley county, Kentucky, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	223,337	1890	262,541
1888	(a)	1891	265,516
1889	184,874		

a Not reported.

Other counties.—In addition to the coal-producing counties of Kentucky, of which mention has been made in the foregoing report, there are twenty-six counties which produced coal from country banks in 1889, and which are not enumerated in this report, the product being included in the 180,000 tons estimated from this source. These counties are Breathitt, Clay, Edmonson, Elliott, Floyd, Grayson, Greenup, Harlan, Jackson, Knott, Lee, Leslie, Letcher, Madison, Magoffin, Martin, Menifee, Morgan, Owsley, Perry, Pike, Powell, Rockcastle, Todd, Wayne and Wolfe.

MAINE.

A discovery of a vein of coal is reported to have been made by a company prospecting on Cape Small Point, in Sagadahoc county. It is on a small point of land projecting into the Atlantic Ocean at the mouth of the Kennebec river. The vein of coal is said to have been struck at the depth of 870 feet. The coal is claimed to resemble English cannel coal, the vein being about 2 feet thick.

MARYLAND.

Total product in 1891, 3,820,239 short tons; spot value, $3,082,515.

The coal product of Maryland in 1890 was 3,357,813 short tons, or 2,998,047 long tons, valued at $2,899,572. The increase in 1891 was, therefore, 462,426 short tons, or 412,845 long tons, with an increase in value of $182,943. In the preceding report (1889 and 1890) it was stated that the rebuilding of the Chesapeake and Ohio canal would afford facilities for increased shipments from the Maryland mines, and the prediction has been borne out in fact. The railroads carrying coal from the Maryland mines (all of which are in Allegany county) are the Pennsylvania, Baltimore and Ohio, Cumberland and Pennsylvania, and the Georges Creek and Cumberland. The total number of employés in 1891 was 3,891, who worked an average of 244 days, against 3,842 men for the same number of days in 1890. The following table shows the distribution of the product in 1891, the estimated output of small banks (8,000 short tons) being included in the amount sold to local trade:

Coal product of Maryland in 1891.

Distribution.	Short tons.
Loaded at the mines for shipment	3,771,584
Sold to local trade and used by employés	36,959
Used at mines for steam and heat	11,696
Total product	3,820,239
Total value	$3,082,515
Total number of employés	3,891
Average number of days worked	244

The following table shows the annual output of coal in Maryland since 1883:

Product of coal in Maryland from 1883 to 1891.

Years.	Short tons.	Years.	Short tons.
1883	2,476,075	1888	3,479,470
1884	2,765,617	1889	2,939,715
1885	2,833,337	1890	3,357,813
1886	2,517,577	1891	3,820,239
1887	3,278,023		

Mr. H. W. Shaidt, manager of the Cumberland Daily News, of Cumberland, Maryland, has furnished the Survey with a copy of the report of the Cumberland coal trade in 1891, from which the following tables are carried forward for that year:

Product of coal in Maryland from 1883 to 1891.

Companies.	1883.	1884.	1885.	1886.	1887.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Consolidation Coal Company	456,238	689,212	710,064	675,652	936,799
New Central Coal Company	210,850	210,140	203,814	149,561	181,906
Georges Creek Coal and Iron Company	257,490	266,042	257,343	265,942	394,012
Maryland Union Coal Company	137,105	117,180	98,095	116,771	148,523
Borden Mining Company	151,665	162,057	179,537	137,747	192,636
Maryland Coal Company	235,854	295,736	365,319	288,742	316,518
American Coal Company	190,055	194,330	220,339	211,305	259,632
Potomac Coal Company	139,723	169,463	196,280	156,757	209,793
Hampshire and Baltimore Coal Company	194,534	36,416	....	....	....
Atlantic and Georges Creek Coal Company (Pekin mine)	69,000	75,457	64,938	7,321	....
Swanton Mining Company	34,905	28,620	52,862	42,688	61,610
Blaen Avon Coal Company	84,721	100,961	69,192	65,830	11,934
Piedmont Coal and Iron Company	4,619	1,250	32	1,678	....
Union Mining Company	5,024	5,310	5,641	6,824	7,500
National Coal Company	38,998	42,680	48,307	62,637	117,775
Davis and Elkins mine	....	74,437	58,002	58,382	82,667
James Ryan	....	....	....	....	3,608
George M. Hansel	....	....	....	....	1,989
Total	2,210,781	2,469,301	2,529,765	2,247,837	2,926,903

Product of coal in Maryland from 1883 to 1891—Continued.

Companies.	1888.	1889.	1890.	1891.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Consolidation Coal Company	1,023,349	871,463	956,031	910,977
New Central Coal Company	169,484	118,885	218,169	206,813
Georges Creek Coal and Iron Company	437,992	311,258	351,310	356,927
Maryland Union Coal Company	106,620			
Borden Mining Company	212,520	206,549	299,055	300,268
Maryland Coal Company	340,866	268,438	366,839	406,464
American Coal Company	287,058	297,537	386,731	449,631
Potomac Coal Company	208,777	205,212	217,232	184,706
Atlantic and Georges Creek Coal Company (Pekin mine)	6,375	3,884	752	
Swanton Mining Company	58,383	40,748	41,401	33,029
Blaen Avon Coal Company				
Union Mining Company	6,396	3,734	17,933	179,232
National Coal Company	76,592	72,571	60,296	
Davis & Elkins mine	98,443	18,089		
James Ryan				
George M. Hansel	3,559	113		
Barton and Georges Creek Valley Company	69,857	123,429	175,838	201,124
Enterprise mine	399	288	11	
Franklin Consolidated Coal Company		71,837	66,644	76,593
Big Vein Coal Company		21,310	52,917	62,832
Piedmont-Cumberland Coal Company		2,493	29,003	42,439
Anthony Mining Company			115	9,725
Total	3,106,670	2,637,838	3,231,187	3,420,760

Total shipments from the Cumberland coal field in

Years.	Frostburg region. Cumberland and Pennsylvania railroad. By Baltimore and Ohio railroad.	By Chesapeake and Ohio canal.	By Pennsylvania railroad.	Total.	Cumberland Coal and Iron Company's railroad. By Baltimore and Ohio railroad.	By Chesapeake and Ohio canal.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1842	757	....	....	757	951	....	951
1843	3,661	....	....	3,661	6,421	....	6,421
1844	5,156	....	....	5,156	9,734	....	9,734
1845	13,738	....	....	13,738	10,915	....	10,915
1846	11,240	....	....	11,240	18,555	....	18,555
1847	20,615	....	....	20,615	32,325	....	32,325
1848	36,571	....	....	36,571	43,000	....	43,000
1849	63,676	....	....	63,676	78,773	....	78,773
1850	73,783	3,167	....	76,950	119,023	875	119,898
1851	70,893	51,438	....	122,331	103,808	31,540	135,348
1852	128,534	46,357	....	174,891	139,925	19,362	159,287
1853	150,381	84,060	....	234,441	155,278	70,535	225,813
1854	148,953	63,731	....	212,684	173,580	92,114	265,694
1855	93,691	77,095	....	170,786	97,710	100,691	198,401
1856	86,994	80,387	....	167,381	121,945	105,149	227,094
1857	80,743	55,174	....	135,917	88,573	54,000	142,573
1858	48,018	166,712	....	214,730	66,009	87,539	153,548
1859	48,415	211,639	....	260,054	72,423	86,203	158,626
1860	70,669	232,278	....	302,947	80,500	63,600	144,100
1861	23,878	68,303	....	92,181	25,983	29,296	55,279
1862	71,745	75,206	....	146,951	41,096	23,478	64,574
1863	117,796	173,269	....	291,065	111,087	43,523	154,610
1864	287,126	194,120	....	481,246	67,676	64,522	132,198
1865	384,297	285,295	....	669,592	104,651	57,907	162,558
1866	592,938	291,019	....	883,957	52,251	52,159	104,410
1867	623,031	385,249	....	1,008,280	40,106	72,904	113,010
1868	659,115	424,406	....	1,083,521	100,345	57,919	158,264
1869	1,016,777	573,243	....	1,590,020	130,017	78,908	208,925
					2,092,660	1,192,224	3,284,884
					Cumberland Branch.		
1870	909,511	520,196	....	1,429,707	114,404	83,941	198,345
1871	1,247,279	656,085	....	1,903,364	69,864	194,254	264,118
1872	1,283,956	612,537	22,021	1,918,514	26,586	203,666	230,252
1873	1,509,570	641,220	114,589	2,265,379	89,765	137,582	227,347
1874	1,295,804	631,882	67,671	1,995,357	113,670	135,182	248,852
1875	1,095,880	715,673	160,213	1,971,766	52,505	164,165	216,670
1876	939,262	443,435	131,866	1,514,563	15,285	189,005	204,290
1877	755,278	473,646	170,884	1,399,808	63,181	111,350	174,531
1878	823,801	486,038	145,864	1,455,703	99,455	123,166	222,621
1879	933,240	397,009	154,264	1,484,513	141,907	104,238	246,145
1880	1,055,491	471,800	213,446	1,740,737	197,525	131,325	328,850
1881	1,113,263	270,156	153,501	1,536,920	271,570	151,526	423,096
1882	576,701	115,344	91,574	783,619	199,183	76,140	275,323
1883	851,985	303,678	217,065	1,371,728	197,235	141,390	338,625
1884	1,193,780	150,471	199,138	1,543,389	289,884	124,718	414,602
1885	1,091,904	171,460	206,227	1,469,591	289,407	117,829	407,236
1886	1,131,949	115,531	141,520	1,389,000	243,321	113,791	357,112
1887	1,584,114	132,177	176,241	1,892,532	332,798	125,305	458,103
1888	1,660,406	155,216	193,046	2,208,668	374,888	95,191	470,079
1889	1,430,381	26,886	177,152	1,634,419	368,497	26,407	394,904
1890	1,511,418	....	291,704	1,803,122	(a)522,334	....	522,334
1891	1,628,574	9,070	289,232	1,926,876	461,479	39,294	500,773
Total	30,555,008	11,040,658	3,317,208	44,912,874	4,534,743	2,589,369	7,124,108

a Of this amount 3,744 tons were shipped to the Pennsylvania railroad.

b Of this amount 307,750 tons were shipped to the Pennsylvania railroad.

Maryland and West Virginia from 1842 to 1891.

Frostburg region.				Piedmont region.		Total.			Aggregate.
George's Creek and Cumberland railroad.				George's Creek railroad.	Hampshire railroad, by Baltimore and Ohio railroad.	Baltimore and Ohio railroad and local.	Chesapeake and Ohio canal.	Pennsylvania railroad.	
By Chesapeake and Ohio canal.	By Pennsylvania railroad.	Local and Baltimore and Ohio.	Total.						
Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
......	......	......	......	......	......	1,708	......	......	1,708
......	......	......	......	......	......	10,082	......	......	10,082
......	......	......	......	......	......	14,890	......	......	14,890
......	......	......	......	......	......	24,653	......	......	24,653
......	......	......	......	......	......	29,795	......	......	29,795
......	......	......	......	......	......	52,940	......	......	52,940
......	......	......	......	......	......	79,571	......	......	79,571
......	......	......	......	......	......	142,449	......	......	142,449
......	......	......	......	......	......	192,806	4,042	......	196,848
......	......	......	......	......	......	174,701	82,978	......	257,679
......	......	......	......	......	......	268,459	65,719	......	334,178
......	......	......	......	73,725	......	376,219	157,760	......	533,979
......	......	......	......	181,303	......	503,836	155,845	......	659,681
......	......	......	......	227,245	65,570	478,486	183,786	......	662,272
......	......	......	......	269,210	42,765	502,330	204,120	......	706,450
......	......	......	......	252,368	51,628	465,912	116,574	......	582,486
......	......	......	......	218,318	63,060	395,405	254,251	......	649,656
......	......	......	......	257,740	47,934	426,512	297,842	......	724,354
......	......	......	......	289,298	52,564	493,031	295,878	......	788,909
......	......	......	......	85,554	36,660	172,075	97,599	......	269,674
......	......	......	......	69,482	36,627	218,950	98,684	......	317,634
......	......	......	......	266,430	36,240	531,553	216,792	......	748,345
......	......	......	......	......	44,552	399,354	258,642	......	657,996
......	......	......	......	......	71,345	560,293	343,202	......	903,495
......	......	......	......	......	90,964	736,153	343,178	......	1,079,331
......	......	......	......	......	72,532	735,669	458,153	......	1,193,822
......	......	......	......	......	88,658	848,118	482,325	......	1,330,443
......	......	......	......	......	83,724	1,230,518	652,151	......	1,882,669
				2,190,673					
				Empire and West Virginia mines.					
......	......	......	......	28,035	60,988	1,112,938	604,137	......	1,717,075
......	......	......	......	81,218	96,453	1,494,814	850,339	......	2,345,153
......	......	......	......	85,441	121,364	1,517,347	816,103	22,021	2,355,471
......	......	......	......	77,582	103,793	1,780,710	778,802	114,589	2,674,101
......	......	......	......	57,492	109,194	1,576,160	767,064	67,671	2,410,895
......	......	......	......	63,537	90,800	1,302,237	879,838	160,698	2,342,773
......	......	......	......	108,723	7,505	1,070,775	632.440	131,866	1,835,081
......	......	......	......	......	......	818,459	584,996	170,884	1,574,339
......	......	......	......	......	998	924,254	609,204	145,864	1,679,322
......	......	......	......	......	51	1,075,198	501,247	154,264	1,730,709
......	......	......	......	66,573	......	1,319,589	603,125	213,446	2.136,160
83,136	125,097	4,947	213,180	88,722	......	1,478,502	504,818	278,598	2,261,918
78,298	93,861	31,436	203,595	277,929	......	1,085,249	269,782	185,435	1,540,466
215,767	202,223	77,829	495,819	338,001	......	1,444,766	680,119	419,288	2,544,173
69,765	156,959	283,336	510,060	466,928	......	2,233,928	344,954	356,097	2,934,979
79,455	214,518	291,685	585,658	403,489	......	2,076,485	368,744	420,745	2,865,974
53,480	98,371	348,196	500,047	346,308	......	2,069,774	282,802	239,891	2,592,467
4,863	153,230	418,057	576,150	449,011	......	2,724,347	262,345	389,104	3,375,796
112	286,787	341,024	627,923	564,397	......	2,669,216	286,700	715,151	3,671,067
......	365,029	243,487	608,516	576,047	......	2,357,585	57,459	798,842	3,213,886
......	677,593	228,138	905,731	(b) 774,904	......	2,723,341	......	1,282,748	4,006,091
......	763,845	229,766	993,111	959,673	......	(c) 2,855,225	51,121	1,474,087	4,380,433
584,876	3,137,513	2,497,401	6,219,790	5,140,185	1,475,969	47,777,369	15,505,660	7,741,289	71,024,318

c Includes 107,846 tons used on line of Cumberland and Pennsylvania railroad and its branches, and at Cumberland and Piedmont; also, 385,822 tons used by the Baltimore and Ohio railroad in locomotives, rolling mills, etc.

MICHIGAN.

Total product in 1891, 80,307 short tons; spot value, $133,387.

The amount of coal produced in Michigan in 1891 was 5,330 short tons more than in 1890, but the value decreased from $149,195 in 1890 to $133,387 in 1891, a loss of $15,808. Jackson and Shiawassee counties continue to produce all of the commercial product, the estimated output from other localities being about 4,000 tons. The coal of Shiawassee county (about 15 per cent. of the total product) is shipped over the Detroit, Grand Haven and Milwaukee railroad, the Jackson county product going over the Michigan Central. The distribution of the coal product of Michigan in 1891 is shown in the following table:

Coal product of Michigan in 1891.

Distribution.	Short tons.
Loaded at mines for shipment	53,133
Sold to local trade and used by employés	21,515
Used at mines for steam and heat	5,659
Total	80,307
Total value	$133,387
Average price per ton	$1.66
Total number of employés	223

In the following table is shown the annual product of coal in Michigan since 1887. The largest output for any one year was in 1882, when a total of 135,339 tons was obtained. The suspension of two of the larger companies in the following year reduced the product nearly 50 per cent., and the loss has not since been made up.

Product of coal in Michigan from 1877 to 1891.

Years.	Short tons.	Years.	Short tons.
Previous to 1877	350,000	1884	36,712
1877	69,197	1885	45,178
1878	85,322	1886	60,434
1879	82,015	1887	71,461
1880	129,053	1888	81,407
1881	130,130	1889	67,431
1882	135,339	1890	74,977
1883	71,296	1891	80,307

MINNESOTA.

Coal is reported to have been discovered near Granite Falls in this State, but the seam is not more than 12 inches in thickness, and it is doubtful if it will prove of practical value.

MISSISSIPPI.

A discovery of a vein of coal has been reported near Alexander, but no attempt to develop the property was made in 1891, so far as could be learned.

MISSOURI.

Total product in 1891, 2,674,606 short tons; spot value, $3,283,242.

The output of coal in Missouri during 1891 exhibits a decrease as compared with 1890 of 60,615 short tons. The decrease in value was $99,616. Comparing the total product as reported to this Bureau with that obtained by Mr. C. C. Woodson, State Mine Inspector, for the fiscal years ending June 30, the following differences are observed: The State report gives the total product for 1891 at 2,650,018 short tons, which is 24,588 short tons less than that obtained by the Survey's inquiries. The value reported by the mine inspectors was $3,480,867, being $197,625 more than that reported to the Survey. These differences, however, being so comparatively small, tend rather to show the correctness of both compilations than any shortcomings in either. The inspector's report shows an increase in the product of 1891 of 212,619 tons over that of 1890. According to the Survey returns for the two years there is a decrease in 1891 of 60,615 short tons. This difference is accounted for by the State reports covering the fiscal year and the one for 1890, including all of the mild winter of 1889–'90, whereas the Survey reports for 1890 get the benefit of the better season in the winter of 1890–'91. The total product for the calendar year 1890, according to the Survey, was 295,822 tons greater than that of the fiscal year reported by the mine inspector.

The following table shows the production of the State, by counties, with the distribution and value:

Coal product of Missouri in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Adair	10,650	40	250	10,940	$19,175	$1.75	300	40
Audrain	2,430	5,499	843	8,772	13,723	1.57	180	33
Barton	83,577	675	750	85,002	103,780	1.22	221	263
Bates	609,300	7,042	12,238	628,580	654,160	1.04	235	1,077
Boone	10,230	6,110	....	16,340	24,510	1.50	257	53
Caldwell	37,324	12,502	1,239	51,065	110,008	2.15	230	194
Callaway	11,740	10,568	150	22,458	32,661	1.42	230	90
Grundy	....	28,000	2,000	30,000	61,500	2.05	297	90
Henry	94,734	7,002	1,130	102,866	137,617	1.33	218	286
Johnson	3,500	1,000	....	4,500	6,750	1.50	164	18
La Fayette	265,747	9,217	2,429	277,393	430,581	1.55	206	850
Linn	22,466	3,987	541	26,994	32,018	1.19	240	90
Macon	559,398	8,033	24,674	592,105	608,974	1.02	228	1,198
Montgomery	156	15,773	200	16,129	21,842	1.35	260	37
Morgan	....	220	....	220	440	2.00	100	3
Putnam	116,677	1,042	4,947	122,666	160,508	1.31	196	430
Randolph	269,794	1,726	3,000	274,520	291,955	1.06	249	535
Ray	204,843	5,683	3,013	213,539	346,236	1.62	178	753
St. Clair	2,500	....	....	2,500	1,800	.72	100	20
Vernon	45,641	1,476	900	48,017	50,004	1.04	131	139
Small mines	....	140,000	....	140,000	175,000	....	....	....
Total	2,350,707	265,595	58,304	2,674,606	3,283,242	1.23	218	6,199

The largest product in any one year was in 1888, when a total of 3,909,967 short tons was reported as having been obtained. This amount was probably an over-estimate, as a study of the following table will show:

Product of coal in Missouri from 1873 to 1891.

Years.	Short tons.	Years.	Short tons.	Years.	Short tons.
1873	784,000	1880	1,680,000	1887	3,209,916
1874	799,680	1881	1,960,000	1888	3,909,967
1875	840,000	1882	2,240,000	1889	2,557,823
1876	1,008,000	1883	2,520,000	1890	2,735,221
1877	1,008,000	1884	2,800,000	1891	2,674,606
1878	1,008,000	1885	3,080,000		
1879	1,008,000	1886	1,800,000		

Strikes.—Mr. Woodson in his report states that during the fiscal year ending June 30, 1891, there were ten strikes in the coal mines of Missouri. Of these, six were unsuccessful, viewed from the miners' standpoint, two succeeded, and two were compromised. By these strikes 603 employés were thrown out of employment, entailing an average loss to each of $39.35, the total loss in wages aggregating $23,730.

PRODUCTION IN 1891, BY COUNTIES.

Adair county.—Coal produced in 1891, 10,940 short tons; spot value, $19,175.

Only two mines in Adair county come within the scope of the Survey investigation, though the State report names five others operating in the winter months for local consumption. The large mines are on the line of the Quincy, Omaha and Kansas City railroad, over which the coal is shipped.

Coal product of Adair county, Missouri, for three years.

Years.	Short tons.	Years.	Short tons.
1889	18,592	1891	10,940
1890	(a) 16,000		

a Estimated.

Audrain county.—Coal produced in 1891, 8,772 short tons; spot value, $13,723.

Owing to incomplete returns the product of Audrain county is partly estimated. As given, there is a decrease as compared with 1890 of 11,489 short tons. The coal is shipped over the Chicago and Alton railroad from Vandalia.

Coal product of Audrain county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	102,032	1890	20,261
1888	(a)	1891	8,772
1889	26,194		

a Not reported.

Barton county.—Coal produced in 1891, 85,002 short tons; spot value, $103,780.

Compared with 1890 the product of Barton county shows an increase of 56,502 short tons, or nearly 200 per cent. The increase in value was $73,580, or about 244 per cent. The increase is due to greater output at the mines of the Wear Coal Company at Minden and the addition of the Morgan shaft, also at Minden, not previously reported. Western Mine No. 4, of the Western Coal and Mining Company, was abandoned on March 1, 1892, having produced only 9,802 tons in 1891. The product of Barton county is shipped over the Kansas City, Fort Scott and Memphis, the Missouri Pacific, and the Gulf, Colorado and Santa Fe railroads.

Coal product of Barton county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	132,275	1890	28,500
1888	(*a*)	1891	85,002
1889	61,167		

a Not reported.

Bates county.—Coal produced in 1891, 628,580 short tons; spot value, $654,160.

Bates county is the most important in point of coal production in the State, though in 1891, owing to a decrease in its output of 123,122 short tons and an increase in the product of Macon county, the latter comes within 10 per cent. of taking the lead.

For the purpose of comparison the following table is given, showing the product of Bates county for the calendar years 1890 and 1891, as reported to the Survey, and for the fiscal year ending June 30, according to Mr. Woodson's report:

Comparative reports of product of Bates county, Missouri, for calendar and fiscal years.

Years.	Survey report.	State report.
	Short tons.	*Short tons.*
1889	751,702	671,373
1890	628,580	726,273
Totals for two years	1,380,282	1,397,646

The following table shows the output of Bates county since 1887:

Coal product of Bates county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	1,071,106	1890	751,702
1888	(*a*)	1891	628,580
1889	755,989		

a Not reported.

The mines of Bates county gave employment in 1891 to 1,077 men for an average of 235 days, as against 1,315 men for 215 days in 1890. The most of the product is shipped over the Missouri Pacific railway from Rich Hill and Worland. The remainder goes over the Kansas City, Fort Scott and Memphis, and the Kansas City, Nevada and Fort Smith.

Boone county.—Coal produced in 1891, 16,340 short tons; spot value, $24,510.

The product of Boone county in 1891 was 660 tons less than in 1890. The average price per ton realized is reported at $1.50 for each year and the value decreased, accordingly, $990. About 10,000 tons of the output in 1891 was shipped over the Wabash railroad; the remainder was used for local consumption.

Coal product of Boone county, Missouri, for three years.

Years.	Short tons.	Years.	Short tons.
1889	31,405	1891	16,340
1890	17,000		

Caldwell county.—Coal produced in 1891, 51,065 short tons; spot value, $110,008.

Only one company reported production in 1890, whereas four contributed to the output in 1891, resulting in an increased product of 29,466 short tons, or nearly 140 per cent. The value increased $67,302, or nearly 158 per cent. The product is shipped over the Chicago, Milwaukee and Saint Paul, and the Hannibal and Saint Joseph railroads.

Coal product of Caldwell county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	26,000	1890	21,599
1888	(*a*)	1891	51,065
1889	13,594		

a Not reported.

Callaway county.—Coal produced in 1891, 22,458 short tons; spot value, $32,661.

The product of coal in this county in 1890 was reported from one mine only. In 1891 seven mines report. Of five of these the output is used entirely for local consumption. The product of one is consumed by the company mining it, in the manufacture of fire brick. About 35 per cent. of the remaining colliery's output is consumed locally, the rest being shipped over the Chicago and Alton railroad.

Compared with 1890, the product of Callaway county in 1891 shows an increase of 17,127 short tons and $24,665.

Coal product of Callaway county, Missouri, for three years.

Years.	Short tons.	Years.	Short tons.
1889	16,053	1891	22,458
1890	5,331		

Cooper county.—No report of production in 1891 has been received by the Survey. The state mine-inspector reports a product of 2,200 tons.

Grundy county.—The product of Grundy county for 1891 was 30,000 short tons, against 24,000 tons in 1890. Shipments are made over the Chicago, Rock Island and Pacific railroad. Following is the annual output of the county since 1887:

Coal product of Grundy county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	36,183	1890	24,000
1888	(*a*)	1891	30,000
1889	23,401		

a Not reported.

Henry county.—Coal produced in 1891, 102,866 short tons; spot value, $137,617.

Comparison with the product of 1890 shows the output in 1891 to have decreased 6,902 short tons, with a loss in value of $24,378. According to the state report the product for the fiscal years increased from 127,281 tons in 1890 to 144,139 tons in 1891, a gain of 16,858 tons. The product is shipped over the Kansas City, Fort Scott and Memphis, the Missouri, Kansas and Texas, and the Kansas City and Southern railroads. The mines gave employment to 286 men for 218 days in 1891, against 311 men for 207 days in 1890.

Coal product of Henry county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	199,777	1890	109,768
1888	(*a*)	1891	102,866
1889	180,118		

a Not reported.

Lafayette county.—Coal produced in 1891, 277,393 short tons; spot value, $430,581.

As a coal-producer Lafayette county comes third in the state, following Bates and Macon counties, but being closely pressed in 1891 by Randolph county, with a product of 274,520 short tons. Compared with 1890, the output of Lafayette county in 1891 has decreased 70,295 short tons. The coal is consumed chiefly in Kansas City, which market, being not more than 50 miles distant from the Lafayette county mines, gives them a considerable advantage over those of other counties. The Missouri Pacific and the Chicago and Alton railroads handle most of the traffic, a small portion of the product going by Missouri river boats. During 1891, 850 men were employed for an average of 206 days.

Coal product of Lafayette county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	352,087	1890	347,688
1888	(*a*)	1891	277,393
1889	348,670		

a Not reported.

Linn county.—Coal produced in 1891, 26,994 short tons; spot value, $32,018.

The total product of Linn county reported to the Survey in 1890 was 1,300 tons, all used for local consumption at Brookfield. The 1891 product is increased by the output of mine No. 32, operated by the Kansas and Texas Coal Company at Marcelline, not previously reported. This mine is on the line of the Atchison, Topeka and Santa Fe railroad, over which it goes to market.

Coal product of Linn county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	728	1890	1,300
1888	(*a*)	1891	26,994
1889	6,992		

a Not reported.

Macon county.—Coal produced in 1891, 592,105 short tons; spot value, $608,974.

As a coal-producer Macon county ranks second in the State, having an output in 1891 but 36,475 tons less than Bates county, which comes first. The product in 1891 was 52,044 short tons in excess of that in 1890, the number of men employed being 1,198 for 228 days against 1,027 men for 259 days in 1890. The coal is shipped over the Hannibal and Saint Joseph, the Chicago, Burlington and Quincy, and the Wabash railroads.

Coal product of Macon county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	637,092	1890	540,061
1888	(*a*)	1891	592,105
1889	446,396		

a Not reported.

Montgomery county.—Coal produced in 1891, 16,129 short tons; spot value, $21,842.

Compared with 1890 the output shows an increase of 2,545 short tons. In the table of distribution the greater part of the product of Montgomery county appears as used for local consumption. This is due to the fact that nearly all of the product of the largest mine is sold to the Wabash railroad and is delivered to the engines at the mines. Fourteen thousand four hundred and twenty-three tons were so disposed of in 1891.

Coal product of Montgomery county, Missouri, for three years.

Years.	Short tons.	Years.	Short tons.
1889	12,300	1891	16,129
1890	13,584		

Putnam county.—Coal produced in 1891, 122,666 short tons; spot value, $160,508.

The output of coal in 1891 was 14,152 short tons more than in 1890, the value increasing $20,494. During 1891, 430 men for an average of 196 days were engaged in the production, against 335 men for 234 days in 1890. The product is shipped over the Chicago, Burlington, and Kansas City railroad.

Coal product of Putnam county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	117,600	1890	108,514
1888	(*a*)	1891	122,666
1889	83,774		

a Not reported.

Randolph county.—Coal produced in 1891, 274,520 short tons; spot value, $291,955.

Randolph county steps from fifth place 1890, to fourth place in 1891, displacing Ray county. The product in the latter year was 5,148 short tons more than in 1890, while the value decreased from $306,736 to $291,955, a loss of $14,781. The Wabash, the Chicago and Alton, and the Missouri, Kansas and Texas railroads carry the product to market.

Coal product of Randolph county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	279,416	1890	269,372
1888	(*a*)	1891	274,520
1889	221,463		

a Not reported.

The coal mines of Randolph county gave employment to 535 men and were in active operation an average of 249 days in 1891, compared to 635 men and 229 working days in 1890.

Ray county.—Coal produced in 1891, 213,539 short tons; spot value, $346,236. In the amount of coal produced in 1891 Ray county ranks fifth, but in the value of the output it comes fourth, being 60,981 short tons less than Randolph county in amount and exceeding it in value by $54,281. Compared with 1890, the amount produced in 1891 shows a decrease of 64,579 short tons, the value falling off $75,838. The average price per ton realized by operators ranged from $1.51 to $2.25 per ton at the mine, the general average being $1.62. The product is shipped over the Atchison, Topeka and Santa Fe, and the Wabash railroads.

Coal product of Ray county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	202,586	1890	278,118
1888	(*a*)	1891	213,539
1889	220,530		

a Not reported.

The mines of Ray county were active an average of 178 days in 1891 and employed a total average of 753 men. In 1890, 687 men were employed and the mines were worked an average of 241 days.

St. Clair county.—Only one mine reports production, the output being 50 per cent. less than in 1890.

Vernon county.—Coal produced in 1891, 48,017 short tons; spot value, $50,004.

A new mine opened by the Keith and Perry Coal Company in October, 1890, began producing in 1891, and as a result the output of the county is largely increased. This mine and one other are on the line of the Missouri, Kansas and Texas railroad. The Kansas City, Fort Scott and Memphis carries the product of the other mines of the county. The mines were producing coal 131 days on an average and employed 139 men, compared to 44 men and 118 days working in 1890.

Coal product of Vernon county, Missouri, since 1887.

Years.	Short tons.	Years.	Short tons.
1887	22,344	1890	13,385
1888	(*a*)	1891	48,017
1889	39,420		

a Not reported.

MONTANA.

Total product in 1891, 541,861 short tons; spot value $1,228,630.

The amount of coal produced in Montana during 1891 was 24,384 tons more than in 1890, but with increasing production the value has declined. The average price per ton realized in 1889 was $3.50, when the total output was 363,301 tons. In 1890 the output was 517,477 short tons, valued at $1,252,492, an average of $2.42 per ton. In 1891 the price again declined to $2.27 per ton on the average, the total value being $23,862 less than in 1890. The decline in value may readily be attributed to greater knowledge and improved methods in mining which enable the producers to furnish coal to consumers at a lower price and yet realize a reasonable profit. One substantial evidence of this was in the declaration of a 2½ per cent. dividend on a capital stock of $4,000,000 made on July 1, 1891, by the Rocky Fork Coal Company, the largest producer in the state. The following table shows the product of Montana in 1891, by counties, with the value and distribution:

Coal product of Montana in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Cascade	197,787	320			198,107	$396,219	$2.00	401
Choteau	280	193			478	1,723	3.60	10
Dawson	250				250	625	2.50	1
Fergus	200	50			250	1,400	5.60	2
Gallatin	55,271	414	438	858	56,981	135,893	2.38	139
Meagher	50				50	200	4.00	4
Park	247,665	4,413	6,000	27,667	285,745	692,570	2.43	562
Total	501,503	5,395	6,438	28,525	541,861	1,228,630	2.27	1,119

Since 1883 the annual production of coal in Montana has been as follows:

Product of coal in Montana from 1883 to 1891.

Years.	Short tons.	Years.	Short tons.
1883	19,795	1888	41,467
1884	80,376	1889	363,301
1885	86,440	1890	517,477
1886	49,846	1891	541,861
1887	10,202		

Cascade county.—Coal produced in 1891, 198,107 short tons; spot value, $396,219.

Compared with 1890 the coal product of Cascade county shows a decrease of 2,328 tons, and in value of $10,529. This apparent decrease is due to the fact that reports from a number of small mines from which returns were received in 1890 are lacking for 1891. In the mines reporting a total of 401 men were employed, as against 379 men in 1890.

Coal product of Cascade county, Montana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	166,480	1891	198,107
1890	200,435		

The principal mines of Cascade county are on the line of the Great Northern railroad, over which the product is shipped.

Choteau county.—Three mines contributed to a total product of 478 short tons, valued at $1,723. The output was 322 tons less than in 1890.

Coal product of Choteau county, Montana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	820	1891	478
1890	800		

Dawson county.—The small product of Dawson county is mined to supply a local trade and the ranchmen of the locality.

Coal product of Dawson county, Montana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	733	1891	25[illegible]
1890	1,260		

Fergus county.—A small output (250 tons) is reported in 1891. It was taken out in the course of development work and sold to local consumers.

Gallatin county.—Coal produced in 1891, 56,981 short tons; spot value, $135,893.

The output in 1891 was 5,529 short tons more than in 1890, the increase in value being $16,809. The producing mines are all in the neighborhood of Bozeman, on the line of the Northern Pacific railroad. In 1891, 139 men were employed as compared with 120 in 1890.

Coal product of Gallatin county, Montana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	43,838	1891	56,981
1890	51,452		

Meagher county.—A small amount of coal (50 tons) was reported in 1891. This is the first product reported from Meagher county.

Park county.—Coal produced in 1891, 285,745 short tons; spot value, $692,570.

Park county is the largest coal producer in the State, the output in 1891 being more than 50 per cent. of the total product of the State. Compared with 1890 there was a gain in product of 33,008 short tons, but in value of only $1,700. The average price per ton declined from $2.73 in 1890 to $2.42 in 1891. The coal is shipped over the Northern Pacific railroad.

Coal product of Park county, Montana, for three years.

Years.	Short tons.	Years.	Short tons.
1889	147,300	1891	285,745
1890	252,737		

Coal mining of Park county gives promise of becoming an extensive industry. In fact a product of nearly 300,000 tons in 1891, and having an aggregate value approaching $700,000, would indicate that it had already become so. The mines of the Rocky Fork Coal Company, the largest in the state, are located at Red Lodge, in this county. The veins worked are said to be 5 feet thick in the narrowest part, and the largest of any yet found west of the Mississippi river. It is stated that this company has made a contract for supplying the Northern Pacific railroad for a period of ninety-nine years. The mines of the county gave employment in 1891 to 562 men. In 1890, 705 men were engaged in producing a smaller amount of coal. The employment of fewer men in 1891 in producing more coal is a satisfactory explanation of the decline in the price.

NEBRASKA.

Nebraska produces about 1,500 short tons of coal annually for a local demand. No regular system of mining is carried on, the coal being dug by farmers in off seasons. The coal when sold brings about $3 per ton, the total product being valued at about $4,500.

NEW MEXICO.

Total product in 1891, 462,328 short tons; spot value, $779,018.

The coal output of New Mexico in 1891 was 86,551 short tons greater than that of 1890. The increase in value was $274,628. It is probable that the output would have been considerably more than reported had not a strike occurred in the mines of Bernalillo county, which reduced the product from 181,647 tons in 1890 to 76,515 tons in 1891.

The total number of men employed during 1891 was 806, against 827 the year before. The statistics relating to the number of days the mines were active were not obtained from a number of New Mexico mines in either 1890 or 1891, and it is therefore not possible to draw a comparison; but no doubt the decrease in the number of employés in 1891 would be made up by a greater number of days' employment.

The following table shows the output of the territory in 1891, by counties, with the value and distribution:

Coal product of New Mexico in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Bernalillo	76,005	210	300		76,515	$113,175	$1.47	187
Colfax	292,348	1,391	1,350		295,089	399,432	1.35	384
Lincoln		1,000			1,000	5,000	5.00	2
Rio Arriba	7,000	100	250		7,350	14,350	1.95	20
San Juan		300			300	600	2.00	2
Santa Fe	12,000	250	250	4,000	16,500	35,100	2.13	36
Socorro	61,259	220	4,095		65,574	211,361	3.22	175
Total	448,612	3,471	6,245	4,000	462,328	779,018	1.68	806

In the following table it is shown that in 1888 New Mexico produced its largest output. There is every reason to believe, however, that the amount reported was an excessive estimate, as in 1889 the Census Office, after a very thorough canvass of the State, reports a product 139,722 tons less than in 1888. On the other hand, later information indicates that the output reported for 1890 was less than the actual product and that it reached a point exceeding 400,000 tons.

Coal product of New Mexico from 1882 to 1891.

Years.	Short tons.	Years.	Short tons.
1882	157,092	1887	508,034
1883	211,347	1888	626,665
1884	220,557	1889	486,943
1885	306,202	1890	375,777
1886	271,285	1891	462,328

Bernalillo county.—Coal produced in 1891, 76,515 short tons; spot value, $113,175.

Compared with 1890 the output in 1891 shows a decrease of 105,132 short tons, for which the strike previously referred to is doubtless responsible. The number of men employed fell off from 375 in 1890 to 187 in 1891. The coal is shipped over the Atlantic and Pacific railroad.

Coal product of Bernalillo county, New Mexico, since 1882.

Years.	Short tons.	Years.	Short tons.
1882	33,373	1887	275,952
1883	42,000	1888	300,000
1884	62,802	1889	233,059
1885	97,755	1890	181,647
1886	106,530	1891	76,515

Colfax county.—Coal produced in 1891, 295,089 short tons; spot value $399,432.

The loss in output experienced by the Bernalillo county mines has been compensated for in the increased product of Colfax county, whose gain over 1890 was 147,689 short tons. The coal is used extensively by the Atchison, Topeka and Santa Fe railroad over which it is shipped. Employment was given to 384 men in 1891, against 375 men in 1890.

Coal product of Colfax county, New Mexico, since 1882.

Years.	Short tons.	Years.	Short tons.
1882	91,798	1887	154,875
1883	112,089	1888	227,427
1884	102,513	1889	151,464
1885	135,833	1890	151,400
1886	87,708	1891	295,089

Lincoln county.—The total product in 1891 was 1,000 short tons, consumed in making steam at the Homestake gold and silver mine.

Coal product of Lincoln county, New Mexico, for three years.

Years.	Short tons.	Years.	Short tons.
1889	1,255	1891	1,000
1890	1,175		

Rio Arriba county.—Coal produced in 1891, 7,350 short tons; spot value, $14,350.

With the exception of a small amount (350 tons) sold to local trade about the mines and used by employés, the entire product is sold to the Denver and Rio Grande railroad for locomotive use.

Coal product of Rio Arriba county, New Mexico, since 1882.

Years.	Short tons.	Years.	Short tons.
1882	12,000	1887	11,000
1883	17,240	1888	12,000
1884	11,203	1889	13,650
1885	14,958	1890	12,175
1886	7,000	1891	7,350

San Juan county.—The total product in 1891 was 300 short tons, against 510 tons in 1890 and 400 tons in 1889. The output is from two mines and supplies a local demand. There is no railroad communication.

Santa Fe county.—Coal produced in 1891, 16,500 short tons; spot value, $35,100.

The output in 1891 was 6,270 short tons less than in 1890, while the value decreased $17,090. The principal mines are at Cerrillos, on the line of the Atchison, Topeka and Santa Fe railroad.

Coal product of Santa Fe county, New Mexico, since 1882.

Years.	Short tons.	Years.	Short tons.
1882	3,600	1887	7,500
1883	3,000	1888	25,200
1884	3,000	1889	34,870
1885	1,000	1890	22,770
1886	1,000	1891	16,500

Socorro county.—Coal produced in 1891, 65,574 short tons; spot value, $211,361.

The coal of Socorro county is shipped over the Atchison, Topeka and Santa Fe railroad, part of it going as far as the city of Mexico for commercial use, and part being used by the smelters of New Mexico and at El Paso, Texas.

Coal product of Socorro county, New Mexico, since 1882.

Years.	Short tons.	Years.	Short tons.
1882	16,321	1887	58,707
1883	37,018	1888	62,038
1884	41,039	1889	52,205
1885	56,656	1890	(a) 50,000
1886	69,047	1891	65,574

a Estimated.

NORTH CAROLINA.

Total product in 1891, 20,355 short tons; spot value, $39,635.

North Carolina began producing coal commercially in 1889, when an output of 192 short tons was obtained in the course of development. In 1890 the output was 10,262 tons, and the product in 1891 shows an increase of nearly 100 per cent. over that of 1890. The product, which is limited to Chatham county, was distributed as follows in 1891:

Coal product of North Carolina in 1891.

Distribution.	Short tons.
Loaded at mines for shipment	18,780
Sold to local trade and used by employés	600
Used at mines for steam and heat	975
Total product	20,355
Total value	$39,635
Total number of men employed	80

The coal is shipped over the Cape Fear and Yadkin Valley railroad.

Coal product of North Carolina for three years.

Years.	Short tons.	Value.
1889	192	$451
1890	10,262	17,864
1891	20,355	39,635

NORTH DAKOTA.

Total product in 1891, 30,000 short tons; spot value, $43,000.

The coal of North Dakota is a lignite of inferior quality and does not compete favorably with that brought from other localities. The cost of mining is high and what is mined is consumed locally.

Coal product of North Dakota from 1884 to 1891.

Years.	Short tons.	Years.	Short tons.
1884	35,000	1888	34,000
1885	25,000	1889	28,907
1886	25,955	1890	30,000
1887	21,470	1891	30,000

OHIO.

Total product in 1891, 12,868,683 short tons; spot value, $12,106,115. In 1890 the total output of the coal mines of Ohio, including nut and slack sizes, whether consumed at the mines or sold for commercial purposes, was 11,494,506 short tons. This was the largest product for any one year in the State's history. In 1891, however, the total output is again increased by 1,374,177 short tons over that of 1890. The value of the product in 1891 was $12,106,115, against $10,783,171 the previous year.

In 1891 the mines employed a total of 22,182 men and were active 206 days on an average. In 1890, 20,576 men were employed and the mines were worked an average of 201 days. Reducing each of these to a year of 300 days, it shows the equivalent employment of 13,786 men in 1890 to 15,232 men in 1891. The following table shows the product in 1891 by counties, with the value and distribution:

Coal product of Ohio in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Short tons*				
Athens	1,421,078	37,166	10,050	14,000	1,482,294	$1,257,081	$0.85	193	2,702
Belmont	658,563	157,923	2,750	....	819,236	690,726	.84	238½	1,276
Carroll	312,463	700	380	....	313,543	254,613	.81	200	589
Columbiana	554,497	20,957	9,954	36,318	621,726	595,390	.96	251	1,031
Coshocton	177,121	12,348	....	....	189,469	189,111	1.00	265	284
Gallia	17,493	....	....	....	17,493	16,133	.92	218	35
Guernsey	386,653	1,600	2,165	....	390,418	306,299	.79	188	810
Harrison	3,800	160	....	....	3,960	5,860	1.48	236	9
Hocking	1,453,706	25,274	36,739	....	1,515,719	1,235,017	.81	241	1,674
Jackson	1,385,769	84,615	5,555	....	1,475,939	1,559,547	1.06	189	3,097
Jefferson	631,093	60,837	2,095	3,168	697,193	589,667	.85	235	1,237
Lawrence	39,800	36,085	350	....	76,235	79,143	1.04	223	232
Mahoning	174,151	24,330	2,253	....	200,734	270,744	1.35	233½	525
Medina	155,204	1,320	3,660	....	160,184	185,462	1.16	221	314
Meigs	148,057	131,852	2,185	....	282,094	271,143	.96	190	623
Muskingum	153,114	7,040	....	....	160,154	130,674	.82	213	338
Noble	3,600	200	....	....	3,800	4,400	1.16	156	10
Perry	1,757,728	15,188	12,710	....	1,785,626	1,483,542	.84	170	3,284
Portage	66,266	1,892	900	....	69,058	104,906	1.52	225	149
Stark	862,006	21,534	34,455	....	917,995	1,148,222	1.25	190	1,952
Summit	125,956	9,133	4,990	....	140,079	193,380	1.38	194	376
Trumbull	82,827	423	700	....	83,950	118,286	1.41	226	176
Tuscarawas	713,377	17,491	5,429	....	736,297	583,206	.79	232	1,161
Vinton	84,566	12,200	1,400	....	98,166	103,148	1.05	206	197
Washington	4,800	1,150	....	....	5,950	5,838	.98	84	36
Wayne	19,521	150	1,700	....	21,371	24,577	1.15	200	65
Small mines	....	600,000	....	....	600,000	700,000	....	....	....
Total	11,393,209	1,281,568	140,420	53,486	12,868,683	12,106,115	.94	206	22,182

In the following table is indicated the annual output of the state, by counties, since 1884:

Coal produced in Ohio since 1884, by counties.

Counties.	1884.	1885.	1886.	1887.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Athens	627,944	823,139	899,046	1,083,543
Belmont	643,129	744,446	573,779	721,767
Columbiana	469,708	462,733	336,063	516,057
Coshocton	56,562	99,609	52,934	124,791
Carroll	102,531	150,695	216,630	293,328
Guernsey	375,427	297,267	433,800	553,613
Gallia	20,372	16,383	17,424	15,365
Holmes	12,052	11,459	12,670	10,526
Hocking	372,694	656,441	741,571	853,063
Harrison	....	....	5,509	4,032
Jackson	831,720	791,608	856,740	1,134,705
Jefferson	316,777	271,329	275,666	293,875
Lawrence	176,412	145,916	166,933	143,559
Medina	77,160	152,721	252,411	225,487
Meigs	248,436	234,756	192,263	185,205
Muskingum	84,398	86,846	96,601	171,928
Mahoning	241,599	275,944	313,040	272,349
Morgan	7,636	5,536	4,370	4,100
Noble	....	....	3,342	6,320
Perry	1,379,100	1,259,592	1,607,666	1,870,840
Portage	65,647	77,071	70,339	65,163
Scioto	3,650	2,440	....	....
Stark	513,225	391,418	593,422	784,164
Summit	253,148	145,134	82,225	95,815
Tuscarawas	317,141	285,545	267,666	506,466
Trumbull	257,683	264,517	188,531	167,989
Vinton	69,740	77,127	60,013	89,727
Wayne	120,571	81,507	109,057	105,150
Washington	5,600	5,000	5,500	1,880
Total	7,640,062	7,816,179	8,435,211	10,300,807

Counties.	1888.	1889.	1890.	1891.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Athens	1,336,698	1,224,186	1,205,455	1,482,294
Belmont	1,108,106	641,862	774,110	819,236
Carroll	355,097	351,782	328,967	313,543
Columbiana	466,191	596,824	567,595	621,726
Coshocton	167,903	166,599	177,700	189,469
Gallia	16,722	23,208	16,512	17,493
Guernsey	383,728	362,168	413,739	390,418
Harrison	2,865	33,724	8,600	3,960
Hocking	1,086,538	845,049	1,319,427	1,515,719
Holmes	8,121	9,423	....	....
Jackson	1,088,761	926,874	970,878	1,475,939
Jefferson	243,178	271,830	491,172	697,193
Lawrence	137,806	102,656	77,004	76,235
Mahoning	231,035	240,563	256,319	200,734
Medina	198,452	136,061	139,742	160,184
Meigs	242,483	220,277	255,365	282,094
Monroe	....	20,725	1,000	....
Morgan	....	8,060	....	....
Muskingum	211,861	214,005	229,719	160,154
Noble	6,200	38,400	6,850	3,800
Perry	1,736,805	1,565,786	1,921,417	1,785,626
Portage	70,923	78,117	70,666	69,058
Stark	793,227	851,994	836,449	917,995
Summit	112,024	50,726	112,997	140,079
Trumbull	157,826	108,120	47,714	83,950
Tuscarawas	546,117	683,505	589,875	736,297
Vinton	108,695	102,040	80,716	98,166
Washington	2,432	18,045	5,990	5,950
Wayne	91,157	84,178	38,528	21,371
Small mines	....	....	550,000	600,000
Total	10,910,951	9,976,787	11,494,506	12,868,683

From the table above the following statement, showing the annual increase and decrease of coal production in the twenty-nine producing counties for the more recent years, is deduced. In the comparisons between 1888 and 1889 and between 1889 and 1890 an apparent inconsistency appears in the net increase or decrease, due to the inclusion of the outputs of country banks in the product of 1889 and the exclusion of the same factor in the other years.

Comparative statistics, by counties, in Ohio from 1886 to 1891.

Counties.	1887 compared with 1886.		1888 compared with 1887.		1889 compared with 1888. (*a*)	
	Increase.	Decrease.	Increase.	Decrease.	Increase.	Decrease.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Athens	184,497		253,155			112,512
Belmont	147,988		386,339			466,244
Carroll	76,698		61,784			3,315
Columbiana	179,994			49,866	130,633	
Coshocton	71,857		43,112			1,304
Gallia		2,059	1,357		6,486	
Guernsey	119,813			169,885		21,560
Harrison		1,477		1,167	30,859	
Hocking	111,492		233,475			241,489
Holmes		2,144		2,405	1,302	
Jackson	278,865			45,944		161,887
Jefferson	18,209			50,697	28,652	
Lawrence		23,374		5,753		35,150
Mahoning		40,691		41,314	9,528	
Medina		26,924		27,035		62,391
Meigs		7,058	57,278			22,206
Monroe					(*d*) 20,725	
Morgan		270		4,100	(*d*) 8,060	
Muskingum	75,327		39,933		2,144	
Noble	2,978			120	32,200	
Perry	263,175			134,035		171,019
Portage		5,176	5,760		7,194	
Stark	190,742		9,063		58,767	
Summit	13,590		16,209			61,298
Trumbull		20,542		10,163		49,706
Tuscarawas	238,800		39,651		137,388	
Vinton	29,714		18,968			6,655
Washington		3,620	552		15,613	
Wayne		3,907		13,933		6,979
Total	2,003,739	137,242	1,166,636	556,477	489,551	1,423,715
Net increase or decrease	1,866,497		610,159			934,164

Counties.	1890 compared with 1889. (*b*)		1891 compared with 1890.	
	Increase.	Decrease.	Increase.	Decrease.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Athens		18,731	276,839	
Belmont	132,248		45,126	
Carroll		22,815		15,424
Columbiana		29,229	54,131	
Coshocton	11,101		11,769	
Gallia		6,696	981	
Guernsey	51,571			23,321
Harrison		25,124		4,640
Hocking	474,378		196,292	
Holmes		(*c*) 9,423		
Jackson	44,004		505,061	
Jefferson	219,342		206,021	
Lawrence		25,652		769
Mahoning	15,756			55,585
Medina	3,681		20,442	
Meigs	35,088		26,729	
Monroe		19,725		1,000
Morgan		(*c*) 8,060		
Muskingum	15,714			69,565
Noble		31,550		3,050
Perry	355,631			135,791
Portage		7,451		1,608
Stark		15,545	81,546	
Summit	62,271		27,082	
Trumbull		60,406	36,236	
Tuscarawas		173,630	146,422	
Vinton		21,324	17,450	
Washington		12,055		40
Wayne		45,650		17,157
Total	1,420,785	533,066	1,652,127	327,950
Net increase or decrease	887,719		1,324,177	

a Includes product of small banks in 1889 and not in 1888.
b Includes product of small banks in 1889 and not in 1890.
c Product of small banks in 1889 not enumerated in 1890.
d Entire product of 1889; no product reported in 1888.

An idea of the development of the coal-mining industry of Ohio may be obtained from the following statements exhibiting the total annual output of the State for twenty years:

Annual coal product of Ohio from 1872 to 1891.

Years.	Short tons.	Years.	Short tons.
1872	5,315,294	1882	9,450,000
1873	4,550,028	1883	8,229,429
1874	3,267,585	1884	7,640,062
1875	4,864,259	1885	7,816,179
1876	3,500,000	1886	8,435,211
1877	5,250,000	1887	10,300,807
1878	5,500,000	1888	10,910,951
1879	6,000,000	1889	9,976,787
1880	7,000,000	1890	11,494,506
1881	8,225,000	1891	12,868,683

PRODUCTION BY COUNTIES.

There are twenty-nine coal-producing counties in the State, but in two of them (Holmes and Morgan) the output is entirely from country banks and does not come within the scope of this report. In 1891 there were four counties in each of which the total product exceeded 1,000,000 tons; these were Athens, Hocking, Jackson and Perry. Five others, Belmont, Columbiana, Jefferson, Stark and Tuscarawas, exceeded 500,000 short tons each. Three—Carroll, Guernsey and Meigs—produced over 250,000 tons each; and five others—Coshocton, Mahoning, Medina, Muskingum and Summit—are each credited with an output exceeding 100,000 tons.

Athens county.—Coal produced in 1891, 1,482,294 short tons; spot value, $1,257,081.

Athens county comes third in rank among the coal-producing counties of the state, and is one of the four whose output exceeded 1,000,000 tons. Compared with 1890 the output increased 276,839 short tons, or 23 per cent. The value of the product increased $258,078, or 26 per cent. During 1891 a total of 2,702 men were employed and the mines averaged 193 working days compared with 2,122 men and 198 working days in 1890. The coal is sent to market over the following railroads: Baltimore and Ohio Southwestern; Columbus, Hocking Valley and Toledo; Toledo and Ohio Central; Kanawha and Michigan, and Columbus, Shawnee and Hocking.

Coal product of Athens county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	627,944	1888	1,336,698
1885	823,139	1889	1,224,186
1886	899,046	1890	1,205,455
1887	1,083,543	1891	1,482,294

Belmont county.—Coal produced in 1891, 819,236 short tons; spot value, $690,726.

As a coal producer Belmont county ranks sixth in the state. The product in 1891 indicates an increase over that of 1890 of 45,126 short tons, but was still 288,870 tons short of the output in 1888, when it reached its highest notch. Of the product in 1891, 157,923 short tons were consumed in iron and steel works at Bridgeport and Bellaire and by the local trade of those cities and vicinity. Shipments are made by Ohio river and the following railroads: Baltimore and Ohio; Bellaire, Zanesville and Cincinnati; and Cleveland, Lorain and Wheeling. The mines employed 1,276 men and were active an average of 238½ days.

Coal product of Belmont county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	643, 129	1888	1, 108, 106
1885	744, 446	1889	641, 862
1886	573, 779	1890	774, 110
1887	721, 767	1891	819, 236

Carroll county.—Coal produced in 1891, 313,543 short tons; spot value, $254,613.

The output of Carroll county in 1891 was 15,424 short tons less than in 1890, the value decreasing $24,091. In fact, the production has decreased annually since 1888, when the output reached the greatest figure. The railroads handling the traffic are the Cleveland and Canton and the Wheeling and Lake Erie. During 1891, 589 men were employed, the mines operating an average of 200 days, against 642 men for 188 days in 1890.

Coal product of Carroll county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	102, 531	1888	355, 097
1885	150, 695	1889	351, 782
1886	216, 630	1890	328, 967
1887	293, 328	1891	313, 543

Columbiana county.—Coal produced in 1891, 621,726 short tons; spot value, $595,390.

Columbiana county is one of the five counties in the State whose product in 1891 was more than 500,000 tons and less than 1,000,000. In producing importance this county takes ninth place. Compared with 1890 the output increased 54,131 short tons, the gain in value being $77,254. The mines were active an average of 251 days in 1891 and gave employment to 1,031 men, against 987 men and 219 days in 1890. The coal was shipped over the Cleveland and Pittsburg, the New York, Lake Erie and Western, the Pittsburg, Fort Wayne and Chicago, and the Pittsburg, Marion and Chicago railroads.

Coal product of Columbiana county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	469, 708	1888	466, 191
1885	462, 733	1889	596, 824
1886	336, 063	1890	567, 595
1887	516, 057	1891	621, 726

Coshocton county.—Coal produced in 1891, 189,469 short tons; spot value, $189,111.

The product in 1891 shows an increase of 11,769 short tons over that of 1890, and, as indicated in the table below, with the exception of 1886, the annual output has increased each year since 1884. During 1891 the mines gave employment to 284 men and were active an average of 265 days. The Pittsburg, Cincinnati, and Saint Louis and the Chicago and Canada Southern railroads carry the coal to market.

Coal product of Coshocton county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	56, 562	1888	167, 903
1885	99, 609	1889	166, 599
1886	52, 934	1890	177, 700
1887	124, 791	1891	189, 469

Gallia county.—The product reported is from one mine only and amounted to 17,493 short tons against 16,512 short tons in 1890. The coal is shipped over the Columbus, Hocking Valley and Toledo railroad and by the Ohio river.

Guernsey County.—Coal produced in 1891, 390,418 short tons; spot value $306,299.

The output of Guernsey county in 1891 was 23,321 short tons less than in 1890, when it amounted to 413,739 short tons. The corresponding loss to the labor of the county is to be observed in the comparison of the number of men employed and the days the collieries were active during the two years. In 1890 there were 788 men employed and the mines were worked an average of 225 days. In 1891, 810 men were employed for an average of 188 days.

The coal of Guernsey county is shipped over the Baltimore and Ohio and the Columbus and Maysville railroads.

Coal product of Guernsey county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	375, 427	1888	383, 728
1885	297, 267	1889	362, 168
1886	433, 800	1890	413, 739
1887	553, 613	1891	390, 418

Harrison county.—Coal produced in 1891, 3,960 short tons; spot value, $5,860.

Compared with 1890 the output of Harrison county decreased 4,640 short tons, or about 54 per cent. The product is almost entirely from one mine, the remainder being insignificant and mined for local trade.

Coal product of Harrison county, Ohio, since 1886.

Years.	Short tons.	Years.	Short tons.
1886	5,509	1889	33,724
1887	4,032	1890	8,600
1888	2,865	1891	3,960

Hocking county.—Coal produced in 1891, 1,515,719 short tons; spot value, $1,235,017.

Hocking county stands second in the amount of coal produced in 1891, being preceded by Perry county, with an output of 1,785,626 short tons. In the value of the product Hocking county drops to the fourth place, following Athens, Jackson, and Perry counties. The number of mines in Hocking county is comparatively small, while the output is large. Reports are received from ten mines operating in 1891, making an average of 151,572 tons each. The mines of Hocking county are all on the line of the Columbus, Hocking Valley and Toledo railroads, over which the coal is shipped.

Coal product of Hocking county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	372,694	1888	1,086,538
1885	656,441	1889	845,049
1886	741,571	1890	1,319,427
1887	853,063	1891	1,515,719

In 1891 the coal mines of Hocking county gave employment to 1,674 men for an average of 241 days. The greatest number of days worked at any one colliery was 320 and the mines working the least time made 118 days. In 1890, 1,625 men were employed for an average of 240 days.

Jackson county.—Coal produced in 1891, 1,475,939 short tons; spot value, $1,559,547.

Thirty-seven mines contributed to the product reported from Jackson county, making an average of 39,890 tons per mine. In the value of its output, Jackson county ranks first in the State, though only fourth in the number of tons taken out. Compared with 1890, the product increased 505,061 tons and the value $584,655. In 1891, 3,097 men were employed for an average of 189 days, against 2,654 men for 180 days in 1890.

Coal product of Jackson county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	831,720	1888	1,088,761
1885	791,608	1889	926,874
1886	856,740	1890	970,878
1887	1,134,705	1891	1,475,939

The following railroads transport the product of Jackson county: Ohio Southern; Cincinnati, Hamilton and Dayton; Baltimore and Ohio Southwestern; Dayton, Fort Wayne and Chicago.

Jefferson county.—Coal produced in 1891, 697,193 short tons; spot value, $589,667.

The product of Jefferson county in 1891 was 206,021 short tons more than in 1890. The value increased from $409,654 to $589,667, a gain of $180,013. The returns for 1891 cover the output of twenty mines, employing an aggregate of 1,237 men for an average of 235 days. Of the total product 53,958 tons were mined and used by parties operating iron mills or engaged in the manufacture of fire brick and tile. Shipments are made over the Wheeling and Lake Erie; Lake Erie, Alliance and Southern; Pittsburg, Cincinnati and Saint Louis, and the Cleveland and Pittsburg railroads and by the Ohio river.

Coal product of Jefferson county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	316,777	1888	243,178
1885	271,329	1889	271,830
1886	275,666	1890	491,172
1887	293,875	1891	697,193

Lawrence county.—Coal produced in 1891, 76,235 short tons; spot value, $79,143.

The production of coal in this county in 1891 was about the same as in 1890, the difference being only 769 short tons. The value, however, fell off from an average of $1.08 per ton in 1890 to $1.04 in 1891, a total loss of $4,122. Of the total product in 1891, 33,135 short tons were consumed at nail works in Ironton, Ohio, the companies mining their own coal and for their own exclusive use. In such cases the value of the product is taken at the price charged to the mill department. During 1890, the number of tons so mined and consumed was 37,404. Shipments are made over the Scioto Valley railroad and by the Ohio river.

Coal product of Lawrence county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	176,412	1888	137,806
1885	145,916	1889	102,656
1886	166,933	1890	77,004
1887	143,559	1891	76,235

Mahoning county.—Coal produced in 1891, 200,734 short tons; spot value, $270,744.

The output of coal in Mahoning county in 1891 was less than for any year since 1884, the earliest year of which there is official record. Compared with 1890, the product falls off 55,585 short tons, representing a loss in value of $35,889. In 1890 an aggregate of 537 men were employed for an average of 220 days. In 1891 employment was given to 525 men for an average of 233½ days.

The railroads transporting the coal product of Mahoning county are the New York, Lake Erie and Western and the New York, Pennsylvania and Ohio.

Coal product of Mahoning county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	241,599	1888	231,035
1885	275,944	1889	240,563
1886	313,040	1890	256,319
1887	272,349	1891	200,734

Medina county.—Coal produced in 1891, 160,184 short tons; spot value, $185,462.

Four mines, employing 314 men for an average of 221 days, contributed to the product of Medina county in 1891. By comparison there is an increase over 1890 of 20,442 short tons in amount and $17,924 in value, the average price per ton declining from $1.20 to $1.16. The labor employed does not show an increase corresponding to that of the output, but rather shows a greater number of tons produced to the man. In 1890, 310 men were employed for an average of 219 days, indicating an output of 2.06 tons per day per man. For 1891, a rate of 2.30⅘ tons per day per man was sustained, an increase of about one-quarter of a ton a day for each man employed about the mines.

The product is shipped to distant points over the New York, Lake Erie and Western railroad.

Coal product of Medina county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	77,160	1888	198,452
1885	152,721	1889	136,061
1886	252,411	1890	139,742
1887	225,487	1891	160,184

Meigs county.—Coal produced in 1891, 282,094 short tons; spot value, $271,143.

The output of Meigs county in 1891 was 26,729 tons more than in 1890, but the value decreased $45,104, the average price per ton declining from $1.24 in 1890 to 96 cents in 1891. Of the amount produced in

1891, 69,299 tons were consumed at Pomeroy and Syracuse in rolling mills and salt works without being shipped and are included in the table of distribution in the amount sold to local trade. Of the coal shipped the greater part goes by Ohio river boats; the remainder is sent over the Columbus, Hocking Valley and Toledo railroad.

In 1890 the coal mines employed 616 men for an average of 202 days. In 1891, 623 men were employed an average of 190 days.

Product of Meigs county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	248,436	1888	242,483
1885	234,756	1889	220,277
1886	192,263	1890	255,365
1887	185,205	1891	282,094

Muskingum county.—Coal produced in 1891, 160,154 short tons; spot value, $130,674.

In 1890 the product of Muskingum county was 229,719 short tons, valued at $197,640, indicating a loss in the succeeding year's output of 69,565 short tons, with a decrease in value of $66,966. The product in 1891 was obtained from thirteen mines, employing a total of 338 men for an average of 213 days. This was one mine less than reported for 1890, in which year 366 men were employed for an average of 250 days.

Transportation is afforded by the Zanesville and Ohio River, the Columbus, Hocking Valley and Toledo, and the Bellaire, Zanesville and Cincinnati railroads, and the Muskingum river.

Coal product of Muskingum county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	84,398	1888	211,861
1885	86,846	1889	214,005
1886	96,601	1890	229,719
1887	171,928	1891	160,154

Noble county.—The output of 3,800 short tons in 1891 was obtained from two mines and was valued at $4,400. The coal is shipped over the Bellaire, Zanesville and Cincinnati railroad.

Perry county.—Coal produced in 1891, 1,785,626 short tons; spot value $1,483,542.

Perry county is the most important coal producing county in the state so far as amount of output is concerned, but takes second place in the value of the product, following Jackson county. The product in 1891 was from thirty-three mines, employing an aggregate of 3,284 men, who averaged 170 working days. Compared with 1890 the output of Perry county decreased 135,791 short tons in quantity and $159,435 in value.

Transportation is afforded by the Cincinnati and Muskingum Valley, the Baltimore and Ohio, the Columbus, Hocking Valley and Toledo, the Columbus and Eastern, and the Toledo and Ohio Central railroads.

Coal product of Perry county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	1,379,100	1888	1,736,805
1885	1,259,952	1889	1,565,786
1886	1,607,666	1890	1,921,417
1887	1,870,840	1891	1,785,626

Portage county.—Coal produced in 1891, 69,058 short tons; spot value, $104,906.

The output in 1891 was 1,608 short tons less than in 1890, the value declining $8,569. There are but two commercial mines in the county. They employed in 1891, 149 men, and worked an average of 225 days.

Coal product of Portage county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	65,647	1888	70,923
1885	77,071	1889	78,117
1886	70,339	1890	70,666
1887	65,163	1891	69,058

Stark county.—Coal produced in 1891, 917,995 short tons; spot value, $1,148,222.

The output of Stark county in 1891 was 81,546 short tons in excess of 1890, the value increasing $59,244. The number of commercial mines reported was twenty-three, giving employment to 1,952 men for an average of 190 days. In 1890, 1,930 men were employed for an average of 182 days.

The following railroads furnish transportation facilities: Cleveland, Lorain and Wheeling; Wheeling, Lake Erie and Western; Cleveland, Akron and Columbus; Pittsburg, Fort Wayne and Chicago; Cleveland and Western; Cleveland and Canton, and Valley.

Coal product of Stark county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	513,225	1888	793,227
1885	391,418	1889	851,994
1886	593,422	1890	836,449
1887	784,164	1891	917,995

Summit county.—Coal produced in 1891, 140,079 short tons; spot value, $193,380.

Compared with 1890, the output of Summit county in 1891 shows a gain of 27,082 short tons. The value of the product increased $24,209. Five mines contributed to the product and gave employment to 376 men for an average of 194 days, against 389 men for 173 days in 1890.

Transportation is furnished by the Cleveland, Akron and Columbus, and the Valley railroads.

Coal product of Summit county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	253,148	1888	112,024
1885	145,134	1889	50,726
1886	82,225	1890	112,997
1887	95,815	1891	140,079

Trumbull county.—Coal produced in 1891, 83,950 short tons; spot value, $118,286.

Returns for Trumbull county for 1890 were incomplete and the total product reported was probably less than the actual output. The product for 1891 indicates an increase over that reported for 1890 of 36,236 short tons. The value increased $60,573. The labor reported for 1890 aggregated 102 men, averaging 243 days. In 1891, 176 men were employed for an average of 226 days.

The coal of Trumbull county is transported over the New York, Lake Erie and Western and the Lake Shore and Michigan Southern railroads.

Coal product of Trumbull county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	257,683	1888	157,826
1885	264,517	1889	108,120
1886	188,531	1890	47,714
1887	167,989	1891	83,950

Tuscarawas county.—Coal produced in 1891, 736,297 short tons; spot value, $583,206.

The output of Tuscarawas county increased from 589,875 short tons in 1890 to 736,297 short tons in 1891, a gain of 146,422 tons. The value of the product increased from $499,685 to $583,206, a gain of $83,521. In 1890 there were employed 1,082 men, who averaged 196 days, which was increased to 1,161 men for 232 days in 1891. The number of commercial mines reporting in 1891 was 19. Transportation for the product is furnished by the Valley, the Cleveland, Lorain and Wheeling, the Cleveland and Pittsburg, the Pittsburg, Cincinnati and Saint Louis, the Cleveland and Marietta, and the Wheeling and Lake Erie railroads, and by the Ohio canal.

Coal product of Tuscarawas county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	317,141	1888	547,117
1885	285,545	1889	683,505
1886	267,666	1890	589,875
1887	506,466	1891	736,297

Vinton county.—Coal produced in 1891, 98,166 short tons; spot value, $103,148.

Five mines are reported in Vinton county, which gave employment to an aggregate of 197 men for 206 days in 1891. The increase over 1890 in amount of coal produced was 17,450 short tons.

The coal is shipped over the Columbus, Hocking Valley and Toledo, and the Baltimore and Ohio Southwestern railroads.

Coal product of Vinton county, Ohio, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	69,740	1888	108,695
1885	77,127	1889	102,040
1886	60,013	1890	80,716
1887	89,727	1891	98,166

Washington and Wayne counties.—There are three mines of comparatively small importance in Washington county, the one mine in Wayne county producing 80 per cent. of the aggregate output of the two counties. The product in Wayne county is, however, decreasing annually. The output of the two counties amounted to 27,321 short tons in 1891, valued at $30,415.

OREGON.

Total product in 1891, 51,826 short tons; spot value, $155,478.

The production of coal in Oregon is still limited to one locality, at Marchfield in Coos county. The output in 1891 was 9,788 tons less than in 1890, but the average price per ton realized advanced from $2.89 to $3, the highest figure realized since 1888. The coal is lignite of good quality and is shipped by sea, principally to San Francisco. Of the amount produced in 1891, 47,541 tons were shipped to distant points, and 4,285 tons were disposed of locally and used at the mines.

The annual product since 1885 has been as follows:

Coal product of Oregon from 1885 to 1891.

Years.	Short tons.	Years.	Short tons.
1885	50,000	1889	64,359
1886	45,000	1890	61,514
1887	31,696	1891	51,826
1888	75,000		

PENNSYLVANIA.

The total product in 1891, including coal shipped by regular establishments, the amount sold to local trade about the mines, and that consumed at the collieries for steam and heat, and the estimated output of country banks, was 93,453,921 short tons; spot value, $111,215,788. Increase over 1890, 4,683,107 short tons; increase in value, $9,455,100.

Anthracite: Total product in 1891, 45,236,992 long tons, or 50,665,431 short tons; spot value, $73,944,735. Increase over 1890, 3,747,134 long tons, or 4,196,790 short tons. Increase in value, $7,560,963.

Bituminous: Total product in 1891, 42,788,490 short tons; spot value, $37,271,053.

PENNSYLVANIA ANTHRACITE.

[By John H. Jones.]

The anthracite coal fields of Pennsylvania are situated in the eastern part of the State, and extend about equal distances north and south of a line drawn through the middle of the State from east to west, in the counties of Carbon, Columbia, Dauphin, Lackawanna, Luzerne, Northumberland, Schuylkill, and Susquehanna, and known under three general divisions, viz: Wyoming, Lehigh, and Schuylkill regions. Geologically they are divided into five well-defined fields or basins, which are again subdivided, for convenience of identification, into districts, as follows:

Geological fields or basins.	*Local districts.*	*Trade regions.*
Northern	Carbondale	Wyoming.
	Scranton	
	Pittston	
	Wilkesbarre	
	Plymouth	
	Kingston	
Eastern Middle	Green Mountain	Lehigh.
	Black Creek	
	Hazleton	
	Beaver Meadow	
Southern	Panther Creek	
	East Schuylkill	Schuylkill.
	West Schuylkill	
	Lorberry	
	Lykens Valley	
Western Middle	East Mahanoy	
	West Mahanoy	
	Shamokin	

The total production of these fields for the calendar year 1891 amounted to 45,236,992 long tons (or 50,665,431 short tons), the largest output for any one year in the history of the anthracite trade.

Of this product 40,450,543 tons were loaded on cars at the mines for shipment, 941,956 tons sold to local trade and used by employés, and 3,844,493 tons consumed at the mines for steam and heat. This latter item is partly approximated, as much of it was culm and dirt, not included in the mining accounts, and given as "estimated" in the operators' reports. This item is, therefore, not included in the basis of valuation at the mines. Excluding this factor, the marketable product was

41,392,499 long tons (or 46,359,599 short tons), valued at $73,944,735, or an average of $1.79 per ton.

The average number of days worked by the collieries during the year 1891 was 203 and the average number of persons employed 126,350, including superintendents, engineers, clerical force, etc., engaged in and about the mines. The total number of collieries equipped for producing and shipping coal in 1891 was 353, of which 26 were idle during the year. The following table gives a comparison of the total production, value of product at the mines, number of persons employed, and number of days worked during the years 1890 and 1891.

Production of anthracite coal in Pennsylvania in 1890 and 1891.

Years.	Total product.	Value at mines.	Average value.	Number of persons employed.	Number of days worked.
	Long tons.		*Per ton.*		
1890	41,489,858	$66,383,772	$1.73	126,000	200
1891	45,236,992	73,944,735	1.79	126,350	203

The following tables will give a comparison of the production and shipments of anthracite coal, by counties, for the years 1890 and 1891.

Distribution of the anthracite product of Pennsylvania in 1890.

Counties.	Total product of coal of all grades for year 1890.	Disposition of total product.		
		Loaded at mines for shipment on railroad cars.	Used by employés and sold to local trade at mines.	Used for steam and heat at mines.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Susquehanna and Sullivan	419,839	399,315	4,569	15,955
Lackawanna	9,109,330	7,978,765	791,716	338,849
Luzerne	16,892,099	15,189,715	599,968	1,102,416
Carbon	1,252,636	1,101,018	26,195	125,423
Schuylkill	9,228,434	7,996,874	246,086	985,474
Columbia	640,692	550,510	21,026	69,156
Northumberland	3,234,900	2,851,769	66,242	316,889
Dauphin	711,928	549,076	30,708	132,144
Total	41,489,858	36,617,042	1,786,510	3,086,306

Distribution of the anthracite product of Pennsylvania in 1891.

Counties.	Total product of coal of all grades for year 1891.	Disposition of total product.		
		Loaded at mines for shipment on railroad cars.	Used by employés and sold to local trade at mines.	Used for steam and heat at mines.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Susquehanna	366,262	342,037	4,225	20,000
Lackawanna	10,639,276	9,607,754	267,508	764,014
Luzerne	17,404,013	15,677,617	388,029	1,338,367
Carbon	1,266,649	1,129,139	40,794	96,716
Schuylkill	10,358,373	9,163,258	128,471	1,066,644
Columbia	717,008	635,740	7,274	73,994
Northumberland	3,720,844	3,313,431	62,655	344,758
Dauphin	764,567	581,567	43,000	140,000
Total	45,236,992	40,450,543	941,956	3,844,493

The annual shipments of anthracite since 1820 are shown in the appended table, which gives the number of tons and percentages shipped from each region.

Years.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Long tons.	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*	*Per ct.*	*Long tons.*
1820			365				365
1821			1,073				1,073
1822	1,480	39.79	2,240	60.21			3,720
1823	1,128	16.23	5,823	83.77			6,951
1824	1,567	14.10	9,541	85.90			11,108
1825	6,500	18.60	28,393	81.40			34,893
1826	16,767	34.90	31,280	65.10			48,047
1827	31,360	49.44	32,074	50.56			63,434
1828	47,284	61.00	30,232	39.00			77,516
1829	79,973	71.35	25,110	22.40	7,000	6.25	112,083
1830	89,984	51.50	41,750	23.90	43,000	24.60	174,734
1831	81,854	46.29	40,966	23.17	54,000	30.54	176,820
1832	209,271	57.61	70,000	19.27	84,000	23.12	363,271
1833	252,971	51.87	123,001	25.22	111,777	22.91	487,749
1834	226,692	60.19	106,244	28.21	43,700	11.60	376,636
1835	339,508	60.64	131,250	23.41	90,000	16.05	560,758
1836	432,045	63.16	148,211	21.66	103,861	15.18	684,117
1837	530,152	60.98	223,902	25.75	115,387	13.27	869,441
1838	446,875	60.49	213,615	28.92	78,207	10.59	738,697
1839	475,077	58.05	221,025	27.01	122,300	14.94	818,402
1840	490,596	56.75	225,313	26.07	148,470	17.18	864,379
1841	624,466	65.07	143,037	14.90	192,270	20.03	959,773
1842	583,273	52.62	272,540	24.59	252,599	22.79	1,108,412
1843	710,200	56.21	267,793	21.19	285,605	22.60	1,263,598
1844	887,937	54.45	377,002	23.12	365,911	22.43	1,630,850
1845	1,131,724	56.22	429,453	21.33	451,836	22.45	2,013,013
1846	1,308,500	55.82	517,116	22.07	518,389	22.11	2,344,005
1847	1,665,735	57.79	633,507	21.98	583,067	20.23	2,882,309
1848	1,733,721	56.12	670,321	21.70	685,196	22.18	3,089,238
1849	1,728,500	53.30	781,556	24.10	732,910	22.60	3,242,966
1850	1,840,620	54.80	690,456	20.56	827,823	24.64	3,358,899
1851	2,328,525	52.34	964,224	21.68	1,156,167	25.98	4,448,916
1852	2,636,835	52.81	1,072,136	21.47	1,284,500	25.72	4,993,471
1853	2,665,110	51.30	1,054,309	20.29	1,475,732	28.41	5,195,151
1854	3,191,670	53.14	1,207,186	20.13	1,603,478	26.73	6,002,234
1855	3,552,943	53.77	1,284,113	19.43	1,771,511	26.80	6,608,567
1856	3,603,029	52.01	1,351,970	19.52	1,972,581	28.47	6,927,580
1857	3,373,797	50.77	1,318,541	19.84	1,952,603	29.39	6,644,941
1858	3,273,245	47.86	1,380,030	20.18	2,186,094	31.96	6,839,369
1859	3,448,708	44.16	1,628,311	20.86	2,731,236	34.98	7,808,255
1860	3,749,632	44.04	1,821,674	21.40	2,941,817	34.56	8,513,123
1861	3,160,747	39.74	1,738,377	21.85	3,055,140	38.41	7,954,264
1862	3,372,583	42.86	1,351,054	17.17	3,145,770	39.97	7,869,407
1863	3,911,683	40.90	1,894,713	19.80	3,759,610	39.30	9,566,006
1864	4,161,970	40.89	2,054,669	20.19	3,960,836	38.92	10,177,475
1865	4,356,959	45.14	2,040,913	21.14	3,254,519	33.72	9,652,391
1866	5,787,902	45.56	2,179,364	17.15	4,736,616	37.29	12,703,882
1867	5,161,671	39.74	2,502,054	19.27	5,325,000	40.99	12,988,725
1868	5,330,737	38.52	2,502,582	18.13	5,968,146	43.25	13,801,465
1869	5,775,138	41.66	1,949,673	14.06	6,141,369	44.28	13,866,180
1870	4,968,157	30.70	3,239,374	20.02	7,974,660	49.28	16,182,191
1871	6,552,772	41.74	2,235,707	14.24	6,911,242	44.02	15,699,721
1872	6,694,890	34.03	3,873,339	19.70	9,101,549	46.27	19,669,778
1873	7,212,601	33.97	3,705,596	17.46	10,309,755	48.57	21,227,952
1874	6,866,877	34.09	3,773,836	18.73	9,504,408	47.18	20,145,121
1875	6,281,712	31.87	2,834,605	14.38	10,596,155	53.75	19,712,472
1876	6,221,934	33.63	3,854,919	20.84	8,424,158	45.53	18,501,011
1877	8,195,042	39.35	4,332,760	20.80	8,300,377	39.85	20,828,179
1878	6,282,226	35.68	3,237,449	18.40	8,085,587	45.92	17,605,262
1879	8,960,829	34.28	4,595,567	17.58	12,586,293	48.14	26,142,689
1880	7,554,742	32.23	4,463,221	19.05	11,419,279	48.72	23,437,242
1881	9,253,958	32.46	5,294,676	18.58	13,951,383	48.96	28,500,017
1882	9,459,288	32.48	5,689,437	19.54	13,971,371	47.98	29,120,096
1883	10,074,726	31.69	6,113,809	19.23	15,604,492	49.08	31,793,027
1884	9,478,314	30.85	5,562,226	18.11	(*a*)15,677,753	51.04	30,718,293
1885	9,488,426	30.01	5,898,634	18.65	(*a*)16,236,470	51.34	31,623,530
1886	9,381,407	29.19	5,723,129	17.89	(*a*)17,031,826	52.82	32,136,362
1887	10,609,028	30.63	4,347,061	12.55	(*a*)19,684,929	56.82	34,641,018
1888	10,654,116	27.93	5,639,236	14.78	(*a*)21,852,366	57.29	38,145,718
1889	10,486,185	29.28	6,294,073	17.57	(*a*)19,036,835	53.15	35,817,093
1890	10,867,822	29.68	6,329,658	17.28	(*a*)19,417,979	53.04	36,615,459
1891	12,741,258	31.50	6,381,838	15.78	(*a*)21,325,240	52.72	40,448,336
Total	277,104,954	35.54	141,210,232	18.11	361,324,140	46.35	779,639,326

a Includes Loyalsock field.

The figures in the above table represent the actual shipments of coal and do not include the quantity used about the mines and sold to the local trade.

The largest actual shipments ever made in each of the months of any year to December, 1891, inclusive, are given in the table below, and show that if the mines should be operated as actively in each month of the year as they ever have been in that month the shipments for the year would be 42,594,894 tons.

Years.	Months.	Tonnage.
1891	January	3,138,961
1887	February	2,551,003
1887	March	2,911,272
1888	April	2,856,593
1891	May	3,339,534
1891	June	3,780,242
1891	July	3,791,339
1888	August	4,097,563
1888	September	3,916,325
1891	October	4,496,534
1891	November	4,127,557
1891	December	3,587,971
	Maximum yearly shipment practicable	42,594,894

Average monthly tonnage based upon the largest shipments ever made, 3,549,575.

The initial lines of transportation from the anthracite-coal fields are operated by the following companies:

Delaware, Lackawanna and Western Railroad Company.
New York, Susquehanna and Western Railroad Company.
New York, Ontario and Western Railroad Company.
Delaware and Hudson Canal Company.
Erie and Wyoming Valley Railroad Company.
Central Railroad Company of New Jersey.
Lehigh Valley Railroad Company (Philadelphia and Reading Railroad Company, lessees).
Pennsylvania Railroad Company.
Philadelphia and Reading Railroad Company.
New York, Lake Erie and Western Railroad Company.
Delaware, Susquehanna and Schuylkill Railroad Company.

The following table, partly approximated, gives a comparison of the distribution of anthracite coal for years 1890 and 1891, showing the percentages of the total shipments consumed in the several sections of the United States:

Distribution of anthracite coal for consumption in 1890 and 1891.

Regions.	Year 1890.		Year 1891.	
	Long tons.	Per cent.	Long tons.	Per cent.
Pennsylvania, New York, and New Jersey	22,719,221	62.05	24,734,103	61.15
New England States	5,442,556	14.86	6,187,665	15.30
Western States	5,459,320	14.91	6,249,526	15.45
Southern States, including Delaware, Maryland, and District of Columbia	1,742,521	4.76	1,826,298	4.51
Pacific coast	11,100	0.03	15,001	0.04
Dominion of Canada	1,196,788	3.27	1,393,998	3.44
Foreign ports	45,536	0.12	43,952	0.11
Totals	36,617,042	100.00	40,450,543	100.00

As will be seen in the above table, the greatest relative increase in consumption has taken place in the western states, although the eastern middle states show the greatest actual increase in tons; their percentage however remains about the same.

In the report for 1890, mention was made of the fact that the governor of Pennsylvania had appointed a commission to look into the matter of utilizing the immense deposits of culm throughout the anthracite regions. Considerable progress has been made during the last year in the investigations upon this subject by the commission, but no definite report has been made public. There are at present quite a number of plants established in different parts of the anthracite field, with facilities for preparing for market the coal contained in these dumps. At some points two or three sizes are prepared suitable for domestic uses, in addition to the pea, buckwheat, and culm secured, and the coal so reclaimed is increasing in quantity each year. The smaller sizes of anthracite, forming so large a percentage of the entire production, are being placed upon the market with marked success in competition with bituminous coal for steam-raising purposes.

In 1891 the legislature of Pennsylvania passed a new anthracite mining law, among the numerous provisions of which was one increasing the number of mine-inspectors' districts in the anthracite regions from seven to eight and appointing an extra inspector for the new district.

Several important collieries in course of construction in 1890 have been completed and put into operation during the year 1891. In some cases entirely new developments have been made; in others, old abandoned workings have been reopened and improved methods and machinery adopted, whereby immense bodies of coal will be secured which under the old systems were inaccessible.

The Delaware, Susquehanna and Schuylkill railroad, which connects all the collieries operated by Messrs. Coxe Bros. & Co., and which affords outlets for their product over either the Pennsylvania Central railroad of New Jersey, or Lehigh Valley railroad, was completed and put into operation during the year. The Philadelphia and Reading Railroad Company completed their Tamaqua, Hazleton and Northern branch, which connects with the Delaware, Susquehanna and Schuylkill railroad, establishing an outlet over the Pennsylvania and Reading railroad in addition to the three roads above named.

Following is a list of the collieries in the anthracite coal regions of Pennsylvania.

Directory of anthracite coal mines in Pennsylvania.

NORTHERN COAL FIELD.

Map Nos.	Names of mines.	Locations.					Operators.	
		Local districts.	Inspector's districts.	Counties.	Railroads.	Nearest stations.	Names.	Post-office addresses.
15	Erie	Carbondale	1	Lackawanna	D. & H. C. Co. R. R	Glenwood	Hillside Coal and Iron Co	Scranton.
16	Glenwood	do	1	do	do	do	do	Do.
17	Keystone	do	1	do	do	Archbald	do	Do.
21	Eaton	do	1	do	do	do	Jones, Simpson & Co	Archbald.
23	Pierce	do	1	do	D., L. & W. R. R	Winton	Pierce Coal Co., limited	Winton.
18	Edgerton	do	1	do	D. & H. C. Co. R. R	Jermyn	Edgerton Coal Co., limited	Jermyn.
6	Elk Creek	do	1	do	N. Y., L. E. & W. R. R	Carbondale	The Frisbie Coal Co	Elmira, N. Y.
25	Sterrick Creek	do	1	do	D. & H. C. Co. R. R	Winton	Sterrick Creek Coal Co	Peckville.
36	Jermyn No. 3	do	1	do	N. Y., S. & W. R. R., and N. Y., O. & W. R. R.	Dickson	John Jermyn	Scranton.
35	Jermyn No. 4	do	1	do	do	do	do	Do.
28	Marshwood	do	1	do	D. & H. C. Co. R. R	Peckville	Moosic Mountain Coal Co	Marshwood.
43	Murray	do	1	do	D., L. & W. R. R	Scranton	Murray, Carney & Co	Dunmore.
5	Simpson	do	1	do	N. Y., L. E. & W. R. R	Carbondale	Simpson & Watkins	Scranton.
27	White	do	1	do	N. Y., S. & W. R. R	Winton	Winton Coal Co., limited	Do.
24	Mount Jessup	do	1	do	D., L. & W. R. R., and N. Y., O. & W. R. R.	do	Mount Jessup Coal Co., limited.	Peckville.
7	Ben Carbon	do	1	do	N. Y., L. E. & W. R. R	Carbondale	Chas. Hutchinson	Kingston.
8	Watkins	do	1	do	D. & H. C. Co. R. R	do	Stroud & Chamberlain	Carbondale.
33	Olyphant No. 2	do	1	do	do	Olyphant	Delaware and Hudson Canal Co.	Scranton.
34	Eddy Creek	do	1	do	do	do	do	Do.
29	Grassy Island	do	1	do	do	do	do	Do.
20	White Oak	do	1	do	do	Archbald	do	Do.
19	Jermyn Shaft	do	1	do	do	Jermyn	do	Do.
11	Coal Brook	do	1	do	do	Carbondale	do	Do.
12	No. 1 Shaft	do	1	do	do	do	do	Do.
13	No. 3 Shaft	do	1	do	do	do	do	Do.
10	Racket Brook	do	1	do	do	do	do	Do.
14	Powderly	do	1	do	do	do	do	Do.
3	Clinton Tunnel	do	1	do	N. Y., L. E. & W. R. R	Forest City	do	Do.
9	Fall Brook	do	1	do	D. & H. C. Co. R. R	Carbondale	John Murrin	Carbondale.
26	Dolph	do	1	do	N. Y., S. & W. R. R	Jessup	Dolph Coal Co., limited	Scranton.
32	Lackawanna	do	1	do	do	Olyphant	Lackawanna Coal Co., limited	Do.
31	Ontario No. 1 & Stg's	do	1	do	N. Y., O. & W. R. R	Peckville	New York and Scranton Coal Co	Peckville.
2	Forest City	do	1	Susquehanna	N. Y., L. E. & W. R. R	Forest City	Hillside Coal and Iron Co	Scranton.
1	Clifford	do	1	do	do	do	do	Do.
	Riverside	do	1	Lackawanna	N. Y., O. & W. R. R	Winton	Riverside Coal Co	Do.

Directory of anthracite coal mines in Pennsylvania—Continued.

NORTHERN COAL FIELDS—Continued.

Map Nos.	Names of mines.	Locations.					Operators.	
		Local districts.	Inspector's districts.	Counties.	Railroads.	Nearest stations.	Names.	Post-office addresses.
69	Archbald	Scranton	2	Lackawanna	D., L. & W. R. R	Scranton	D., L. & W. R. R. Co	Scranton.
63	Bellevue	do	2	do	do	Bellevue	do	Do.
60	Brisbin	do	2	do	do	Scranton	do	Do.
59	Cayuga	do	2	do	do	do	do	Do.
66	Central	do	2	do	do	do	do	Do.
68	Continental	do	2	do	do	do	do	Do.
64	Dodge	do	2	do	do	Bellevue	do	Do.
67	Hampton	do	2	do	do	Scranton	do	Do.
71	Holden	do	2	do	do	Taylorville	do	Do.
65	Hyde Park	do	2	do	do	Scranton	do	Do.
62	Oxford	do	2	do	do	do	do	Do.
73	Pyne	do	2	do	do	Taylorville	do	Do.
70	Sloan	do	2	do	do	Scranton	do	Do.
44	Storrs	do	2	do	do	Priceville	do	Do.
72	Taylor	do	2	do	do	Taylorville	do	Do.
61	{Diamond No. 1	do	2	do	do	Scranton	do	Do.
	{Diamond No. 2	do	2	do	do	do	do	Do.
	{Tripp Shaft	do	2	do	do	do	do	Do.
38	Dunmore No. 1	do	1	do	E. & W. V. R. R	Dunmore	Pennsylvania Coal Co	Dunmore.
41	Dunmore No. 5	do	2	do	do	do	do	Do.
	Bunker Hill	do	2	do	do	do	do	Do.
30	Rushbrook	do	1	do	N. Y., O. & W. R. R	Peckville	Blue Ridge Coal Co	Peckville.
	Austin	do	2	do	L. V. R. R.	Lackawanna	Austin Coal Co	Scranton.
40	{Gypsy Grove, No. 3	do	1	do	E. & W. V. R. R	Dunmore	Pennsylvania Coal Co	Dunmore.
	{Gypsy Grove, No. 4	do	1	do	do	do	do	Do.
52	Pine Brook	do	2	do	D., L. & W. R. R	Scranton	Lackawanna Iron and Coal Co	Scranton.
53	Capouse	do	2	do	do	do	do	Do.
55	Church	do	2	do	do	Green Ridge	Church Coal Co., Limited	Do.
54	Clark Tunnel	do	2	do	do	Scranton	James Flynn	Do.
76	Greenwood No. 1	do	2	do	do	Peckville	Greenwood Coal Co., Limited	Do.
77	Greenwood No. 2	do	2	do	do	Minooka	do	Do.
80	Jermyn Nos. 1 and 2	do	2	do	do	Taylorville	Jermyn & Co	Do.
37	Pancoast	do	1	do	do	Dickson City	Pancoast Coal Co	Do.
56	Providence	do	2	do	do	Green Ridge	Providence Coal Co., Limited	Do.
79	Sibley	do	2	do	do	Lackawanna	Elliott, McClure & Co	Do.
42	Spencer	do	2	do	do	Dunmore	A. D. & F. M. Spencer	Dunmore.
	Tripp	do	2	do	do	Providence	Tripp & Co	Scranton.

74	Meadow Brook	do	2	do	do	Taylorville	William Connell & Co	Do.
75	National	do	2	do	do	do	do	Do.
	Stafford	do	2	do	do	do	do	Do.
49	Manville (*a*)	do	2	do	D. & H. C. Co. R. R	Green Ridge	Delaware and Hudson Canal Co.	Do.
46	Leggitt Creek	do	2	do	do	Providence	do	Do.
45	Marvine	do	2	do	do	do	do	Do.
48	Von Storch	do	2	do	do	do	do	Do.
47	Dickson	do	2	do	do	Green Ridge	do	Do.
50	Green Ridge	do	2	do	do	do	O. S. Johnson	Do.
	Richmond	do	2	do	do	Providence	Elk Hill Coal and Iron Co	Do.
57	Mount Pleasant	do	2	do	D., L. & W. R. R	Scranton	Wm. T. Smith	Do.
81	William A	Pittston	2	do	L. V. R. R	Lackawanna	Connell Coal Co	Do.
88	Katydid	do	3	do	E. & W. V. R. R	Moosic	Robertson & Law	Moosic.
87	Central No. 13	do	3	do	do	Pleasant Valley	Pennsylvania Coal Co	Dunmore.
	Law Shaft	do	3	do	do	do	do	Do.
86	Old Forge	do	2	do	do	Lackawanna	do	Do.
109	Ewen Breaker	do	3	Luzerne	do	Pittston	do	Do.
	Shaft No. 4	do	3	do	do	do	do	Do.
110	Breaker No. 6	do	3	do	do	Port Blanchard	do	Do.
	Breaker No. 8	do	3	do	do	Pittston	do	Do.
99	Breaker No. 10	do	3	do	do	do	do	Do.
111	Breaker No. 14	do	3	do	do	Port Blanchard	do	Do.
100	Barnum	do	3	do	do	Pittston Junction	do	Do.
112	Annora	do	3	do	C. R. R. of N. J	Laflin	Annora Coal Co	Wilkesbarre.
91	Avoca	do	3	do	L. V. R. R	Avoca	Avoca Coal Co., Limited	Avoca.
90	Langcliffe	do	3	do	do	do	Langcliffe Coal Co	Do.
101	Twin	do	3	do	do	Pittston	Newton Coal Mining Co	Pittston.
	Ravine	do	3	do	do	do	do	Do.
102	Seneca	do	3	do	do	do	do	Do.
98	Mosier	do	3	do	do	do	do	Do.
108	Hunt	do	3	do	D., L. & W. R. R	Wyoming	Delaware, Lackawanna and Western Railroad Co.	Scranton.
83	Hallstead	do	3	do	do	Duryea	do	Do.
95	Butler	do	3	do	L. V. R. R	Pittston	Butler Mine Co., Limited	Pittston.
97	Fernwood	do	3	do	do	Yatesville	do	Do.
106	Schooley	do	3	do	do	West Pittston	do	Do.
84	Columbia	do	3	do	D., L. & W. and L. V. R. R	Duryea	Old Forge Coal Co	Do.
85	Phœnix	do	3	do	do	do	do	Do.
82	Babylon	do	3	do	L. V. R. R	Coxton	Babylon Coal Co	Scranton.
89	Consolidated	do	3	do	E. & W. V. R. R	Moosic	Hillside Coal and Iron Co	Do.
103	Clear Spring	do	3	do	D., L. & W. R. R	West Pittston	Clear Spring Coal Co	Pittston.
94	Elmwood	do	3	do	L. V. R. R	Avoca	Florence Coal Co., Limited	Dupont.
96	Fairmount	do	3	do	D. & H. C. Co. R. R	Pittston	W. M. Mallory, Est	Pittston.
113	Keystone	do	3	do	do	Mill Creek	Keystone Coal Co	Wilkesbarre.
104	Stevens	do	3	do	L. V. R. R	Exeter	Stevens Coal Co	Scranton.
107	Mount Lookout	do	3	do	D., L. & W. and L. V. R. R	do	Mount Lookout Coal Co	Do.
	Morning Star	do	3	do	L. V. R. R	Wyoming	J. A. Hutchins	Wyoming.
105	Exeter	do	3	do	do	West Pittston	Lehigh Valley Coal Co	Wilkesbarre.
92	Heidelberg No. 1	do	3	do	do	do	do	Do.
93	Heidelberg No. 2	do	3	do	do	do	do	Do.

a Operated jointly with D., L. & W. R. R. Co.

Directory of anthracite coal mines in Pennsylvania—Continued.

NORTHERN COAL FIELD—Continued.

Map Nos.	Names of mines.	Locations.					Operators.	
		Local districts.	Inspector's districts.	Counties.	Railroads.	Nearest stations.	Names.	Post-office addresses.
	Spring Brook	Pittston	3	Luzerne	D. & H. C. Co. R. R.	Moosic	Whitney & Kemmerer	Philadelphia.
133	Diamond No. 1	Wilkesbarre	4	do	C. R. R. of New Jersey	Ashley	Lehigh and Wilkesbarre Coal Co.	Wilkesbarre.
132	Hollenback No. 2	do	4	do	do	Wilkesbarre	do	Do.
134	Empire No. 4	do	4	do	do	Ashley	do	Do.
137	S. Wilkesbarre No. 5	do	4	do	do	S. Wilkesbarre	do	Do.
135	Stanton No. 7	do	4	do	do	Ashley	do	Do.
138	Jersey No. 8	do	4	do	do	do	do	Do.
139	Sugar Notch, No. 9	do	4	do	do	Sugar Notch	do	Do.
143	Wanamie, No. 18	do	4	do	do	Wanamie	do	Do.
142	Alden	do	4	do	do	Alden	Alden Coal Co	Alden.
148	Newport, No. 1	do	4	do	do	Lee	Newport Coal Co	Wilkesbarre.
130	Red Ash, No. 1	do	4	do	do	Ashley	Red Ash Coal Co	Do.
131	Red Ash, No. 2	do	4	do	do	do	do	Do.
144	Colliery, No. 1	do	4	do	P. R. R.	Nanticoke	Susquehanna Coal Co	Do.
145	Colliery, No. 2	do	4	do	do	do	do	Do.
146	Colliery, No. 5	do	4	do	do	do	do	Do.
147	Colliery, No. 6	do	4	do	do	Glen Lyon	do	Do.
117	Bennett	do	3	do	C. R. R. of New Jersey	Mill Creek	Thomas Waddell & Co	Pittston.
141	Warrier Run	do	4	do	L. V. R. R	Warrior Run	A. J. Davis	Wilkesbarre.
149	West End, No. 1	do	4	do	P. R. R.	Mocanaqua	West End Coal Co	Shickshinny.
140	Maffett	do	4	do	C. R. R. of New Jersey	Sugar Notch	Hanover Coal Co	Wilkesbarre.
118	Abbott	do	3	do	L. V. R. R.	Miners Mills	P. J. Mallory	Do.
129	Hillman Vein	do	3	do	do	Wilkesbarre	Hillman Vein Coal Co	Do.
136	Franklin	do	4	do	do	Ashley	Lehigh Valley Coal Co	Do.
119	Enterprise	do	3	do	do	Port Bowkley	do	Do.
120	Henry	do	3	do	do	do	do	Do.
	Midvale	do	3	do	do	do	do	Do.
124	Mineral Spring	do	3	do	do	Wilkesbarre	do	Do.
122	Prospect	do	3	do	do	do	do	Do.
123	Dorrance	do	3	do	do	do	do	Do.
121	Wyoming	do	3	do	do	Port Bowkley	do	Do.
115	Mill Creek	do	3	do	D. & H. C. Co. R. R.	Mill Creek	Delaware & Hudson Canal Co	Scranton.
116	Pine Ridge	do	3	do	do	Miners Mills	do	Do.
125	Laurel Run	do	3	do	do	Parsons	do	Do.
126	Baltimore Slope	do	3	do	do	do	do	Do.
	Baltimore Red Ash, No. 2.	do	3	do	do	do	do	Do.

127	Baltimore Tunnel	do	3	do	do	Wilkesbarre	do	Do.
128	Conyngham	do	3	do	do	do	do	Do.
114	Delaware	do	3	do	do	Mill Creek	do	Do.
168	Lance, No. 11	Plymouth	4	do	D., L. & W. R. R	Plymouth	Lehigh & Wilkesbarre Coal Co	Wilkesbarre.
169	Nottingham, No. 15	do	4	do	do	do	do	Do.
170	Reynolds, No. 16	do	4	do	do	do	do	Do.
172	Avondale	do	4	do	do	Avondale	D., L. & W. R. R. Co	Scranton.
160	Woodward	do	4	do	do	Kingston	do	Do.
166	Dodson	do	4	do	do	Plymouth	John C. Haddock	Wilkesbarre.
155	East Boston	do	3	do	do	Kingston	W. G. Payne & Co	Kingston.
171	Parrish	do	4	do	do	Plymouth	Parrish Coal Co	Plymouth.
173	Colliery, No. 3	do	4	do	do	West Nanticoke	Susquehanna Coal Co	Wilkesbarre.
	Salem	do	4	do	do	Shickshinny	E. S. Stackhouse	Shickshinny.
161	Boston	do	4	do	D. & H. C. Co. R. R	Plymouth	Delaware & Hudson Canal Co	Scranton.
162	Plymouth, No. 2	do	4	do	do	do	do	Do.
163	Plymouth, No. 3	do	4	do	do	do	do	Do.
164	Plymouth, No. 4	do	4	do	do	do	do	Do.
165	Plymouth, No. 5	do	4	do	do	do	do	Do.
159	Pettebone	Kingston	3	do	D., L. & W. R. R	Bennett	D., L. & W. R. R. Co	Do.
156	Kingston, No. 1	do	3	do	do	Kingston	Kingston Coal Co	Kingston.
158	{Kingston, No. 2	do	3	do	do	do	do	Do.
	{Kingston, No. 3	do	3	do	do	do	do	Do.
157	Kingston, No. 4	do	3	do	do	do	do	Do.
167	Gaylord	do	4	do	do	Plymouth	do	Do.
152	Harry E	do	3	do	do	Bennett	Wyoming Valley Coal Co	Wilkesbarre.
151	Harry E., No. 2	do	3	do	do	Maltby	do	Do.
154	Black Diamond	do	3	do	do	Kingston	John C. Haddock	Do.
153	Mill Hollow	do	3	do	do	Bennett	Thomas Waddell	Pittston.
150	Maltby	do	3	do	do	Maltby	Lehigh Valley Coal Co	Wilkesbarre.

EASTERN MIDDLE COAL FIELD.

175	Upper Lehigh, No. 2	Green Mountain	5	Luzerne	C. R. R. of New Jersey	Upper Lehigh	Upper Lehigh Coal Co	Upper Lehigh.
176	Upper Lehigh, No. 4	do	5	do	do	do	do	Do.
191	Milnesville	Black Creek	5	do	L. V. R. R	Hazleton	A. S. Van Wickle & Co	Milnesville.
188	Lattimer, No. 1 }							
189	Lattimer, No. 2 }	do	5	do	do	do	Pardee Bros. & Co	Hazleton.
190	Lattimer, No. 3 }							
192	Hollywood	do	5	do	do	do	Calvin Pardee & Co	Do.
177	Sandy Run	do	5	do	C. R. R. of New Jersey	Sandy Run	M. S. Kemmerer & Co	Sandy Run.
178	Highland, No. 1	do	5	do	L. V. R. R	Highland	G. B. Markle & Co	Jeddo.
179	Highland, No. 2	do	5	do	do	do	do	Do.
184	Jeddo, No. 3	do	5	do	do	Jeddo	do	Do.
185	Jeddo, No. 4	do	5	do	do	do	do	Do.
195	Deringer	do	5	do	D. S. & S. R. R	Deringer	Coxe Bros. & Co	Drifton.
180	Drifton, No. 1	do	5	do	do	Drifton	do	Do.
181	Drifton, No. 2	do	5	do	do	do	do	Do.
	Drifton, No. 3	do	5	do	do	do	do	Do.

Directory of anthracite coal mines in Pennsylvania—Continued.

EASTERN MIDDLE COAL FIELD—Continued.

Map Nos.	Names of mines.	Locations.					Operators.	
		Local districts.	Inspector's districts.	Counties.	Railroads.	Nearest stations.	Names.	Post-office addresses.
183	Eckley, No. 5	Black Creek	5	Luzerne	D. S. & S. R. R	Eckley	Coxe Bros. & Co.	Drifton.
182	Eckley, No. 10	do	5	do	do	do	do	Do.
196	Gowen	do	5	do	do	Gowen	do	Do.
194	Tomhicken	do	5	do	do	Tomhicken	do	Do.
	Oneida, Nos. 1, 2, & 3	do	5	do	do	Oneida	do	Do.
197	Hazlebrook	Hazleton	5	do	L. V. R. R	Hazlebrook	J. S. Wentz & Co	Mauch Chunk.
209	Humboldt	do	5	do	do	Hazleton	Linderman, Skeer & Co	South Bethlehem.
201	East Sugar Loaf, No. 1.	do	5	do	do	Stockton	do	Do.
200	East Sugar Loaf, No. 2.	do	5	do	do	do	do	Do.
199	East Sugar Loaf, No. 5.	do	5	do	do	do	do	Do.
208	Harwood	do	5	do	D. S. & S. R. R	Hazleton	Pardee Sons & Co	Harwood Mines.
198	Stockton	do	5	do	do	Stockton	Coxe Bros. & Co	Drifton.
207	Cranberry	do	5	do	L. V. R. R	Hazleton	A. Pardee & Co	Hazleton.
205	Hazleton, No. 1	do	5	do	do	do	do	Do.
204	Hazleton, No. 2	do	5	do	do	do	do	Do.
206	Hazleton, No. 3	do	5	do	do	do	do	Do.
203	Laurel Hill	do	5	do	do	do	do	Do.
202	South Sugar Loaf	do	5	do	do	do	do	Do.
217	Beaver Brook	Beaver Meadow	5	do	L. V. & C. R. R. of New Jersey	Audenried	C. M. Dodson & Co	Audenried.
211	Beaver Meadow	do	5	Carbon	do	Beaver Meadow	Coxe Bros. & Co	Drifton
218	Honeybrook, No. 2	do	5	do	C. R. R. of New Jersey	Audenried	Lehigh and Wilkesbarre Coal Co.	Wilkesbarre.
219	Honeybrook, No. 4	do	6	Schuylkill	do	do	do	Do.
220	Honeybrook, No. 5	do	6	do	do	do	do	Do.
221	Silver Brook, Nos. 1 and 2.	do	6	do	L. V. R. R	Silver Brook	Silver Brook Coal Co	Mauch Chunk.
	Washery, No. 1	do	6	do	C. R. R. of New Jersey	Audenried	Lehigh and Wilkesbarre Coal Co.	Wilkesbarre.
	Washery, No. 2	do	5	Carbon	do	Treskow	do	Do.
212	Coleraine	do	5	do	L. V. R. R	Beaver Meadow	W. T. Carter & Co	Philadelphia.
210	Evans	do	5	do	do	do	Evans Coal Co	Beaver Meadow.
216	Spring Brook	do	5	do	do	Audenried	George H. Myers & Co	Wilkesbarre.
213	Spring Mount, No. 1	do	5	do	do	Jeansville	J. C. Haydon & Co	Jeansville.
214	Spring Mount, No. 4	do	5	Luzerne	do	do	do	Do.

WESTERN MIDDLE COAL FIELD.

235	Ellangowan	East Mahanoy	6	Schuylkill	P. & R. R. R	St. Nicholas	Philadelphia and Reading Coal and Iron Co.	Pottsville.
230	Elmwood	do	6	do	do	Mahanoy City	do	Do.
236	Knickerbocker	do	6	do	do	Yatesville	do	Do.
229	Mahanoy City	do	6	do	do	Mahanoy City	do	Do.
228	North Mahanoy	do	6	do	do	do	do	Do.
227	Schuylkill	do	6	do	do	do	do	Do.
233	Suffolk	do	6	do	do	St. Nicholas	do	Do.
232	St. Nicholas	do	6	do	do	do	do	Do,
231	Tunnel Ridge	do	6	do	do	Mahanoy City	do	Do.
225	Glendon	do	6	do	L. V. R. R	do	J. C. Haydon & Co	Jeansville.
330	Middle Lehigh	do	7	do	do	New Boston	Mill Creek Coal Co	New Boston.
223	Buck Mountain	do	6	do	do	Buck Mountain	do	Do.
331	Morea	do	8	do	P. R. R., & L. V. R. R	Morea	Dodson Coal Co	Morea Colliery.
222	Park, No. 2	do	6	do	L. V. R. R.	Park Place	Lentz, Lilly & Co	Park Place.
226	Springdale	do	6	do	do	do	do	Do.
224	Primrose	do	6	do	do	Mahanoy City	Primrose Coal Co.	New York City.
234	Maple Hill	do	6	do	P. & R. R. R	St. Nicholas	P. & R. Coal and Iron Co	Pottsville.
284	Alaska	West Mahanoy	7	Northumberland	do	Alaska	do	Do.
283	Locust Gap	do	7	do	do	Locust Gap	do	Do.
282	Locust Spring	do	7	do	do	do	do	Do.
279	Merriam	do	7	do	do	Locust Summit	do	Do.
280	Monitor	do	7	do	do	Locust Gap	do	Do.
281	Reliance	do	7	do	do	Mount Carmel	do	Do.
285	Black Diamond	do	7	do	L. V. & N. C. Rwy	do	Ferndale Coal Co	Mt. Carmel.
276	Mount Carmel	do	7	do	P. & R., N. C., & L. V. R. R	do	Thomas M. Righter & Co	Do.
274	Bellmore (*a*)	do	7	Columbia	L. V. R. R.	do	S. S. Bickel & Co.	Do.
271	Centralia	do	7	do	do	Centralia	Lewis A. Riley & Co.	Centralia.
272	Logan	do	7	do	do	do	do	Do.
273	Morris Ridge	do	7	do	do	Mount Carmel	May, Troutman & Co	Shamokin.
268	North Ashland	do	7	do	P. & R. R. R	Continental	P. & R. Coal and Iron Co	Pottsville.
278	Potts	do	7	do	do	Locust Dale	do	Do.
270	Continental (*b*)	do	7	do	L. V. R. R.	Centralia	Lehigh Valley Coal Co.	Wilkesbarre.
	Locust Run	do	7	Schuylkill	P. & R. R. R.	Ashland	P. & R. Coal and Iron Co	Pottsville.
267	Bast	do	7	do	do	do	do	Do.
247	Bear Ridge	do	6	do	do	Mahanoy Plane	do	Do.
238	Boston Run	do	6	do	do	St. Nicholas	do	Do.
237	Bear Run	do	6	do	do	do	do	Do.
241	Gilberton	do	6	do	do	Gilberton	do	Do.
	Sidney	do	6	do	do	Maizeville	Sidney Coal Co	Mahanoy Plane.
260	Girard Mammoth	do	6	do	do	Raven Run	P. & R. Coal and Iron Co	Pottsville.
263	Girard	do	6	do	do	Girardville	do	Do.
262	Hammond	do	6	do	do	Conner	do	Do.
248	Indian Ridge	do	6	do	do	Shenandoah	do	Do.
252	Kohinoor	do	6	do	do	do	do	Do.
277	Keystone	do	7	do	do	Locust Dale	do	Do.
249	Shenandoah City	do	6	do	do	Shenandoah	do	Do.

a The mine extends into Northumberland county.

b Idle in 1891.

Directory of anthracite coal mines in Pennsylvania—Continued.

WESTERN MIDDLE COAL FIELD—Continued.

Map Nos.	Names of mines.	Locations.					Operators.	
		Local districts.	Inspector's districts.	Counties.	Railroads.	Nearest stations.	Names.	Post-office addresses.
266	Tunnel	West Mahanoy	7	Schuylkill	P. & R. R. R	Ashland	P. & R. Coal and Iron Co	Pottsville.
250	Turkey Run	do	6	do	do	Shenandoah	do	Do.
251	West Shenandoah	do	6	do	do	do	do	Do.
264	Preston, No. 2	do	7	do	do	Girardville	do	Do.
265	Preston, No. 3	do	7	do	do	do	do	Do.
269	Big Mine Run	do	7	do	do	Ashland	A. Taylor	Ashland.
253	Cambridge	do	6	do	do	Shenandoah	Cambridge Coal Co	Shenandoah.
242	Draper	do	6	do	do	Gilberton	P. & R. Coal and Iron Co	Pottsville.
239	Furnace	do	6	do	do	do	Furnace Coal Co	Gilberton.
254	Kehley Run	do	6	do	do	Shenandoah	Thomas Coal Co	Philadelphia.
245	Lawrence	do	6	do	do	Mahanoy Plane	Simon Moore & Co	Mahanoy Plane.
255	William Penn	do	6	do	do	Shaft	William Penn Coal Co	Shaft.
258	Packer, No. 2	do	6	do	L. V. R. R	Lost Creek	Lehigh Valley Coal Co	Wilkesbarre.
256	Packer, No. 3	do	6	do	do	Shenandoah	do	Do.
257	Packer No. 4	do	6	do	do	do	do	Do.
259	Packer No. 5	do	6	do	do	Girardville	do	Do.
305	Bear Valley	Shamokin	7	Northumberland	P. & R. R. R	Shamokin	P. & R. Coal and Iron Co	Pottsville.
293	Buck Ridge	do	7	do	do	Greenback	do	Do.
304	Burnside	do	7	do	do	Shamokin	do	Do.
299	Henry Clay	do	7	do	do	do	do	Do.
306	North Franklin	do	7	do	do	Treverton	do	Do.
297	Cameron	do	7	do	N. C. Ry	Shamokin	Mineral Railroad and Mining Co	Wilkesbarre.
296	Luke Fidler	do	7	do	do	do	do	Do.
290	Hickory Ridge	do	7	do	do	Lancaster Switch	Union Coal Co	Shamokin.
291	Hickory Swamp	do	7	do	do	do	do	Do.
286	Pennsylvania	do	7	do	do	Mt. Carmel	do	Do.
287	Enterprise	do	7	do	P. & R. R. R	Excelsior	Enterprise Coal Co	Excelsior.
288	Excelsior	do	7	do	do	do	Excelsior Coal Co	Do.
289	Corbin	do	7	do	do	do	do	Do.
292	Colbert	do	7	do	N. C. Ry	Lancaster Switch	Smith & Keiser	Do.
302	Neilson	do	7	do	P. & R. R. R	Shamokin	J. Langdon & Co	Elmira, N. Y.
	Natalie	do	7	do	do	do	Patterson Anthracite Mining Co	Mt. Carmel.
275	Midvalley	do	7	do	L. V. R. R	Mt. Carmel	Midvalley Coal Co	Wilburton.

SOUTHERN COAL FIELD.

307	Colliery No. 1	Panther Creek	5	Carbon	C. R. R. of New Jersey	Nesquehoning	Lehigh Coal and Navigation Co.	Lansford.
308	Colliery No. 4	do	5	do	do	Lansford	do	Do.
309	Colliery No. 5	do	5	do	do	do	do	Do.
	Colliery No. 6	do	5	do	do	do	do	Do.
311	Colliery No. 8	do	8	Schuylkill	do	Coaldale	do	Do.
310	Colliery No. 9	do	5	Carbon	do	do	do	Do.
313	Colliery No. 10	do	8	Schuylkill	do	Tamaqua	do	Do.
314	Colliery No. 11	do	8	do	do	do	do	Do.
312	Colliery No. 12	do	8	do	do	Coaldale	do	Do.
315	Colliery No. 13	do	8	do	do	Tamaqua	do	Do.
337	Beechwood	East Schuylkill	8	do	P. & R. R. R	Pottsville	P. & R. Coal and Iron Co	Pottsville.
327	Eagle	do	8	do	do	St. Clair	do	Do.
324	Eagle Hill	do	8	do	do	Cumbola	do	Do.
332	Chamberlain	do	8	do	do	St. Clair	Thomson, Hiatt & Co., Limited	St. Clair.
316	East Lehigh	do	8	do	do	Tamaqua	Mitchell & Shepp	Tamaqua.
336	Flowery Field	do	8	do	do	St. Clair	Sturdevant & Clark	St. Clair.
321	Kaska William	do	8	do	do	Middleport	Alliance Coal Mining Co	Lansford.
329	Roberts	do	8	do	P. R. R.	Newcastle	Tyler & McTurk	St. Clair.
335	Vulcan or Reserve	do	8	do	P. & R. R. R	St. Clair	John Denning	Do.
334	Wadesville	do	8	do	do	Pottsville	P. & R. Coal and Iron Co	Pottsville.
325	Pine Forest	do	8	do	do	Mill Creek	do	Do.
322	Silver Creek	do	8	do	do	Patterson	do	Do.
317	Tamaqua	do	8	do	do	Tamaqua	Dunkelburger & Co	Tamaqua.
326	Hooker or Mt. Hope	do	8	do	do	St. Clair	G. B. Linderman & Co	South Bethlehem.
338	York Farm	do	8	do	L. V. R. R.	do	Lehigh Valley Coal Co.	Wilkesbarre.
344	Glendower	West Schuylkill	8	do	P. & R. R. R	Glen Carbon	P. & R. Coal and Iron Co	Pottsville.
350	Otto	do	8	do	do	Branch Dale	do	Do.
342	Thomaston	do	8	do	do	Heckscherville	do	Do.
349	Phœnix Park	do	8	do	do	Llewellyn	do	Do.
343	Richardson	do	8	do	do	Glen Carbon	do	Do.
339	Ellsworth	do	8	do	do	Broad Mountain	John H. Davis	Broad Mountain.
	Jugular	do	8	do	do	do	Jacob S. Hepner	Do.
345	Oak Hill	do	8	do	do	Minersville	Leisenring & Co	Minersville.
352	Blackwood	do	8	do	L. V. R. R	Blackwood	Lehigh Valley Coal Co	Wilkesbarre.
351	Feger Ridge (*a*)	do	8	do	P. & R. R. R	Newtown	do	Do.
354	East Franklin	Lorberry	8	do	do	Tremont	P. & R. Coal and Iron Co	Pottsville.
353	Middle Creek	Lykens Valley	8	do	do	Swatara Switch	do	Do.
359	West Brookside	do	8	do	do	Brookside	do	Do.
355	Lincoln	do	7	do	do	Lorberry Junction	do	Do.
	North Brookside	do	8	do	do	Good Spring	do	Do.
358	Good Spring	do	8	do	do	do	do	Do.
	Pine Grove	do	8	do	do	Tremont	John D. Felty	Pine Grove.
360	Williamstown	do	8	Dauphin	N. C. Rwy	Williamstown	Summit Branch Railroad Co	Wilkesbarre.
361	Short Mountain	do	8	do	do	Lykens	Lykens Valley Coal Co	Do.

GENERAL OFFICES OF CORPORATIONS NAMED IN FOREGOING DIRECTORY.

Pennsylvania Coal Company, No. 1 Broadway, New York.
Lehigh and Wilkesbarre Coal Company, No. 143 Liberty street, New York.
Delaware, Lackawanna and Western Railroad Company, No. 26 Exchange Place, New York.
Delaware and Hudson Canal Company, No. 21 Cortlandt street, New York.
Coxe Bros. & Co., No. 143 Liberty street, New York.
Philadelphia and Reading Coal and Iron Company, No. 108 South Fourth street, Philadelphia, and 143 Liberty street, New York.
Lehigh Valley Coal Company, No. 228 South Third street, Philadelphia.
Lehigh Coal and Navigation Company, No. 108 South Fourth street, Philadelphia.
New York, Susquehanna & Western Railroad Company, 15 Cortlandt street, New York.
Hillside Coal and Iron Company, 21 Cortlandt street, New York.
Susquehanna Coal Company, No. 233 South Fourth street, Philadelphia.
Lykens Valley Coal Company, No. 233 South Fourth street, Philadelphia.
Mineral Railroad and Mining Company, No. 233 South Fourth street, Philadelphia.
Summit Branch Railroad Company, No. 233 South Fourth street, Philadelphia.
State Line and Sullivan Railroad Company, No. 204 Walnut Place, Philadelphia.
Union Coal Company, Erie, Pennsylvania.
New York, Ontario and Western Railroad Company, 16 Exchange Place, New York.

Many new shafts have been sunk and enlargements and extensions of breakers have been in progress in all parts of the field. It is noticeable that in the line of improvements in the facilities for mining, preparing and shipping coal, especially by the larger companies, the most advanced methods only are employed, looking to a much larger production at a reduced rate of cost, some of these monster breakers being able to hoist and prepare over one thousand mine cars per day.

The following table shows the apparent consumption of anthracite coal during the years 1888, 1889, 1890, and 1891:

Consumption of Pennsylvania anthracite during the past four years.

	1888.	1889.	1890.	1891.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Stock, January 1	130, 977	652, 156	1, 026, 107	565, 652
Shipments	38, 145, 718	35, 407, 710	35, 865, 174	40, 450, 543
Total supply	38, 276, 695	36, 059, 866	36, 891, 281	41, 016, 195
Stock, December 31	652, 156	1, 026, 107	565, 652	754, 432
Consumption	37, 624, 539	35, 033, 759	36, 325, 629	40, 261, 763

These figures, however, take no account of the large and annually increasing quantities accumulated, at certain seasons, at the inland storage yards, of the larger producing companies, and in the yards of dealers.

The shipments to tide-water points for distribution by water are given in the table below. New avenues by rail, however, to eastern markets hitherto reached only by water are materially changing the relations of the tide-water trade.

Shipments of Pennsylvania anthracite to tide-water from 1888 to 1891.

	Long tons.		Long tons.
1888	13, 657, 604	1890	11, 792, 317
1889	12, 217, 862	1891	13, 313, 719

Prices have been reported by the companies as not renumerative during the year, owing to the fact that production is kept constantly in advance of the demand. Efforts have been made each year to overcome this condition, but no improvement has been realized. During the early part of 1892 a consolidation of several of the larger producing interests was consummated, whereby a large portion of the tonnage fell under the control of one company, and it is earnestly believed that the production can now be brought and kept nearer to the demands of the trade, and thus sustain reasonable prices and yield fair profits to those engaged in the mining of anthracite coal. The character of the arrangement or "deal" referred to above is concisely stated by Mr. F. E. Saward in his valuable annual "The Coal Trade" for 1892: "Financiers who are interested in the shares of certain of the coal-carrying roads have entered into an arrangement by which they hope to receive a more certain income on their investments. These roads own, through their coal companies or other allied interests, or control in the matter of transportation, about 69 per cent. of the anthracite-coal output, according to the figures for the past year. The necessity for unity of action on the part of those who are owners of this valuable fuel (and the share-owners above referred to are surely included in this category) has been apparent for some time. It has been evident that the presidents or sales agents could do nothing to maintain the price of this valuable fuel; twenty, thirty, or forty agreements to restrict have been made only to come to naught. The Philadelphia and Reading Railroad Company acquires by lease the railroad systems heretofore operated by the Lehigh Valley Railroad Company and the Central Railroad Company of New Jersey. The Delaware, Lackawanna and Western Railroad Company is also at least friendly to the arrangement. The magnitude and importance of this deal can hardly be overestimated. It makes the Philadelphia and Reading system the largest in the country in the extent of its operations, transforms it into a great trunk line with unsurpassed facilities at Philadelphia, New York, and Buffalo. It gives the Philadelphia and Reading the control of the anthracite-coal trade, and will enable it to introduce economies and equalizations of coal prices which will give a profit on the coal produced and sold."

In a public statement made by the president of the Philadelphia and Reading Railroad Company he said: "There can be no reason why a great Pennsylvania product like anthracite coal, which can be obtained nowhere else, should be mined without a fair profit to the mine-owners and to the railroad companies which carry it to the market. No pool arrangement can prevail against the varying interests of the different parties engaged in it. Even if the principals strive to maintain honestly an arrangement entered into, it is always defeated by some of the agents. Very great economies will necessarily result by reason of the saving of large amounts which have heretofore been necessary, but uselessly, paid to rival agents for selling coal. The mining of coal can henceforth be done under the most economical management possible, and the saving in expense which will probably be effected will be very great. Good mines will be able to be worked in the best possible manner and unprofitable mines can be abandoned. The revenue of the leased roads, with proper management, will be sufficient to pay the rentals which have been guaranteed, without any necessity for infringing upon the revenues of the Reading. Transportation can be made in the directions which will be most profitable. The roads can be utilized in a way which was not possible under separate systems of management. Coal can be sent to the points of supply by the most direct route.

"The arrangement consists in the leasing to a New Jersey corporation (the Port Reading Railroad Company) of the system of the Central Railroad of New Jersey. The arrangement became possible because of mutual interest, and it is guaranteed, not only by a lease fair to both companies, but by arrangements for traffic and otherwise which insure perpetuity. The lease and other traffic arrangements which have been made insure the payment to it of a guaranteed dividend of 7 per cent. on the stock, with a division between the lessor and the lessee of the surplus earning up to 10 per cent., and of the receipt by the Port Reading of all in excess of 10 per cent. The present earnings of the Central Railroad of the New Jersey system are such as will make the carrying out of the contract by the Port Reading railroad very easy. The economies which will now be possible, and the additional business which will inevitably inure to this system, will make it, with any reasonable success, much more than self-sustaining. Before the lease of the Central Railroad of New Jersey, an arrangement was effected with the Lehigh Valley Railroad Company by which its lines were leased to this company. About the same time the Philadelphia and Reading Coal and Iron Company secured control of the Lehigh Valley Coal Company through a lease and stock arrangements. The terms of the Lehigh Valley lease are similar in character to those of the Central Railroad of New Jersey lease. By means of its lease of the Lehigh Valley railroad this company secures not only a through outlet for anthracite coal in the West, such as will enable it to fill the large and growing demand from that region, but also secures a trunk line to Buffalo which will enable three of the largest coal-carrying companies to send their coal to the West, and to secure its use for the merchandise traffic which is so largely increasing each year."

PENNSYLVANIA BITUMINOUS COAL.

Total product in 1891, 42,788,490 short tons; spot value, $37,271,053.

The bituminous coal fields of Pennsylvania form the northeastern end of the Appalachian field. The total area underlaid by workable coal beds is about 900 square miles. The coal mines of the state are confined to twenty-seven counties, later enumerated. The largest coal area is contained in the western and southwestern parts of the state, extending west from the crest of the Alleghany mountains to the Ohio line, and southwest of a line drawn from New Castle, in Lawrence county, northeast to Kane, in McKean county, and thence southeast in the direction of Bellefonte, in Center county. Ragged edges of broken Coal Measures extend beyond these lines. In addition, isolated areas are found in the Wellersburg Basin, in Somerset county; in the Broad Top coal field, in Huntingdon, Blair, and Fulton counties; in the Tipton field, west of Altoona, in Blair county, and in the fields in Bradford and Tioga counties. The characteristics of the Coal Measures in which these beds occur have been described in former reports.

A comparison of the bituminous coal production of Pennsylvania in 1891 with that of 1890 shows that the product increased 486,317 short tons, or but a trifle over 1 per cent. A glance at the table of production by counties shows distinctly to what this very small increase is due. The great strike in the Connellsville coke region embracing Fayette and Westmoreland counties caused a falling off in the product as compared with 1890 of 630,508 short tons in the former, and 323,011 short tons in the latter. The product of the state was further shortened by a decreased output of 147,934 short tons in Elk county, 230,509 short tons in Washington county, and in minor degrees by a falling off in the product of Beaver, Bedford, Blair, Bradford, Clarion, Clinton, Huntingdon, and Somerset counties.

As a set-off to these losses it will be noted that the increase in the output of Allegheny county was 746,297 short tons; in Cambria county, 142,019 short tons; in Clearfield county, 491,795 short tons; in Indiana county, 133,447 short tons; in Jefferson county, 309,815, and smaller amounts in Armstrong, Butler, Center, Lawrence, McKean, Mercer, and Tioga counties. The details of the respective increases and decreases in the production of the state by counties for the past three years are shown in the following table, together with a statement of the production in 1886, 1887, and 1888:

Comparative statistics of the Pennsylvania bituminous mines, by counties.

Counties.	1886.	1887.	1888.	1889. Total product.	1889. Increase over 1888.	1889. Decrease from 1888.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Allegheny	4, 202, 086	4, 680, 924	5, 575, 505	4, 717, 431	....	858, 074
Armstrong	210, 856	235, 221	226, 093	289, 218	63, 125	....
Beaver	208, 820	197, 863	63, 900	93, 461	29, 561	....
Bedford	173, 372	311, 452	248, 159	257, 455	9, 294	....
Blair	305, 695	287, 367	314, 013	215, 410	....	98, 603
Bradford	206, 998	167, 416	163, 851	129, 141	....	34, 710
Butler	162, 306	161, 764	194, 715	288, 591	93, 876	....
Cambria	1, 222, 028	1, 421, 980	1, 540, 460	1, 751, 664	211, 204	....
Cameron	3, 200	3, 000	700	2, 300	1, 600	....
Center	313, 383	508, 255	382, 770	395, 127	12, 357	....
Clarion	429, 544	593, 758	535, 192	596, 589	61, 397	....
Clearfield	3, 753, 986	5, 180, 311	5, 398, 981	5, 224, 506	....	174, 475
Clinton	....	....	32, 000	106, 000	74, 000	....
Elk	526, 036	609, 757	555, 960	614, 113	58, 153	....
Fayette	4, 494, 613	4, 540, 322	5, 208, 993	5, 897, 254	688, 261	....
Greene	5, 600	3, 002	5, 323	53, 714	48, 391	....
Huntingdon	313, 581	265, 479	281, 823	280, 133	....	1, 690
Indiana	103, 615	207, 597	157, 285	153, 698	....	3, 587
Jefferson	1, 023, 186	1, 693, 492	2, 275, 349	2, 896, 487	621, 138	....
Lawrence	101, 154	125, 361	106, 921	143, 410	36, 489	....
McKean	617	9, 214	10, 443	11, 500	1, 057	....
Mercer	537, 712	539, 721	487, 122	575, 751	88, 629	....
Somerset	349, 926	416, 240	370, 228	442, 027	71, 799	....
Tioga	1, 384, 800	1, 328, 963	1, 106, 146	1, 036, 175	....	69, 971
Venango	2, 500	2, 296	2, 000	6, 911	4, 911	....
Washington	1, 612, 407	1, 751, 615	1, 793, 022	2, 364, 901	571, 879	....
Westmoreland	5, 446, 480	6, 074, 486	6, 519, 773	7, 631, 124	1, 111, 351	....
Small mines	....	200, 000	240, 000	(*a*)	....	....
Total	27, 094, 501	31, 516, 856	33, 796, 727	36, 174, 089	3, 852, 472	1, 241, 110
Net increase	....	4, 422, 355	2, 279, 871	2, 377, 362	2, 377, 362	....

Counties.	1890. Total product.	1890. Increase over 1889.	1890. Decrease from 1889.	1891. Total product.	1891. Increase over 1890.	1891. Decrease from 1890.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Allegheny	4, 894, 372	176, 941	....	5, 640, 669	746, 297	....
Armstrong	380, 554	91, 336	....	484, 000	103, 446	....
Beaver	139, 117	45, 656	....	129, 961	....	9, 156
Bedford	445, 192	187, 739	....	389, 257	....	55, 935
Blair	298, 196	82, 786	....	237, 626	....	60, 570
Bradford	126, 687	....	2, 454	68, 697	....	57, 990
Butler	167, 578	....	121, 013	211, 647	44, 069	....
Cambria	2, 790, 954	1, 039, 290	....	2, 932, 973	142, 019	....
Cameron	....	....	(*d*)	....	....	....
Center	452, 114	56, 987	....	526, 753	74, 639	....
Clarion	512, 387	....	84, 202	479, 887	....	32, 500
Clearfield	6, 651, 587	1, 427, 081	....	7, 143, 382	491, 795	....
Clinton	159, 000	53, 000	....	130, 802	....	28, 198
Elk	1, 121, 534	507, 421	....	973, 600	....	147, 934
Fayette	6, 413, 081	515, 827	....	5, 782, 573	....	630, 508
Greene	(*b*)	....	(*d*)	....	....	....
Huntingdon	322, 630	42, 497	....	269, 021	....	53, 609
Indiana	357, 580	203, 882	....	456, 077	98, 497	....
Jefferson	2, 850, 799	....	45, 688	3, 160, 614	309, 815	....
Lawrence	140, 528	....	2, 882	164, 669	24, 141	....
McKean	(*b*)	....	(*d*)	15, 345	15, 345	....
Mercer	524, 319	....	51, 432	526, 220	1 901	....
Somerset	522, 796	80, 769	....	480, 194	....	42, 602
Tioga	903, 997	....	132, 178	1, 010, 872	106, 875	....
Venango	(*b*)	....	(*d*)	....	....	....
Washington	2, 836, 667	471, 766	....	2, 606, 158	....	230, 509
Westmoreland	8, 290, 504	659, 380	....	7, 967, 493	....	323, 011
Small mines	(*c*)1, 000, 000	925, 575	....	1, 000, 000	....	....
Total	42, 302, 173	6, 567, 933	439, 849	42, 788, 490	2, 158, 839	1, 672, 522
Net increase	6, 128, 084	6, 128, 084	....	486, 317	486, 317	....

a Included in county distribution.
b Included in product of country banks.
c Estimate based on the census returns for small banks, which for 1889 were, approximately, 800,000 short tons, showing that previous estimates of the product from this source were too small.
d All product from country banks and decrease deducted from total estimated production.

It will be seen from the foregoing table that in 1889 Allegheny county suffered the greatest loss in tonnage, having over 66 per cent. of the loss sustained in all the counties in which decreases in product occurred. Westmoreland county showed a remarkable increase, being nearly one-half of the total net increase of the state and exceeding by 38,058 short tons the aggregate increase of the county from 1886 to 1888. Fayette county came second in increased tonnage, with a gain of 688,261 short tons; Jefferson, third, with an increase of 621,138 short tons, and Washington, fourth, shows 571,879 short tons in excess of the preceding year's product.

In 1890 the county showing the greatest gain on the preceding year was Clearfield, whose product in 1890 was 1,427,081 short tons greater than in 1889. Cambria county increased 1,039,290 short tons, and the other notable increases were in Westmoreland county, 659,380 short tons; Fayette county, 515,827 short tons; Elk county, 507,421 short tons, and Washington county, 471,766 short tons. The counties having an increased production in 1889 and an apparent decreased product in 1890 were Butler, Clarion, Jefferson, Lawrence, and Mercer. But against this must be set the fact that the product of small mines is included in the county distribution in 1889 and not accounted for in 1890, except in a total estimate for the State.

The following tables show the bituminous-coal product of Pennsylvania in 1889, 1890, and 1891, by counties, with the distribution and value:

Bituminous coal product of Pennsylvania in 1889, by counties.

Counties.	Disposition of total product.				Total product.	Value of total product at mines.	Average number of persons employed.
	Loaded at mines for shipment on railroad cars and boats.	Used by employés and sold to local trade.	Used for steam and heat at mines.	Made into coke.			
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*		
Allegheny	4, 464, 376	204, 282	25, 103	23, 670	4, 717, 431	$4, 000, 104	9, 386
Armstrong	229, 402	59, 460	356		289, 218	210, 067	459
Beaver	44, 932	48, 180	249	100	93, 461	110, 604	162
Bedford	237, 554	6, 932	3, 889	9, 078	257, 453	205, 672	560
Blair	80, 777	4, 188	2, 918	127, 527	215, 410	210, 466	466
Bradford	121, 976	6, 365	800		129, 141	171, 387	321
Butler	183, 477	94, 064	2, 162	8, 888	288, 591	270, 394	451
Cambria	1, 174, 508	179, 525	7, 296	390, 335	1, 751, 664	1, 348, 484	2, 791
Center	380, 331	4, 964	115	9, 717	395, 127	311, 544	750
Clarion	535, 251	57, 500	3, 370	468	596, 589	430, 850	940
Clearfield	4, 937, 506	89, 580	19, 651	177, 769	5, 224, 506	4, 403, 551	7, 703
Elk	596, 014	7, 549	4, 789	5, 761	614, 113	498, 728	1, 185
Fayette	593, 149	111, 714	101, 272	5, 091, 119	5, 897, 254	3, 702, 548	6, 567
Greene		53, 714			53, 714	57, 307	
Huntingdon	185, 799	9, 111	3, 129	82, 094	280, 133	211, 597	538
Indiana	53, 498	80, 200		20, 000	153, 698	124, 088	139
Jefferson	2, 371, 703	53, 684	11, 403	459, 697	2, 896, 487	2, 117, 531	3, 738
Lawrence	117, 094	25, 696	620		143, 410	150, 537	267
Mercer	509, 737	51, 231	14, 783		575, 751	511, 202	1, 094
Somerset	370, 791	50, 909	586	19, 741	442, 027	308, 400	525
Tioga	1, 010, 544	12, 572	8, 543	4, 516	1, 036, 175	1, 264, 889	2, 400
Washington	2, 261, 040	64, 847	11, 972	27, 042	2, 364, 901	1, 557, 486	4, 005
Westmoreland	3, 488, 873	299, 874	109, 597	3, 732, 780	7, 631, 124	5, 674, 493	9, 109
Cameron, Clinton, Lycoming, McKean, and Venango	111, 581	14, 510	334	286	126, 711	101, 386	224
Total	24, 059, 913	1, 590, 651	332, 937	10, 190, 588	36, 174, 089	27, 953, 315	53, 780

Bituminous coal product of Pennsylvania in 1890, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Allegheny	4,643,050	174,870	37,496	38,956	4,894,372	$4,534,708	198	9,036
Armstrong	341,447	11,064	2,480	25,563	380,554	275,011	251	661
Beaver	119,216	18,355	1,286	260	139,117	145,946	251	205
Bedford	305,282	10,279	1,400	128,231	445,192	356,005	288	662
Blair	163,399	1,852	506	132,439	298,196	241,678	284	595
Bradford	121,359	1,355	3,973	....	126,687	161,751	196	292
Butler	147,935	9,372	2,471	7,800	167,578	146,162	237	314
Cambria	2,487,414	26,348	15,186	262,006	2,790,954	2,332,997	261	4,140
Center	378,384	5,684	200	67,846	452,114	356,121	230	623
Clarion	501,563	8,425	2,399	....	512,387	386,617	237	938
Clearfield	6,351,454	9,629	61,715	228,789	6,651,587	5,642,098	236	9,324
Clinton	159,000	....	....	....	159,000	123,326	265	200
Elk	1,064,372	11,788	374	45,000	1,121,534	942,081	255	1,871
Fayette	996,469	12,044	123,264	5,281,304	6,413,081	4,931,015	247	6,503
Huntingdon	229,855	8,486	3,222	81,067	322,630	247,364	237	611
Indiana	283,102	2,184	112	72,182	357,580	294,389	245	668
Jefferson	2,678,522	7,805	6,820	157,652	2,850,799	2,421,960	245	3,971
Lawrence	94,908	45,109	511	....	140,528	142,682	232	307
Mercer	488,205	25,313	10,801	....	524,319	446,392	231	1,023
Somerset	486,322	10,041	593	25,840	522,796	341,518	225	646
Tioga	852,621	19,986	11,405	19,985	903,997	995,936	192	2,019
Washington	2,775,610	8,253	12,454	40,350	2,836,667	2,649,627	227	4,644
Westmoreland	3,619,434	45,075	97,169	4,528,826	8,290,504	6,691,532	228	12,080
Small mines	....	1,000,000	....	....	1,000,000	750,000	....	....
Total	29,288,923	1,473,317	395,837	11,144,090	42,302,173	35,376,916	232	61,333

Bituminous coal product of Pennsylvania in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Short tons*				
Allegheny	5,282,424	311,352	22,614	24,279	5,640,669	$5,790,967	$1.03	199	11,194
Armstrong	446,233	12,380	1,189	24,198	484,000	367,906	.76	230	805
Beaver	110,440	17,517	1,180	824	129,961	130,051	1.00	201½	228
Bedford	319,430	13,473	2,159	54,195	389,257	324,402	.83	230	605
Blair	122,767	2,598	1,335	110,926	237,626	205,989	.87	249	503
Bradford	67,721	500	476	....	68,697	92,054	1.34	228	169
Butler	208,764	911	1,972	....	211,647	187,481	.89	240	342
Cambria	2,079,475	347,631	12,728	493,139	2,932,973	2,354,831	.80	258	4,284
Center	369,098	36,046	400	121,209	526,753	397,451	.75	200	823
Clarion	468,717	10,184	986	....	479,887	361,741	.75	221	895
Clearfield	6,787,128	22,463	35,614	298,177	7,143,382	5,968,763	.84	227	10,067
Clinton	130,802	....	....	....	130,802	149,830	1.15	291	181
Elk	956,146	5,050	6,159	6,245	973,600	804,635	.83	229	1,622
Fayette	1,077,570	81,017	95,795	4,528,191	5,782,573	4,755,444	.82	216½	7,545
Huntingdon	157,871	13,495	6,298	91,357	269,021	210,918	.78	246	595
Indiana	326,861	1,767	949	126,500	456,077	345,623	.76	227	561
Jefferson	2,533,331	19,261	10,996	597,026	3,160,614	2,774,610	.88	237	4,172
Lawrence	164,039	537	93	....	164,669	168,114	1.02	236	327
McKean	15,345	....	....	....	15,345	16,112	1.05	230	42
Mercer	506,569	7,445	12,206	....	526,220	474,853	.90	241	972
Somerset	428,620	8,005	380	43,189	480,194	338,533	.71	266	531
Tioga	934,917	16,555	5,811	53,589	1,010,872	1,156,959	1.14	241	1,980
Washington	2,577,791	19,592	8,775	....	2,606,158	2,251,788	.87	222	4,135
Westmoreland	3,904,855	59,569	93,110	3,909,959	7,967,493	6,891,998	.87	221	11,083
Small mines	....	1,000,000	....	....	1,000,000	750,000	....	....	....
Total	29,976,914	2,007,348	321,225	10,483,003	42,788,490	37,271,053	.87	223	63,661

From the preceding table it is seen that the average price realized for the coal ranged from 71 cents per ton in Somerset county to $1.34 in Bradford county. It is to be remarked that, with the exception of

Allegheny and Tioga counties, none of the counties producing over 200,000 tons realized more than 90 cents per ton and only one reached that figure. The general average for the State was 87 cents per ton, against 83½ cents per ton in 1890.

Allegheny county.—Coal produced in 1891, 5,640,669 short tons; spot value, $5,790,967.

The output of coal in Allegheny county in 1891 was 746,297 short tons larger than in 1890, and exceeded that of any previous year, being 65,164 tons more than in 1888, which was until 1891 the banner year in the history of coal production in Allegheny county. The total number of persons employed in and about the mines increased from 9,036 in 1890 to 9,734 in 1891, the number of working days remaining practically the same—198 in 1890 and 199 in 1891.

Coal product of Allegheny county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	2,863,631	1888	5,575,505
1885	3,588,244	1889	4,717,431
1886	4,202,086	1890	4,894,372
1887	4,680,924	1891	5,640,669

As will be seen from the following statement a large portion of the product of Allegheny and Washington counties, comprising the Pittsburg district, is shipped by the Monongahela and Ohio rivers, and the remainder is shipped by rail over the following lines: Pittsburg and Lake Erie; Montour; Pittsburg, Chartiers and Youghiogheny; Pennsylvania; Pittsburg, Cincinnati, Chicago and Saint Louis; McKeesport and Bellevernon; Pittsburg and Castle Shannon; Baltimore and Ohio; Pittsburg and Western, and Allegheny Valley.

The following table shows the shipments from the Pittsburg district by slack-water navigation down the Monongahela and Ohio rivers since 1860:

Shipments of Pittsburg coal by slack-water navigation since 1860.

Years.	Quantity.	Years.	Quantity.
	Short tons.		*Short tons.*
1860	1,517,909	1876	2,495,800
1861	834,630	1877	2,677,460
1862	743,358	1878	2,797,530
1863	1,134,150	1879	2,623,232
1864	1,402,828	1880	3,361,934
1865	1,580,791	1881	3,450,186
1866	1,704,212	1882	4,057,384
1867	1,202,908	1883	4,339,492
1868	1,812,040	1884	3,170,900
1869	2,100,504	1885	3,298,200
1870	2,303,856	1886	4,123,945
1871	1,944,852	1887	3,065,240
1872	2,291,220	1888	4,498,430
1873	2,094,312	1889	4,250,000
1874	2,503,504	1890	4,400,000
1875	2,275,265	1891	4,276,588

The falling off in the water shipments in 1891 were due to low water in the rivers during the year.

Armstrong county.—Coal produced in 1891, 484,000 short tons; spot value, $367,906.

Armstrong county produced 103,446 short tons more in 1891 than in 1890, increasing the value of the output $92,895 and employing 144 more men, though the average number of working days decreased from 251 to 230. The Pennsylvania, the Western New York and Pennsylvania, and the Allegheny Valley railroads furnish transportation.

Coal product of Armstrong county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	170, 826	1888	226, 093
1885	139, 327	1889	289, 218
1886	210, 856	1890	380, 554
1887	235, 221	1891	484, 000

Beaver county.—Coal produced in 1891, 129,961 short tons; spot value, $130,051.

Complete returns from all commercial mines in Beaver county give a total product in 1891 of 129,961 short tons. This shows a decrease, as compared with 1890, of 9,156 short tons.

The Erie and Pittsburg and the Pittsburg, Marion and Chicago railroads are the means of transportation.

Coal product of Beaver county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	156, 695	1888	63, 900
1885	184, 631	1889	93, 461
1886	208, 820	1890	139, 117
1887	197, 863	1891	129, 961

Bedford county.—Coal produced in 1891, 389,257 short tons; spot value, $324,402.

All of the commercial mines of this county reported their production in 1891 to the Survey. The total output for the year was 55,935 short tons less than in 1890, the mines employing 57 less men and being idle a greater number of days. That is, the number of men employed in 1891 was 605 against 662 in 1890, and the number of working days 230 against 288. The product is shipped over the Huntingdon and Broad Top and the Pennsylvania railroads.

The coal beds of this county belong to the Lower Productive Coal Measures. The names which have been adopted for these coal beds have been local, since it has only been within the last few years that the geological survey of the State has established the identity of these coal beds with those of the Freeport, Kittanning, and Clarion beds of the western Pennsylvania bituminous coal fields.

The annual production of Bedford county for seven years has been as follows:

Coal product of Bedford county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	69,770	1888	248,159
1885	107,694	1889	257,453
1886	173,372	1890	445,192
1887	311,452	1891	389,257

Blair county.—Coal produced in 1891, 237,626 short tons; spot value, $205,989.

Following an increased product of 82,786 tons in 1890 over 1889, the output in 1891 dropped 60,570 short tons. The number of producing mines remained the same as in 1890, two that reported in that year being idle in 1891 and two new ones being added. The number of employés decreased from 595 to 503. All of the product shipped goes over the Pennsylvania railroad.

Coal product of Blair county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	208,541	1888	314,013
1885	205,075	1889	215,410
1886	305,695	1890	298,196
1887	287,307	1891	237,626

Bradford county.—Coal produced in 1891, 68,697 short tons; spot value, $92,054.

Since 1884 the production of coal in this county has decreased annually. The Towanda Coal Company, which has been producing coal continuously since 1856, ceased operations in 1890, and as a consequence the output in 1891 declined nearly 50 per cent.

Coal product of Bradford county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	313,575	1888	163,851
1885	249,920	1889	129,141
1886	206,998	1890	126,687
1887	167,416	1891	68,697

Butler county.—Coal produced in 1891, 211,647 short tons; spot value, $187,481.

Butler county produced 44,069 short tons more in 1891 than in 1890, the value of the product increasing $41,319. The number of men employed increased from 314 to 342, and the average number of days worked from 237 to 240. The product is shipped over the Pittsburg and Lake Erie, the Pittsburg, Chenango and Lake Erie, the New York, Pennsylvania and Ohio, the Pittsburg and Western, the Western New York and Pennsylvania, and the Lake Shore and Michigan Southern railroads.

Coal product of Butler county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	151,355	1888	194,715
1885	85,429	1889	288,591
1886	162,306	1890	167,578
1887	161,764	1891	211,647

Cambria county.—Coal produced in 1891, 2,932,973 short tons; spot value $2,354,831.

The increase in the production of coal in Cambria county in 1891 was 142,019 short tons and adds another year to the regularly increasing annual product of the county. In 1884 the output was 659,843 short tons, showing an increase of over 340 per cent. in eight years and an average yearly increase of 284,141 short tons. The number of employés increased from 4,140 in 1890 to 4,284 in 1891, the average time made being 261 days in 1890 and 258 in 1891. The railroads over which the product of Cambria county is shipped are the Pennsylvania, the Baltimore and Ohio, the Cresson, Clearfield County and New York Short Route, and the Pennsylvania and Northwestern.

The following table exhibits the annual output of the coal mines of Cambria county since 1884:

Coal product of Cambria county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	659,843	1888	1,540,460
1885	1,037,000	1889	1,751,664
1886	1,222,028	1890	2,790,954
1887	1,421,980	1891	2,932,973

Cameron county.—No coal production has been reported from Cameron county since 1889. The one company operating in the county assigned in 1890 and no new operations were begun until after the close of 1891.

Center county.—Coal produced in 1891, 526,753 short tons; spot value, $397,451.

The product of coal in Center county for 1891 was 74,639 tons more than in 1890 and reached the highest point in its history. The coal deposits of Center county occur in what is known as the Snow Shoe basin. The coal is of a superior quality, but occurs in limited quantities and the cost of mining it is excessive when compared with the more favorable conditions in the adjoining county of Clearfield, and the product is therefore restricted. The Pennsylvania and Beech Creek railroads furnish the necessary transportation facilities.

Coal product of Center county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	216, 422	1888	382, 770
1885	373, 504	1889	395, 127
1886	313, 383	1890	452, 114
1887	508, 255	1891	526, 753

Clarion county.—Coal produced in 1891, 479,887 short tons; spot value, $361,741.

This county's product in 1891 was 32,500 short tons less than in 1890. The value fell off $24,876 and the number of employés decreased from 938 to 895. The average number of days made by the men also shows a loss, being 237 in 1890 and 221 in 1891. The county is well provided with railroad facilities by the Allegheny Valley, the Baltimore and Ohio, the Western New York and Pennsylvania, and the Pittsburg and Western lines.

Coal product of Clarion county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	329, 973	1888	535, 192
1885	299, 216	1889	596, 589
1886	429, 544	1890	512, 387
1887	593, 758	1891	479, 887

Clearfield county.—Coal produced in 1891, 7,143,382 short tons; spot value, $5,968,763.

Clearfield county ranks second in the state as a coal-producer. Its output in 1891 was 491,795 short tons more than in 1890 and 824,111 tons less than Westmoreland county, which ranks first. In 1890 its output was 1,638,917 tons behind Westmoreland county, their relative ranks being the same. There were 9,324 men employed in 1890 and 10,067 in 1891, an increase of 743, but the average time made decreased from 236 to 227 days.

The coal of Clearfield county is famous for its steam-producing qualities and is more widely distributed than any other coal produced in the United States, though the Pocahontas coal is looming up as a formidable rival. The following railroads distribute the product: Pennsylvania; Beech Creek; Buffalo, Rochester and Pittsburg; Allegheny Valley; New York, Lake Erie and Western; Western New York and Pennsylvania; Pennsylvania and Northwestern; Reynoldsville and Falls Creek.

The Pennsylvania (Tyrone and Clearfield branch) and the Beech Creek railroads are the most important of the carriers, and the following tables, showing the shipments over these lines for a series of years, will give an excellent idea of the tendency of trade in this region.

Coal carried over the Tyrone and Clearfield branch railroad since 1862.

Years.	Short tons.	Years.	Short tons.
1862	7,239	1877	1,374,927
1863	24,330	1878	1,295,201
1864	65,380	1879	1,631,120
1865	60,629	1880	1,739,873
1866	107,878	1881	2,401,987
1867	166,364	1882	2,838,970
1868	170,335	1883	2,857,710
1869	259,994	1884	3,173,303
1870	379,863	1885	2,901,613
1871	542,896	1886	2,273,147
1872	431,915	1887	3,256,328
1873	592,860	1888	3,389,864
1874	639,630	1889	3,215,630
1875	928,297	1890	3,389,450
1876	1,281,861	1891	3,256,147

Beech Creek railroad tonnage since 1884.

Years.	Short tons.	Years.	Short tons.
1884	234,751	1888	1,694,495
1885	774,055	1889	1,556,930
1886	1,050,238	1890	2,081,173
1887	1,351,579	1891	2,632,714

Coal product of Clearfield county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	2,177,543	1888	5,398,981
1885	3,368,671	1889	5,224,506
1886	3,753,986	1890	6,651,587
1887	5,180,311	1891	7,143,382

Clinton county.—Coal produced in 1891, 130,802 short tons; spot value, $149,830.

The output of Clinton county is from one mine and was 28,198 tons less in 1891 than in 1890. The colliery is on the Philadelphia and Erie branch of the Pennsylvania railroad.

Coal product of Clinton county, Pennsylvania, since 1888.

Years.	Short tons.	Years.	Short tons.
1888	32,600	1890	159,000
1889	106.000	1891	130,802

Elk county.—Coal produced in 1891, 973,600 short tons; spot value, $804,635.

Elk county's product in 1891 was 147,934 tons less than in 1890. The total number of employés decreased from 1,871 to 1,622 and the average working days from 255 to 239. The coal is shipped over the Pennsylvania and the New York, Lake and Western railroads.

Coal product of Elk county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	413, 243	1888	555, 960
1885	537, 826	1889	614, 113
1886	526, 036	1890	1, 121, 534
1887	609, 757	1891	973, 600

Fayette county.—Coal produced in 1891, 5,782,573 short tons; spot value, $4,755,444.

Owing largely to the strike in the Connellsville coke region, mention of which has been already made, the output of Fayette county fell off 630,508 short tons. The product of the H. C. Frick Coke Company, the largest operator in the county and at whose works the strike occurred, decreased over 1,250,000 tons, indicating that the production of other mines in the county increased their aggregate output by about 650,000 tons and that but for the labor troubles the total output of the county would have shown a substantial increase. The Pennsylvania and Baltimore and Ohio railroads, with their branches, are the principal carriers. In addition to these are the Pittsburg and Lake Erie railroad and the Monongahela river.

Coal product of Fayette county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	4, 041, 643	1888	5, 208, 993
1885	3, 192, 172	1889	5, 897, 254
1886	4, 494, 613	1890	6, 413, 081
1887	4, 540, 322	1891	5, 782, 573

Huntingdon county.—Coal produced in 1891, 269,021 short tons; spot value, $210,918.

The output of the Huntingdon county mines in 1891 was 53,609 short tons less than in 1890. The number of men employed decreased from 611 to 595, but the average number of days the mines were active increased, being 237 in 1890 and 246 in 1891.

The coal fields of the county are contained exclusively in the Broad Top semi-bituminous field. The mines are located in what is known as the Broad Top mountain field, being opened on both sides of the mountain, and known, respectively, as the east and west fields.

On account of the superior character of the coal it is much sought for by the trade to supply special consumers. Although a very small area of the southwestern corner of the county is underlaid by coal beds, yet the amount of available coal is very considerable, and there are no facts to warrant the popular impression that the coal beds will be early exhausted, since the amount of available tonnage contained is such as to make it impracticable at the present time to enter into any speculation on this question.

Coal product of Huntingdon county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	212,587	1888	281,823
1885	247,424	1889	280,133
1886	313,581	1890	322,630
1887	265,479	1891	269,021

The Huntingdon and Broad Top Mountain and the East Broad Top railroads carry the product to Huntingdon and Mount Union for transportation over the Pennsylvania railroad, the former line also handling the shipments from Bedford county. The tables below show the amount of coal carried annually on these roads since 1873:

Coal carried by the Huntingdon and Broad Top railroad to the Pennsylvania railroad at Huntingdon.

Years.	Short tons.	Years.	Short tons.
1873	350,245	1883	196,534
1874	226.693	1884	192,706
1875	204,921	1885	176,075
1876	159,779	1886	385,796
1877	140,143	1887	357,438
1878	150,204	1888	375,958
1879	141,594	1889	376,801
1880	174,736	1890	515,309
1881	204,819	1891	523.638
1882	271,216		

Coal carried by the East Broad Top railroad to the Pennsylvania railroad at Mount Union

Years.	Short tons.	Years.	Short tons.
1875	43,567	1884	43,514
1876	66,104	1885	51,878
1877	54,738	1886	51,050
1878	63,068	1887	48,581
1879	67,929	1888	55,795
1880	72,450	1889	72,253
1881	91,745	1890	70,764
1882	99,095	1891	47,575
1883	44,737		

Indiana county.—Coal produced in 1891, 456,077 short tons; spot value, $345,623.

The output of this county in 1891 was 98,497 short tons more than in 1890. The product of Indiana county in 1884 was only 30,758 tons, since which time the development of the fields has been very rapid, especially in the last two years. In 1891 employment was given to 561 men, against 668 men in 1890, indicating that the increased production was obtained with less labor, probably due to the employment of more men in development work during 1890. The product is carried exclusively by the Pennsylvania railroad.

Coal product of Indiana county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	30,758	1888	157,285
1885	82,750	1889	153,698
1886	103,615	1890	357,580
1887	207,597	1891	456,077

Jefferson county.—Coal produced in 1891, 3,160,614 short tons; spot value, $2,774,610.

An increase of 309,815 short tons is shown in the product of 1891 over 1890, changing Jefferson county from sixth place to fifth in producing importance. In 1884 the product was 450,079 short tons, showing a gain in seven years of 2,710,535 tons, or an annual average increase of 387,219 tons. The railroads transporting the coal are the Buffalo, Rochester and Pittsburg, the Pennsylvania and Northwestern, and the Allegheny Valley.

Coal product of Jefferson county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	450,079	1888	2,275,349
1885	479,675	1889	2,896,487
1886	1,023,186	1890	2,850,799
1887	1,693,492	1891	3,160,614

Lawrence county.—Coal produced in 1891, 164,669 short tons; spot value, $168,114.

The output of Lawrence county was 24,141 short tons larger in 1891 than in the preceding year. The number of men employed increased from 307 to 327, and the average number of working days from 232 to 237. The county is well supplied with transportation facilities by the Erie and Pittsburg, the Pittsburg, Youngstown and Ashtabula, the Pittsburg, Fort Wayne and Chicago, and the Western New York and Pennsylvania.

Coal product of Lawrence county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	42,818	1888	106,921
1885	42,137	1889	113,410
1886	101,154	1890	140,528
1887	125,361	1891	164,669

McKean county.—Coal produced in 1891, 15,345 short tons; spot value, $16,112.

The output of McKean county is from one mine and is used principally by locomotives of the Western New York and Pennsylvania railroad. The mine was idle in 1890.

Shipments of coal from McKean county, Pennsylvania, since 1875.

Years.	Short tons.	Years.	Short tons.
1875	33,501	1884	78,870
1876	81,830	1885	44,312
1877	73,222	1886	617
1878	72,098	1887	8,761
1879	85,745	1888	10,443
1880	100,046	1889	11,500
1881	110,099	1890	(a)
1882	73,834	1891	15,345
1883	84,899		

a None.

Mercer county.—Coal produced in 1891, 526,220 short tons; spot value, $474,853.

The product of Mercer county increased 1,901 short tons over 1890, but was accomplished with the employment of a smaller force, the total number employed in 1890 being 1,023, and in 1891, 972. The coal is freighted over the Lake Shore and Michigan Southern, the Pittsburg, Shenango and Lake Erie, and the Western New York and Pennsylvania railroads.

Coal product of Mercer county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	276,350	1888	487,122
1885	378,508	1889	575,751
1886	537,712	1890	524,319
1887	539,721	1891	526,220

Somerset county.—Coal produced in 1891, 480,194 short tons; spot value, $338,533.

Somerset county produced 522,796 short tons in 1890, having a spot value of $341,392. The output in 1891 shows a loss of 42,602 short tons in quantity, but of only $2,859 in value, indicating an advance in the average price per ton from 65 to 70 cents. The number of employés fell off from 646 to 531 and the average number of working days increased from 225 to 266. All of the coal is shipped over the Baltimore and Ohio railroad.

Coal product of Somerset county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	269,930	1888	370,238
1885	302,715	1889	442,027
1886	349,926	1890	522,796
1887	416,240	1891	480,194

Tioga county.—Coal produced in 1891, 1,010,872 short tons; spot value, $1,156,959.

Until 1891 the annual output of Tioga county has steadily decreased since 1886, and, although the production in the past year exceeded that of 1890 by 106,875 tons, the improvement can hardly be looked upon as indicating increased business in the future. Owing to the unfavorable situation of the coal areas and their scattered condition, the cost of mining is too great to admit of profitable competition with the more western counties of the State, where conditions are more favorable for economical mining. The production of Tioga county since 1884 is shown in the following table:

Coal product of Tioga county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	931,922	1888	1,106,146
1885	1,067,081	1889	1,036,175
1886	1,384,800	1890	903,997
1887	1,328,963	1891	1,010,872

Venango county.—There are a few scattered areas in Venango county underlaid by coal beds, but none of the coal is mined on a commercial scale, the product being limited to small mines operated to supply a local trade.

Washington county.—Coal produced in 1891, 2,606,158 short tons; spot value, $2,251,788.

Compared with 1890 the coal product of Washington county in 1891 decreased 230,509. The only cause to which this loss may reasonably be assigned was the unfavorable condition of the Monongahela river, which being generally low during the year and particularly at the time when high water usually prevails, shipments were necessarily curtailed. The decrease in production entailed compulsory idleness to 509 men (the total employés in 1890 being 4,644 and in 1891, 4,135), while the average days worked fell off from 227 to 222.

In addition to the Monongahela river as a means of transportation, are the Pennsylvania, the Baltimore and Ohio, and the Pittsburg, Cincinnati, Chicago and Saint Louis railroads.

Coal product of Washington county, Pennsylvania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	707,262	1888	1,793,022
1885	836,633	1889	2,364,901
1886	1,612,407	1890	2,836,667
1887	1,751,615	1891	2,606,158

Westmoreland county.—Coal produced in 1891, 7,967,493 short tons; spot value, $6,891,998.

The same cause which curtailed the output of Fayette county affected the production of Westmoreland and a decreased product of 323,011 short tons is observed in 1891. The county, however, maintains its position as the largest coal-producer in Pennsylvania, having in 1891 an output of 824,111 tons larger than Clearfield county, the second in production. The year 1891 makes the first break in an otherwise steadily increasing output. The number of men employed fell off from 12,080 in 1890 to 11,083 in 1891 and the average working days from 228 to 221.

The Pennsylvania and the Baltimore and Ohio railroads, with their branches, are the means of transportation.

Coal product of Westmoreland county, Pennysl vania, since 1884.

Years.	Short tons.	Years.	Short tons.
1884	3, 282, 733	1888	6, 519, 773
1885	3, 774, 072	1889	7, 631, 124
1886	5, 446, 480	1890	8, 290, 504
1887	6, 074, 486	1891	7, 967, 493

TENNESSEE.

Total product in 1891, 2,413,678 short tons; spot value, $2,668,188.

Notwithstanding serious outbreaks and acts of lawlessness arising from opposition to the employment of convicts in the mines in competition with free labor, and which brought the coal regions of Tennessee into unpleasant notoriety during the year, the output in 1891 surpassed that of any previous year. In Anderson county, the immediate scene of the troubles, the output in 1891 was 5,155 short tons larger than in 1890. The total increase of the State over 1890 was 244,093 short tons, the value of the product showing a gain of $272,442.

The following table exhibits the coal product of the State in 1891, by counties, with the distribution and value:

Coal product of Tennessee in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Anderson	580, 558	4, 500	2, 500	....	587, 558	$671, 633	$1. 15	242	1, 350
Campbell	158, 306	1, 531	100	....	159, 937	203, 729	1. 27	145	451
Claiborne	53. 283	....	....	20, 455	73, 738	87, 624	1. 19	172	165
Franklin	700	700	....	....	1, 400	2, 800	2. 00	100	10
Grundy	180, 298	923	2, 725	214, 990	398, 936	353, 313	. 886	311	515
Hamilton	206, 298	2, 000	2, 000	33, 000	243, 298	282, 502	1. 12	213	475
Marion	137, 582	34, 593	1, 080	98, 554	271, 809	301, 910	1. 11	220	615
Morgan	124, 586	501	200	....	125, 287	135, 202	1. 09	250	363
Rhea	....	4, 876	15, 466	193, 307	213, 649	213, 649	1. 00	250	350
Roane	....	35, 200	4, 431	72, 677	112, 308	129, 468	1. 15	277	210
Scott	115, 353	6, 139	1, 500	19, 951	142, 943	179, 165	1. 254	182	347
White	70, 000	5, 015	3, 300	....	78, 315	102, 593	1. 31	228	246
Small mines	....	4, 500	....	....	4, 500	4. 600	....	....	....
Total	1. 626, 964	109, 478	33, 302	652, 934	2, 413, 678	2, 668, 188	1. 105	230	5, 097

The total number of men employed in 1891 was 5,097, averaging 230 working days, against 5,082 men for an average of 263 days in 1890. The average price per ton realized in 1891 was $1.105, against $1.104 in 1890, an advance of one-tenth of a cent per ton. The very substantial increase in the amount of coal produced in the state without any decline in the price indicates the industry to have been in a very satisfactory condition during the year.

As indicative of the relative production of the several counties in 1890 and 1891, the following comparative tables, showing the increase or decrease in the two years, is given:

Comparative coal product of Tennessee in 1890 and 1891, by counties.

Counties.	Product in 1890.	Product in 1891.	Increase.	Decrease.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Anderson	582, 403	587, 558	5, 155	
Campbell	126, 367	159, 937	33, 570	
Claiborne	(*a*)	73, 738	73, 738	
Franklin	1, 500	1, 400		100
Grundy	349, 467	398, 936	49, 469	
Hamilton	277, 896	243, 298		34, 598
Marion	213, 202	271, 809	58, 607	
Morgan	143, 518	125, 287		18, 231
Rhea	211, 465	213, 649	2, 184	
Roane	70, 452	112, 308	41, 856	
Scott	136, 365	142, 943	6, 578	
White	52, 650	78, 315	25, 665	
Total	2, 165, 285	2, 409, 178	296, 822	52, 929
Net increase	243, 893		243, 893	

a Developing.

The almost uninterruptedly steady growth of the coal-mining industry in Tennessee during the past nineteen years may be seen in the following table, showing the annual output since 1873:

Coal product of Tennessee from 1873 to 1891.

Years.	Short tons.	Years.	Short tons.
1873	350, 000	1883	1, 000, 000
1874	350, 000	1884	1, 200, 000
1875	360, 000	1885	1, 440, 957
1876	550, 000	1886	1, 714, 290
1877	450, 000	1887	1, 900, 000
1878	375, 000	1888	1, 967, 297
1879	450, 000	1889	1, 925, 689
1880	641, 042	1890	2, 169, 585
1881	750, 000	1891	2, 413, 678
1882	850, 000		

Anderson county.—Coal produced in 1891, 587,558 short tons; spot value, $671,633.

Eight mines, employing an aggregate of 1,350 men, contributed to the product in 1891. This output exceeded that of 1890 by 5,155 short tons, while the value of the product decreased $8,616. In the order of importance, as well as alphabetically, Anderson county stands at the head of the list, leading Grundy county, the second in importance, by 188,622 short tons.

Coal product of Anderson county, Tennessee, for three years.

Years.	Short tons.	Years.	Short tons.
1889	457,069	1891	587,558
1890	582,403		

Shipments are made from Briceville and Coal Creek by the East Tennessee, Virginia and Georgia railroad.

Campbell county.—Coal produced in 1891, 159,937 short tons; spot value, $203,729.

Campbell county embraces what is known as the Jellico coal fields. The coal is popular for steam-making and domestic use on account of low percentage of ash and sulphur. It is shipped over the East Tennessee, Virginia and Georgia railroad to Savannah and Brunswick and other coast ports for steamer fuel, and to Atlanta, Macon, and other interior points. The product for the past three years has been as follows:

Coal product of Campbell county, Tennessee, for three years.

Years.	Short tons.	Years.	Short tons.
1889	123,103	1891	159,937
1890	126,367		

Claiborne county.—The product in 1891 is the first reported from Claiborne county. A small amount was taken out in 1890, but the quantity was not reported. Extended preparations were made during the year for further development of the coal properties of Claiborne county, and of Bell county, Kentucky, just across the State line, and a larger output may be looked for in the near future. The coal is shipped over the Louisville and Nashville railroad north from Middlesboro, Kentucky, and south by the Knoxville, Cumberland Gap, and Louisville railroad.

Franklin county.—The output of Franklin county is from one mine at Sewanee. Half of the product is consumed locally, supplying the military college at Sewanee and residents in the vicinity, and half is shipped over the Nashville, Chattanooga and Saint Louis railroad.

Hamilton county.—Coal produced in 1891, 243,298 short tons; spot value, $282,502.

The output of Hamilton county in 1891 was 34,598 short tons less than in 1890; the value declined $35,826. The product is from three mines of commercial importance. They employed, in 1891, 475 men, who averaged 213 days against 500 men for 285 days in 1890.

Coal product of Hamilton county, Tennessee, for three years.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1889	241,067	$313,991	1.30\frac{1}{4}$	625
1890	277,896	318,898	1.14$\frac{3}{4}$	500
1891	243,298	282,502	1.12	475

Transportation is obtained by the Cincinnati, New Orleans and Texas Pacific railroad and the Tennessee river.

Grundy county.—Coal produced in 1891, 398,936 short tons; spot value, $353,313.

Grundy county is the second county in the state in importance of coal production. The product in 1891 was 49,469 tons larger than in 1890, the value increasing $26,486. The total number of employés in 1891 was 515, averaging 311 working days. The Nashville, Chattanooga and Saint Louis railroad carries the coal to market.

Coal product of Grundy county, Tennessee, for three years.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1889	400,107	$395,767	0.98\frac{4}{5}$	501
1890	349,467	326,827	.93$\frac{1}{2}$	880
1891	398,936	353,313	.88$\frac{3}{5}$	515

The apparent discrepancy between the decreased production in 1890 and the larger number of employés is unaccounted for, but was probably due to the making of new openings and other construction and development work.

Marion county.—Coal produced in 1891, 271,809 short tons; spot value, $301,910.

Notwithstanding the fact that one of the important producing companies of Marion county, the Etna Coal Company, of Whiteside, went into the hands of a receiver about the first of the year, and no product from its mine was reported, the output of the county was nearly 10 per cent. over that of 1891. The product reported was from five mines, one of which, the Thomas mine of the Tennessee Coal and Iron Company, produced about 93 per cent., the other four combined contributing only 7 per cent. of the total. Marion county adjoins Hamilton and the coal is shipped by the same routes.

Coal product of Marion county, Tennessee, for three years.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1889	203,923	$230,116	$1.13	423
1890	213,202	225,403	1.05$\frac{3}{4}$	523
1891	271,809	301,910	1.11	615

Morgan county.—Coal produced in 1891, 125,287 short tons; spot value, $135,202.

One mine, productive in 1890, was idle in 1891 and one was discontinued. One new one was started. The six producing mines in 1890 were reduced, therefore, to five in 1891, and the amount of product fell off 18,231 tons. The value declined from $158,243 in 1890 to $135,302. in 1891, a loss of $22,941, the price per ton remaining nearly the same. The total number of employés in the two years was the same, 363, but the average number of working days decreased from 258 in 1890 to 250 in 1891. All of the coal sent to a distance is shipped from Oliver Springs, in Anderson county, over the East Tennessee, Virginia and Georgia railroad.

Coal product of Morgan county, Tennessee, for three years.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1889	68, 229	$91, 511	$1. 34	135
1890	143, 518	158, 243	1. 10	363
1891	125, 287	135, 202	1. 09	363

Rhea county.—Coal produced in 1891, 213,649 short tons; spot value, $213,649.

The product of Rhea county is from two mines, operated by one company. Shipments are made over the Cincinnati, New Orleans and Texas Pacific railroad. The mines gave employment to 350 men for an average of 250 days.

Coal product of Rhea county, Tennessee, for three years.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1889	149, 194	$164, 118	$1. 10	475
1890	211, 465	211, 465	1. 00	450
1891	213, 649	213, 649	1. 00	350

With the exception of a comparatively small amount of coal sold to local trade and used by employés and the amount consumed in operating the mine, all of the product is made into coke and mostly consumed in the company's iron furnaces at Dayton.

Roane county.—Coal produced in 1891, 112,308 short tons; spot value, $129,468.

The output in 1891 was from two mines, one reporting this year for the first time. The product of the new mine supplies the local trade of Harriman. All of the output of the other colliery, except that used at the mines for steam and heat, is made into coke for use in the iron mills of the company.

Scott county.—Coal produced in 1891, 142,943 short tons; spot value, $179,165.

Notwithstanding a strike of six months' duration at the largest producing mine in the county, the product for the year was 6,578 short tons larger than during the previous year. One mine producing in 1890 was abandoned, and the product for 1891 was obtained from four collieries. These employed an aggregate of 347 men, who averaged 182 days, the working time being reduced by the strike above mentioned. The coal is shipped by the Cincinnati, New Orleans and Texas Pacific railroad.

Coal product of Scott county, Tennessee, for three years.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1889	108,027	$145,075	$1.34	180
1890	136,365	175,327	1.29	475
1891	142,943	179,165	1.25⅜	347

White county.—Coal produced in 1891, 78,315 short tons; spot value, $102,593.

Coal production in White county is limited to one mine. It employed in 1891 246 men and was operated 228 days. A branch of the Nashville, Chattanooga and Saint Louis railroad furnishes transportation.

TEXAS.

Total product in 1891, 172,100 short tons; spot value, $412,360.

Reports have been received from all but one of the coal mines operating on a commercial scale, and estimating the output of the delinquent mine on the basis of its product in 1890, there is a loss in the output of the state of 12,340 short tons in quantity and $53,540 in value. The distribution of the product for the past three years is shown in the following table:

Coal product of Texas in 1889, 1890, and 1891.

Distribution.	1889.	1890.	1891.
	Short tons.	*Short tons.*	*Short tons.*
Loaded at mines for shipment	120,602	180,800	169,300
Sold to local trade and used by employés	6,552	1,840	900
Used for steam and heat at mines	1,062	1,800	1,900
Total	128,216	184,440	172,100
Total value	$340,617	$465,900	$412,360

THE COAL FIELDS OF TEXAS.

[By Robert T. Hill.]

Coal of various qualities and diverse geological age occurs in the Texas region as follows:

1. *Carboniferous coals of the central Texas region.*—The true Coal Measures of the Carboniferous period, outcrop along an approximately north and south belt, in the central portion of the state, from near Red river, in Montague county, to the Colorado, in Travis.

The area of outcrop is separable into two divisions by an overlapping remnant of the Cretaceous formation, which once covered the whole region along the divide of the Brazos and Colorado rivers. The northernmost of these two areas consists of a continuous outcrop of the Carboniferous formation in western Montague, Wise, Parker, northwest Erath, northern Comanche, Brown, Eastland, Palo Pinto, Stephens, Young, and eastern Shackelford.

The southernmost area, once so continuous like the northern area and covered by the Cretaceous rocks, has itself been much destroyed by erosion, and now occurs in large but remnantal traces around the perimeter of the older paleozoic rocks in the medial drainage basin of the Colorado river. The principal outcrops are in Brown, Coleman, McCulloch, and San Saba, while smaller outcrops occur in Burnet and Mason counties, the principal one of which is near Smith Mills and Travis Peak, about 40 miles southwest of Austin.

Although erroneously published as a portion of the Missourian coal field, and popularly supposed to be a southward continuation of the merchantable coals of the Indian Territory, the Texas area is, as has been recently shown, entirely separate and different from them. The merchantable coals of Indian Territory do not outcrop south of the great folded east and west axis of the Ouachita mountain system, which extends across southern Indian Territory and constitutes a complete barrier between the natural features of the Missourian and Texan regions. South of this system the Coal Measures occur under entirely different structural conditions, having been submerged during subsequent geologic epochs, which events seem to have charged them with certain impurities that render them of less commercial value than the coals of similar age from the unsubmerged areas. Neither does the outcrop of the Texan coal field cross Red River, as popularly supposed.

The general extent of the Texas coal field was first made known by Dr. B. F. Shumard, the able State Geologist, in 1860, and several papers have since been published which amplified the facts he set forth. Dr. C. A. Ashburner, in the Transactions of the American Institute of Mining Engineers for 1880–'81, published a valuable paper on the Brazos Coal Field of Texas, in which the stratigraphy and succession of the beds were set forth. Thus far, however, the State has made no attempt to have the coal fields accurately mapped and studied by a recognized expert.

2. *The Cretaceous and Laramie coal fields.*—Bituminous coal of good quality is found in the uppermost Cretaceous and Laramie beds of the Rio Grande, in the vicinity of Eagle Pass, on the Mexican side, and mined in large quantities by the Southern Pacific Railway Company at San Felipe, on the Rio Sabinas. This coal field extends a slight distance into Texas, and is found at a great depth at Eagle Pass, where a company is now preparing for operation. It is superior to the Carboniferous coals of Texas in quality, but to the eastward, away from the mountain movements, toward Laredo and Santa Tomas, the beds are lignite and impure. These coals resemble and are similar to the coals of the Rocky Mountain region. Other deposits of similar nature have frequently been rumored in the trans-Pecos region of Texas, but have not been authenticated.

3. *The lignite beds of Texas.*—There are many deposits of lignite, which have frequently been taken for coal. The chief of these extends across the eastern portion of the State, coincident with the Eocene Tertiary formation, in which it occurs. Its general extent was outlined by Dr. B. F. Shumard, in 1880, but no systematic survey of them has been made. Dr. R. A. F. Penrose, professor of Economic Geology in the University of Chicago, and formerly of the Texas Geological Survey, who has published an able report upon the geology of the Tertiary formations of Texas, speaks as follows concerning the economic possibilities of the Texas lignite beds.

"*San Tomas coal mine.*—This is the only place where fuel is mined on any considerable scale east of a line drawn between Eagle Pass and Dallas. The coal bed is 2½ feet thick, and separated in the middle by a 2-inch seam of hard black clay. The coal is jet black, highly glossy, and has a conchoidal fracture. It is generally massive, though sometimes it has the structure of bituminous coal. It is light and friable, and has the appearance of being an altered lignite.

"This material has proved a very serviceable fuel, and is especially valuable in a country like southern Texas, where there is no other coal, and where wood is very scarce. It is extensively used on the Mexican National Railroad, and for steam and household purposes in Laredo, and has already become an important factor in the welfare of the region.

"*Uses of lignite.*—The San Tomas coal is so vastly superior to any of the East Texas lignites that it can not fairly be classed with them, and therefore the following remarks are not intended to refer to it. The lignite beds have not yet been worked to any considerable extent. Some of the material has been taken out at the following places: In Raines county; at Alamo, in Cass county; some three miles southwest of Athens, Henderson county; at Calvert Bluff, Robertson county; and in other places in small quantities; but, so far as the knowledge of the writer goes, it has in every case been attended with unsatisfactory results. There are three causes for this.

"1. The lignite, even when it is sun-dried, contains a high percentage of water—ten to twenty per cent.—and when it is burned a large amount of the heating power of the fuel is consumed in evaporating the moisture and is absolutely lost for all practical purposes. This water in the sun-dried material is chemically combined with the lignite, and can not be removed without decomposing it. Hence the popular saying that the lignite 'burns without heating.'

"2. Most all the lignites have a strong tendency to crumble when exposed to the air, and a large part of it is wasted by being carried up the flues of a furnace even by an ordinary draft. Also, a finely crumbled fuel is difficult to handle in a furnace, and its transportation is expensive and accompanied by a large amount of waste.

"3. The part of East Texas where lignite is found is heavily timbered, not only with pine, but with hard woods. Railroads in many places can have this fuel placed on the track for from $2 to $4 per cord, and it requires a very good and cheap coal to compete with that price for railroad and furnace purposes. It might be said that the wood will run out and the lignite will then be used, but as the hard wood of East Texas is increasing every year, and spreading over areas that were once prairies, the outlook in this direction is not encouraging. As the value of lignite will not stand transportation it can not, except under special conditions, be sent into the regions where wood is scarce. There are, however, uses to which lignite can be applied.

"1. The better grades can be used for household purposes.

"2. It can be ground and pressed into bricks, with some cementing substance like asphalt or coal tar, and thus gotten into a much more serviceable shape than that in which it naturally occurs. This does away with the inconvenience of having it crumble. Such bricks are considerably used in France and Belgium for railroad and other purposes.

"3. Lignite of a black color, in a finely powdered state, has been used in England, under the name of 'Cologne earth,' as the basis of a black paint.

"4. Lignite has been successfully used in place of bone black in clarifying sugar."

This report of Dr. Penrose is of value, inasmuch as for twenty years past, since the first publication of the idea by Dr. Buckley, the former State geologist, it has been extensively agitated that these lignites could be converted into commercial fuel, as is done in Germany. The only difficulty thus far developed is the fact that it can not be done economically. Other lignite beds occur in the Lower Cross Timber or Dakota sands, but not in quantity. In the Trinity, or Upper Cross Timber sands, there are still other lignites, but usually they occur as single isolated logs or trunks of trees.

UTAH.

Total product in 1891, 371,045 short tons; spot value, $666,646.

It is to be regretted that so little positive knowledge regarding the coal fields of Utah has been obtained. It is estimated that there are over 2,000 square miles of area in the territory underlaid by workable coal beds, and the increasing annual output would indicate the advisability of a thorough survey of the coal areas in order to determine their future possibilities.

At present the principal operations are being carried on in Emery county, the largest producing mines being the Pleasant Valley No. 1 mine, operated by the coal department of the Union Pacific railroad, and the Castle Gate and Winter Quarters mines of the Pleasant Valley Coal Company.

The Wasatch mine of the Home Coal Company, in Summit county, is the fourth in importance, having a production in 1891 of 41,966 short tons. The coal of this mine is really lignite, but serves very well for domestic use and for stationary boilers.

Three mines were operated in San Pete county in 1891. One of these, the Old Canyon operated by the Central Pacific Coal and Coke Company, disposes of its entire product to the San Pete Valley railway. The output of the other two supplies a local demand.

In Morgan county 100 tons were produced in 1891 for purely local consumption. Following is a table showing the production by counties. with the distribution and value of the product:

Coal product of Utah in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Emery	277, 639	4, 179	18, 000	25, 451	325, 269	$584, 972	$1. 80	461
Morgan	(*a*)1, 200	2, 510			3, 710	7, 930	2. 14	10
San Pete		100			100	225	2. 25	3
Summit	36, 872	1, 444	3, 650		41, 966	73, 519	1. 75	147
Total	315, 711	8, 233	21, 650	25, 451	371, 045	666, 646	1. 80	621

a Sold to railroads for locomotive use.

Summarized by the distribution of the product, and compared with the product for the two preceding years, the following is obtained:

Coal product of Utah in 1889, 1890, and 1891.

Distribution.	1889.	1890.	1891.
	Short tons.	*Short tons.*	*Short tons.*
Loaded at mines for shipment	216, 960	279, 336	315, 711
Sold to local trade and used by employés	17, 062	13, 749	8, 233
Used for steam at mines	412	1, 015	21, 650
Made into coke	2, 217	24, 059	25, 451
Total	236, 651	318, 159	371, 045
Total value	$377, 456	$552, 390	$666, 646

No record of the production of the Territory prior to 1885 was kept. Subsequent to that year the annual output has been as follows:

Coal product of Utah from 1885 to 1891.

Years.	Short tons.	Years.	Short tons.
1885	213,120	1889	236,651
1886	200,000	1890	318,159
1887	180,021	1891	371,045
1888	258,961		

VIRGINIA.

Total product in 1891, 736,399 short tons; spot value, $611,654.

The coal product of Virginia has shown an annual decrease since 1888, the output in 1891 being 47,612 short tons less than that of 1890. Practically all of this decrease is observed in the output of Tazewell county, the largest coal producer in the state. The mines at Winterpock, in Chesterfield county, were flooded in 1890 and had not resumed operations at the close of 1891. The output of the other three producing counties did not materially change.

Descriptions of the Virginia coal fields have been published in previous volumes of "Mineral Resources."

The product in 1891, by counties, was as follows:

Coal product of Virginia in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Henrico	13,075				13,075	$16,344	$1.25	100	8
Montgomery	1,460	2,577	178		4,215	9,930	2.36	94	28
Pulaski	12,766	9,377			22,143	24,419	1.10	256	38
Tazewell	555,781	4,731	3,000	133,454	696,966	560,961	.80	253	746
Total	583,082	16,685	3,178	133,454	736,399	611,654	.83	246	820

Coal product of Virginia since 1880.

Years.	Short tons.	Years.	Short tons.
1880	112,000	1886	684,951
1881	112,000	1887	825,263
1882	112,000	1888	1,073,000
1883	252,000	1889	865,786
1884	336,000	1890	784,011
1885	567,000	1891	736,399

From the above table it appears that the largest product in any one year was in 1888. Although that year was one of large coal production throughout the country, and the output of Virginia doubtless the largest in its history, still the amount reported was in all probability excessive and due to Virginia being credited with shipments from the Flat Top region of coal produced at mines in McDowell and Mercer counties, West Virginia.

The output of Henrico county goes over the Chesapeake and Ohio railroad. All of the other counties ship on the Norfolk and Western railroad.

New developments.—With the extension of the Clinch Valley branch of the Norfolk and Western railroad and the construction of the South Atlantic and Ohio railroads penetrating into Wise county attention has been directed to the coal properties known to exist there, and companies have been formed to develop them. The Big Stone Gap Coal Company, of Big Stone Gap, is opening up mines at that point, and the Kentucky Coal and Coke Company has been organized to open mines at Guests Station. Attempts are also being made to interest capital in the development of coal land in Wythe and Augusta counties and to extend operations in Montgomery county.

WASHINGTON.

Total product in 1891, 1,056,249 short tons; spot value, $2,437,270.

From reports to the technical press a largely increased output was looked for from Washington during 1891, but returns show that such expectations were not only not realized, but on the other hand a decided decrease occurs. None of the new companies organized during the year had any product to report, though some began shipping early in 1892. The one mine in Thurston county was not operated in 1891, and a strike of several months' duration, caused by an attempt to introduce negro and non-union labor, shortened the output in King county. The output of Kittitas county also shows a large decrease. It is very probable that the heavy importations of foreign coal into San Francisco was in part responsible for the smaller output of Washington coal.

The following table shows the product of the State for the past five years by counties:

Product of coal in Washington for five years, by counties.

Counties.	1887.	1888.	1889.	1890.	1891.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
King	339,961	546,535	415,779	517,492	429,778
Kittitas	104,782	220,000	294,701	445,311	348,018
Pierce	229,785	276,956	273,618	285,886	271,053
Thurston	15,295	42,000	46,480	15,000	1,400
Whatcom	....	....	....	....	6,000
Not specified	82,778	130,259	....	....	....
Total	772,601	1,215,750	1,030,578	1,263,689	1,056,249

The first discovery of coal in Washington was made in 1852, and the first mine was opened on Bellingham bay in 1854. The coal from this mine was shipped to San Francisco and was the only coal shipped out of the Territory until 1870, when exportation commenced at Seattle, from the Seattle, Renton, and Talbot mines in the vicinity. In 1874 the product from the Seattle mines was 50,000 tons; from July 1, 1878, to July 1, 1879, the product was 155,900 tons. In the year ended December 31, 1879, the product was 137,207 short tons. The Renton mine, opened in 1874, produced, in 1875 and 1876, 50,000 short tons. The Talbot mine, opened in 1875, produced, in 1879, 18,000 short tons of coal. Records of the operations of Washington coal mines are incomplete, and entirely wanting from 1879 to 1884. The mining during this time was confined to King and Pierce counties. During the fiscal year ended June 30, 1885, the total product of the Territory is given at 380,250 short tons, of which King county is credited with 204,480 short tons and Pierce county with 175,770 short tons. The annual product since that time has been as follows:

Product of coal in Washington from 1885 to 1891.

Years.	Total product.	Total value.	Average price per ton.	Total employés.	Average number of days worked.
	Short tons.				
1885	380,250				
1886	423,525	$952,931	$2.25		
1887	772,601	1,699,746	2.19	1,571	
1888	1,215,750	3,647,250	3.00		
1889	1,030,578	2,393,238	2.32	2,657	
1890	1,263,689	3,426,590	2.71	2,206	270
1891	1,056,249	2,437,270	2.31	2,447	211

Coal product of Washington in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
King	417,591	4,533	7,654		429,778	$1.009,278	$2.35	226	1.285
Kittitas	337,852	2,809	7,357		348,018	772,421	2.22	148	501
Pierce	246,053	4,683	5,317	15,000	371,053	632,671	2.33	236	601
Skagit	1,000		100	300	1,400	4,900	3.50	100	30
Whatcom	6,000				6,000	18,000	3.00	150	30
Total	1,008,496	12,025	20,428	15,300	1,056,249	2,437,270	2.31	211	2,447

King county.—Coal produced in 1891, 429,778 short tons; spot value, $1,009,278.

The output of King county in 1890 was 517,492 short tons, valued at $1,352,920, showing a decrease in 1891 of 87,714 short tons in amount and $343,642 in value. The decrease is attributed to the labor troubles previously referred to, which practically suspended operations at some of the mines about three months. One mine not affected by the strike increased its output about 80,000 tons, the gross loss distributed among the other three producing mines being about 160,000 tons. A number of new mines were opened in 1891, one of which began producing January 1, 1892, and an increased product for the county may be looked for in future reports.

The Columbia and Puget Sound and the Seattle, Lake Shore and Eastern railways furnish transportation facilities for the coal product of King county.

Coal product of King county, Washington, for five years.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	339,961			
1888	546,535			
1889	415,779	$954,295	$2.55	1,220
1890	517,492	1,352,920	2.61	1,098
1891	429,778	1,009,278	2.35	1,285

Kittitas county.—The entire product of Kittitas county is from the Roslyn mine, operated by the Northern Pacific Coal Company. The output in 1891 was 97,293 short tons less than in 1890. The coal is shipped from Roslyn over the Northern Pacific railroad, and is largely consumed by the railroad locomotives.

Coal product of Kittitas county, Washington, for five years.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	104,782			
1888	220,000			
1889	294,701	$777,450	$2.64	
1890	445,311	1,229,330	2.76	489
1891	348,018	772,421	2.22	501

Pierce county.—Coal produced in 1891, 271,053 short tons; spot value, $632,671.

Four counties, the same as in 1890, contributed to the product, which was 14,833 short tons less than the year before. The value of the product decreased $181,669, the average price per ton declining from $2.85½ in 1890 to $2.33½ in 1891. As in King county, a number of new operations were begun in 1891, but only development work was done, and no coal was shipped from them. The Northern Pacific railroad is the initial line of transportation.

Coal product of Pierce county, Washington, for five years.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	229,785			
1888	276,956			
1889	273,618	$578,493	$2.11½	759
1890	285,886	814,340	2.85½	589
1891	271,053	632,671	2.33½	601

Skagit and Whatcom counties.—Skagit and Whatcom counties appear as coal-producers for the first time in 1891, with a combined output of 7,400 tons, 6,000 tons of which were from Whatcom county and 1,400 tons from Skagit. Of the latter 300 tons were coked. The output is from one mine in each county. Other properties are being opened and 1892 will probable show considerable production in both counties.

The following analyses have been reported on coal from the Connor mine, Skagit county, Washington.

Analyses of coal from the Connor mine, Skagit county, Washington.

	Vein No. 1 (a).	Vein No. 2 (b).
	Per cent.	*Per cent.*
Fixed carbon	70.24	80.20
Volatile matter	18.68	12.05
Sulphur	.952	
Phosphorus	.015	
Water	.52	.45
Ash	9.59	7.30
Total	99.997	100.00

a Made by Otto Worth, Pittsburg, Pennsylvania.
b Made by D. I. Davis, Wilkeson, Washington.

Mining inspectors.—A law was passed by the legislature of the State of Washington in the winter of 1891–92 which has for its object the providing of proper ventilation of coal mines and prescribing the manner of appointment of inspectors. One of the main features of the bill, is the providing for the appointment of two inspectors, who shall have been recommended by an examining board appointed by the governor, and who shall each receive a salary of $1,500 annually and mileage actually paid out. Section 7 of the bill provides, as amended, that charges may be preferred against the mining inspector upon a petition signed by ten reputable citizens, who shall be miners, mine-owners, or lessees of mines. The bill provides that in no case shall less than 100 cubic feet of air for each person per minute pass a given point.

THE COAL FIELDS OF WASHINGTON.

[By W. H. Ruffner, LL. D.] (*a*.)

It is only of late that the Laramie or Cretaceous coals of Washington have been divided into lignites, bituminous coals, and anthracites. These grade into each other so insensibly that it would be impossible to classify them sharply. None of the lignites which the writer saw were as low in grade as the typical lignite. The woody structure was quite discernible in some samples of the Franklin coal and less in the Newcastle and Green River coals; but, in respect to the two latter, the

a From Prof. Ruffner's "Report on Washington Territory" (now State of Washington), compiled for the Seattle, Lake Shore and Eastern railway and published in this volume by permission of Mr. J. H. Bryant, vice-president. A few minor changes have been made in the original from later data.

writer could not with the naked eye discern more of the woody structure than has been seen in some of the West Virginia coals, which belong to the Carboniferous period. Fires of Newcastle and neighboring coals produce no unusual amount of smoke and no peculiar odor. By analysis, these coals show a larger percentage of oxygen than the typical bituminous coal, but decidedly less than is found in the brown coal of Germany or in some of the lignites of Montana. They need a new name. Their heating power is not so great as that of the bituminous coals of the same region. Their streak and powder are less black and their fracture more conchoidal, but not decidedly so.

The bituminous coals have the usual cubical fracture. The Wilkeson readily breaks down into small cubes. The lignites are black and lustrous. They come out as lumpy as ordinary coal and, when exposed to weather, do not break up into powder and grits like ordinary lignite. This is true, at least, of the Newcastle coal.

The coking quality of these coals can not be determined by calculating the proportion between the fixed carbon and the volatile, combustible matter. So far as now known, only a few of the Washington coals can be made into good coke. On this point, however, we have only laboratory and rough field tests, excepting at the Wilkeson mines, where 25 ovens were turning out a superior quality of coke, as proved by every test save the use of it in high furnace stacks, in which there had been no opportunity for trial. It is claimed by many persons that seams on Green river, Skagit, Yakima, and Snoqualmie will furnish good coking coal. The coal on Snoqualmie mountain, near Hop Ranch, has not been studied, but it certainly has the external characteristics of good coking coal, and Mr. Peter Kirke made a rough trial of it in an earth-pit with decidedly encouraging results.

Somewhat similar coal is found on Raging river, but, where opened, so much slate was interleaved with the coal that washing would be necessary before use. More will be said hereafter with regard to these coals; but the remark may be repeated here in respect to the entire Puget sound basin, that much additional examination is necessary before its coals will be fully understood. The variations in character of these are not owing entirely, or even chiefly, to their relative ages, but also to the conditions to which they have been subjected, especially in respect to heat. This metamorphic agency has acted not only in the body of the Cascade mountains, but all through the coal fields, where faults, flexures, and intrusive rocks have occasioned changes in the original condition of the coal beds, giving results along the whole scale of metamorphism from lignite to anthracite.

The different mines.—In brief sketches are grouped the coal beds as follows: (1) Carbon River group; (2) the Green River group; (3) Cedar River group; (4) the Squak, Raging River, and Snoqualmie groups; (5) the Yakima and Wenatchie group; (6) Bellingham bay, Skagit river, etc.

1. *Carbon River group.*—These beds lie on South Prairie creek and Carbon river, tributaries of the Puyallup river. Limited occurrences of anthracite coal in thin beds are reported high up on Carbon river, near the base of Mount Ranier, the result of metamorphism. Also undeveloped outcrops of soft coal at numerous points on the same river. There are, however, only three collieries at work in this group. One is called the Carbonado mines, which are on the Carbon river. Three miles north, a little east, are the famous Wilkeson mines and 2 miles northwest of Wilkeson are the South Prairie mines, on South Prairie creek. These coal beds stand at high angles (50 degrees and upwards) and dip in various directions. At Carbonado there are four seams in pairs, separated by Carbon river and having a complicated folded and faulted structure. At the South Prairie mines there are two seams, one of which dips to the east and the other to the west. At Wilkeson there are three seams, opened on both limbs of an anticlinal. Mr. Bailey Willis interprets this coal field as being a domelike anticlinal, with compressed and crumpled sides, whose major axis runs nearly north and south. The Wilkeson and South Prairie mines are on the line of the major axis, whilst the Carbonado mines are in a group of subordinate short folds lying south of the main line. The anticline extends to Nisqually river and shows two other coal areas south of Carbon river, the coal of which is said to resemble the Wilkeson coal.

The Carbon River coal field, first having been almost ingulfed by volcanic uplifts and overflows and almost buried by glacial drift, is now visible only in narrow strips along creeks and at intervals along the Carbon river.

Owing probably to the heating of its beds, we find in this little field the coal which stands highest in reputation for coking and heating qualities. There are some differences in the coal at the three mines. That at South Prairie was sold chiefly for making gas. The best of the Wilkeson coal is made into coke and is in demand beyond the supply. The entire product of the Carbonado mines is said to go to the Central Pacific railway. It is impossible to say what may be under the drift, but wherever streams expose sections or borings have been made good coal beds have been found which will be valuable in spite of the disturbed structure of the field.

2. *The Green river group.*—Included in this group are the Black Diamond and Franklin collieries, the Kirke or Moss Bay Company mines, and the Sugar Loaf mountain beds. This, as well as the Carbon river field, is nearly equidistant from Tacoma and Seattle, being about 30 miles in a right line from each place. The Carbon river basin is geologically associated with Mount Ranier; the Green river basin with the outliers or foot ridges of the Cascade mountains. The latter are much more approachable than the former. At the east edge of this field, the Northern Pacific railroad emerges from the Cascade mountains, having come down the canyon of Green river. This point is

known as "The Common Point," because the cities of Tacoma and Seattle are about equally distant, and the routes afford equally good grades from this point.

The narrow-gauge road from Seattle now comes to the Franklin mines, and by continuing it a few miles to connect with the Northern Pacific there would be railroad connection to Seattle as well as to Tacoma. The river here cuts through the coal measures, leaving the less valuable part of the field on the south side. The area of this field is roughly estimated at 50 square miles. It contains all, or nearly all, the grades of coal from lignite to bituminous, the variety of coal depending upon the degree of local disturbance. As a rule, so long as the coal is not crushed, the more pitched and flexed the rocks, the better the coal, which fact indemnifies the miner for extra expense in mining. Here, the tendency is for the seams to become steeper and more broken from west to east; that is, as they approach the foot-hills of the Cascade mountains. The strata in Lizard mountain on the south side, however, form an exception. Here the strata are nearly horizontal.

The Franklin mines are on the north bank of Green river and at the south edge of what has been known as the McKay basin, and the Black Diamond mines are on, or near, the north edge of the same small, oval synclinal basin. From this basin the dips become steeper toward the mountain, where Kirke's beds stand at a high angle. On the west edge of the Green river basin, say a mile west of Franklin, there is an outcrop of lignite. The coal of the Franklin and Black Diamond mines is bituminous lignite. The Kirke coal, or at least part of it, as judged by the eye, may be called bituminous coal, though not so much deoxidized as the Wilkeson. The coals mined in this basin are firm, black and shiny; they burn freely, and make but little dust. They have not, however, so far as tested, the heating power or coking qualities of the Wilkeson coal. Two seams are worked at Franklin, and three at Black Diamond. All of the seams worked are above 4 feet. A number of volcanic dikes and flows are found in and around this basin.

The Kirke or Moss Bay Company mines are 6 miles east of Franklin, and within a mile of Green river. They lie against the mountain. The coal beds dip toward the mountain at a high angle. There are five seams of from 5 to 15 feet in thickness; one of them (No. 2) may be said to be over 47 feet in thickness, though containing much bone coal.(*a*)

3. *The Cedar river group.*—This group consists of the Cedar river mines, 19 miles from Seattle by rail; the Renton and Talbot mines, 10 miles, and the Newcastle, 18 miles. These coals are in the same river basin, and are all high-grade lignites.

The first shipment made from the Cedar river mines was in July, 1884. There are two good seams here, one of which measures 11 feet. The outcrop curves from a south to a southwest strike. The dip is 20 degrees toward the east.

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a For analyses and cross-sections of coal beds in the Wilkeson and Green river fields see Tenth Census Reports, Vol. XV, pp. 769–771, and plates xcii to cii.

The Talbot and Renton mines, 10 miles from Seattle, are on the same seam, but owing to faults and other causes, they have not been worked of late. The seam is 7 to 9 feet of good coal, resembling the Newcastle, but has a bad roof, and soon reaches water. The dip is to the southeast at the grade of 10 to 25 degrees. The principal mine in this basin is the Newcastle, from which more coal by far has been mined than from any other. Its present annual output is equaled only by the Carbonado mines, which are pressed to their full capacity by the Central Pacific railroad. The Newcastle coal is a high grade lignite, of firm texture, shining black color, and angular fracture. It is not a coking coal, but has a wide and established reputation for grate, stove and boiler uses. It is the typical "Seattle" coal, and is sold chiefly in Oregon and California. It has not the heating power of bituminous coal, but it is greatly superior to many of the lignitic coals. Many difficulties have been met with in the mining at Newcastle, the most of which seem to have been owing to the necessity for mining on the down grade, or fall of the coal; and the mines being now 1,000 feet deep.

4. *The Squak creek, Raging river, and Snoqualmie Group.*—These are not all in the same hydrographic basin, but they are all considered together because they are coals which will be reached by the Seattle railroad. A great out-crop of coal seams occurs in the valley of Squak creek in the mountain spur which lies between Squak and the Newcastle mines. These seams are now being opened by the Seattle Coal and Iron Company, and are known as the Gilman mines.

The geological structure of the Squak mountain and its coal seams is peculiar. With all their local irregularities, the general trend of the coal-bearing rocks in Washington territory is north and south; so determined by the line of the Cascade mountains, which is the main axis of elevation, with numerous subordinate and parallel axes. But on Squak mountain we find the whole group of rocks and coal seams lying at right angles to the general line. In other words, their general direction is east and west, instead of north and south, and the rocks lie in regular order against their central axis, dipping northward at a high angle. These coal seams are thus carried almost squarely across the spur from Squak creek to Coal creek, or from the Gilman mines to the Newcastle mines.

The part of the mountain which holds the coal seams is a high spur which puts off at right angles northward from the crest or backbone and continues to Lake Washington, a distance of 5 miles. At the point where the spur leaves the backbone it is about 1,000 or 1,200 feet high, and it declines gradually to the lake and then makes a bluff shore line. On the east side of the spur on Squak creek it is steep, whilst on the west side, next Newcastle, it drops off more gradually. This difference of grade occasions a great difference in the economy of mining on the two sides. On the east or Squak creek side the ends of the seams are boldly presented, showing, in diagonal parallel lines extending from the top of the spur to the creek level, an average exposure of, say, 900 feet in elevation. Here the entries are being driven in horizontally near the water level, and the future progress of the mining will be inward and upward instead of downward and sidewise, as at Newcastle. The entries will all be on the horizontal line crossing the seams. The extreme distance, 1,300 feet. The length of the seams on the company's land is about 2 miles.

The Seattle Coal and Iron Company own this property, which consists of 1,300 acres underlaid by seven coal seams, five of which will be mined ultimately, three in the beginning.

The Washington mines, on one of the upper branches of Squak creek, show the outcroppings of three seams of lignite coal, dipping south of west.

Six miles east of Gilman mines, where the railroad enters the Raging River valley, is found another group of coal seams, older than the Squak coals and perhaps corresponding in age with the Franklin and Black Diamond coals though apparently more bituminous than they. Raging river is about 12 miles long, and the railroad first approaches it about midway its length. There are indications of local metamorphism visible in the rocks between Squak creek and Raging river, and this is further indicated by an outcrop of anthracite at the north end of the coal seams, within a mile of the road. Mr. Whitworth represents this anthracite seam as five feet thick, but crushed and fragile. Its structure is laminated and it breaks into small cubes. He spoke, also, of another seam of anthracite high up on Raging river, 3 feet thick, with 3 inches slate 6 inches from the top. He mined in on this for 30 feet without observing any change. The outcrop of this group of coal seams extends from near the line of the railroad, up the west side of the valley, parallel with the river and about a mile from it and lying in high hills. This coal property is also owned by the Seattle Coal and Iron Company. The principal mining camp is near the head of the valley, 10 miles above Falls City, 6 miles above the line of railway. Here I saw the coal seams, which had been uncovered without having been cut into sufficiently to fully determine their character. One seam is open in a ravine half way up the mountain, but most of them are near the top, at an elevation of about 800 feet above the river. There are at least six seams, and possibly seven. The coal generally is of good quality, bituminous, with cubical fracture; but its value is greatly diminished by numerous slate partings, and some of the seams are too thin for profitable mining. The dip is to the southwest at high angles, about 80 degrees on the mountain side, less in the top seams.

5. *The Yakima and Wenatchie Group.*—This field lies on the east flank of the Cascade mountains, on the waters of the Yakima and its tributaries, Cle-ellum and Teanaway valley. Although the area here

is probably disconnected from the Yakima area, the writer purposely refrained from visiting this region, and for the following statements is indebted to Mr. F. H. Whitworth, Mr. Charles Burch, and Mr. Jamieson, of the Kirke Mines.

The Yakima area lies north of the Yakima river, near to the Northern Pacific railroad and to the projected line of the Seattle, Lake Shore and Eastern railway, and extends about 60 miles east and west and 6 miles north and south. Its dip is gentle, say 12 to 20 degrees. It holds three coal seams of 2 feet 6 inches, and 5 feet and 5 feet, respectively. There is not much evidence of fracture in any part of the field. The total thickness of the coal-bearing rocks is estimated to be 1,000 feet. The best seam is mined at Roslyn, 4 miles north of the Northern Pacific railroad, in the interest of that railroad.

The seam here furnishes upward of 4 feet of good coal. The coal is bituminous, dull black, firm, and free burning. Mr. Jamieson thinks it will not make good coke. Others, however, think that it will, and these are supported partially by the laboratory test in Washington city, D. C.

This coal is used chiefly in the locomotives; but the popular demand for it is very great in the plateau country of East Washington.

The information regarding the coal on Wenatchie river has been obtained from Mr. Burch, who says that there are two seams of coal exposed in that valley, one of 8 feet and one of 3 feet. The coal-bearing rocks extend for 35 miles up the river and have a width of 10 miles.

The coal is reported by Mr. Burch to appear east of the Columbia river, opposite to the fields just described, and to disappear under the basalt.

6. *Bellingham Bay, Skagit River, and other coal fields.*—The first shipping of coal from Washington territory was done from the Seahome mines, on Bellingham bay, Puget sound, about 25 miles south of the Canada line. The mines were very badly managed; they took fire on several occasions. The coal was of the lignitic grade, but not of the best quality, and when other mines of better coal were opened the Bellingham Bay mines were closed. It is reported that coking coal has been found some distance back from the bay.

Coal has also been found on Skagit river, which, from a sample, is good and possibly might coke well. One of the coal properties is held by A. Ford and others. The following description is furnished by Mr. Norman B. Kelly:

It is found about 3 miles north of the Skagit river and about 5 miles from Sedro. The country is hilly. There are at least six or eight coal seams, perhaps more. Those examined run from 18 to 30 inches and are thought to be clean coal. The seams lie between sand rocks. The outcrops begin near the level of the valley and continue in a series to an altitude of 550 feet above the valley. The highest outcrops are those of the lowest seams geologically. The strike is north 60 degrees west. At the foot of the hill the seams dip 45 degrees to the southwest, but the angle becomes steeper on the mountain side until finally they are vertical. All the outcrops are within 1,500 feet, horizontal distance. Blacksmiths use the coal and pronounce it equal to Cumberland. It cokes readily in the open fire, burns with a bright, hot, but small flame, and seems to leave but little ash.

Of course the thinness of these seams is an objection. There is coal also upon the south side of the river, but there has been but little development in this field.

WEST VIRGINIA.

Total product in 1891, 9,220,665 short tons; spot value, $7,359,816.

The rapid development of the coal fields of West Virginia in the last few years is worthy of special note. The increase of product in 1890 over that of 1889 was 1,162,774 short tons or more than 18 per cent. The increase in 1891 was still more remarkable, being 1,826,011 short tons or nearly 25 per cent. The largest increase was in Fayette county, the total output for the county being 2,307,421 short tons, against 1,591,298 short tons in 1890, a gain of 716,123 tons or 45 per cent. Marion county increased its product from 455,728 short tons in 1890 to 1,000,047 short tons, a gain of 544,319 short tons or nearly 120 per cent. McDowell county augmented its product 310,914 short tons or more than 32 per cent.; Mercer county added 167,040 short tons to the general increase, a gain of nearly 17 per cent., and Tucker county, 113,356 tons or more than 46 per cent.

In order of coal-producing importance West Virginia holds fourth place, being preceded by Pennsylvania, Illinois, and Ohio in the order named. During 1891 many new companies began work, and, while not reaching the stage of production before the close of the year, most of them will be in full operation in 1892, and the product for the present year will doubtless show large increases, and it is not hazardous to predict that within a few years West Virginia will appear as the third, if not the second, coal-producing State in the Union.

The following table exhibits the annual output of the State since 1873:

Coal product of West Virginia since 1873.

Years.	Short tons.	Years.	Short tons.
1873	672,000	1883	2,335,833
1874	1,120,000	1884	3,360,000
1875	1,120,000	1885	3,369,062
1876	896,000	1886	4,005,796
1877	1,120,000	1887	4,881,620
1878	1,120,000	1888	5,498,800
1879	1,400,000	1889	6,231,880
1880	1,568,000	1890	7,394,654
1881	1,680,000	1891	9,220,665
1882	2,240,000		

In the preceding table the figures quoted for the years prior to 1880 are largely estimated, and are therefore not included in the following statement showing the annual increase for each year:

Annual increase in coal product of West Virginia since 1880.

Years.	Short tons.
1881 over 1880	112, 000
1882 over 1881	560, 000
1883 over 1882	95, 833
1884 over 1883	1, 024, 167
1885 over 1884	9, 062
1886 over 1885	636, 734
1887 over 1886	875, 824
1888 over 1887	617, 180
1889 over 1888	733, 080
1890 over 1889	1, 162, 774
1891 over 1890	1, 826, 011
Total increase in eleven years	7, 652, 665
Average annual increase	695, 697

Distributed by counties and by the disposition of the product, the statistics of the output of coal in West Virginia in 1891 are, as follows:

Coal product of West Virginia in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Number of days active.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Brooke	13, 000	20, 780	170	....	33, 950	$28, 000	$0. 82	274	59
Fayette	1, 581, 548	33, 002	7, 696	685, 175	2, 307, 421	1, 958, 016	. 85	245	3, 823
Harrison	123, 762	14, 351	560	11, 849	150, 522	108, 911	. 72	214	285
Kanawha	1, 290, 895	26, 245	4, 859	2, 789	1, 324, 788	1, 285, 164	. 97	217	2, 802
Marion	580, 648	5, 916	13, 369	400, 114	1, 000, 047	705, 853	. 71	279	1, 408
Marshall	167, 203	25, 000	1, 500	....	193, 703	154, 402	. 80	257	190
Mason	76, 592	81, 568	1, 830	....	159, 990	144, 052	. 90	236	311
McDowell	878, 483	6, 194	3, 786	378, 673	1, 267, 136	856, 292	. 68	227	1, 536
Mineral	675, 288	17, 838	448	....	693, 574	581, 814	. 84	259½	624
Mercer	1, 004, 740	5, 226	7, 067	155, 877	1, 172, 910	861, 709	. 73	244	1, 510
Monongalia	12, 000	10, 000	....	9, 000	31, 000	20, 150	. 65	260	50
Ohio	15, 000	74, 435	1, 165	....	90, 600	70, 553	. 78	276	131
Preston	58, 187	1, 488	2, 578	78, 146	140, 399	89, 829	. 64	221	304
Putnam	89, 230	4, 000	1, 000	....	94, 230	112, 282	1. 19	143	526
Taylor	86, 621	1, 929	....	13, 111	101, 661	61, 488	. 60	287	118
Tucker	233, 954	1, 906	1, 135	121, 739	358, 734	231, 301	. 64	306	550
Small mines	....	100, 000	....	....	100, 000	100, 000	....	....	....
Total	6, 887, 151	429, 878	47, 163	1, 856, 473	9, 220, 665	7, 359, 816	. 80	237	14, 227

In the following table is shown the tendency of coal production in West Virginia from 1886 to 1891:

Coal production in West Virginia from 1886 to 1891, by counties.

Counties.	1886.	1887.	1888.	1889.	1890.	1891.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Brooke	22,880	40,366	11,568	31,119	36,794	33,950
Fayette	1,413,778	1,252,427	1,977,030	1,450,780	1,591,298	2,307,421
Harrison	234,597	154,220	109,515	174,115	144,403	150,522
Kanawha	876,785	1,126,839	863,600	1,218,236	1,421,116	1,324,788
McDowell	....	....	....	586,529	956,222	1,267,136
Marion	172,379	365,844	363,974	282,467	455,728	1,000,047
Marshall	251,333	92,368	47,702	47,706	123,669	193,703
Mason	150,878	140,968	72,410	185,030	145,314	459,990
Mercer	328,733	575,885	969,395	921,741	1,005,870	1,172,910
Mineral	361,312	478,636	456,361	493,464	573,681	693,574
Monongalia	....	....	....	74,031	31,360	31,000
Ohio	(*a*)	131,936	140,019	143,170	103,586	90,600
Preston	170,721	276,224	231,540	129,932	178,439	140,399
Putnam	(*b*)	53,200	145,440	218,752	205,178	94,230
Taylor	(*c*)	168,000	55,729	83,012	76,618	101,661
Tucker	22,400	24,707	62,517	173,492	245,378	358,734
Other counties and small mines	....	....	....	18,304	100,000	100,000
Total	4,005,796	4,881,620	5,498,800	6,231,880	7,394,654	9,220,665

a Included in product of Marshall county.
b Included in product of Mason county.
c Included in product of Harrison county.

New railroads.—The construction of several new lines of railroads now in progress will act as a potent factor in increasing the output of coal in West Virginia in the near future. The Norfolk and Western extension building from the Flat Top region to the Ohio river opens valuable coal lands lying along the Twelve Pole river in Wayne county, as well as new fields in McDowell and Logan counties. These counties lie along the southern extremity of the State. In the central portion of the State the Kanawha and Elk River Railroad Company, newly incorporated, proposes to construct a line from a point on the Kanawha river a few miles west of Charleston, following the line of the Elk River, to Sutton, in Braxton county. At the latter point it will make connection with the Fairmont, Morgantown and Pittsburg Railroad, a branch of the Baltimore and Ohio, and at the southern terminus makes connection with the Kanawha and Michigan railroad and with Kanawha river boats. The road will open up coal lands in Kanawha, Clay, and Braxton counties. The northern part of the State is to have a new railroad from Blacksville, in Monongalia county, through Mannington, Marion county, to Clarksburg, Harrison county.

PRODUCTION BY COUNTIES.

Brooke county.—Coal produced in 1891, 33,950 short tons; spot value, $28,000.

The output of Brooke county in 1891 was 2,844 short tons less than in the preceding year. The value declined $520, the average price per ton increasing from 77½ cents in 1890 to 82½ cents in 1891. The coal is shipped over the Pittsburg, Cincinnati, Chicago and Saint Louis railroad.

Coal product of Brooke county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	22,880			
1887	40,366	$37,394	$0.94	50
1888	11,568			
1889	31,119	22,828	.73	50
1890	36,794	28,520	.77½	50
1891	33,950	28,000	.82½	59

Fayette county.—Coal produced in 1891, 2,307,421 short tons; spot value, $1,958,016.

Fayette county is the largest coal-producing county in the state, having, in 1891, a product of nearly 1,000,000 tons greater than Kanawha county, which comes second. The output in 1891 was 716,123 short tons, or 45 per cent. more than in 1890, the value of the product increasing $519,404. There were 27 mines operated in the county during 1891, and all, with one exception, made complete returns to the Survey. Nearly all of the product of Fayette county is shipped over the Chesapeake and Ohio railroad, a small amount going west via the Great Kanawha river.

Coal product of Fayette county, West Virginia, for six years.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	1,413,778			
1887	1,252,427	$1,127,184	$0.90	3,030
1888	1,977,030			
1889	1,450,780	1,302,438	.90	2,644
1890	6,591,298	1,438,612	.90	2,824
1891	2,307,421	1,958,016	.85	3,823

Harrison county.—Coal produced in 1891, 150,522 short tons; spot value, $108,911.

The product of Harrison county in 1891 increased 6,119 short tons, and the value, $8,093, the average price per ton increasing from 70 cents to 72 cents. The coal product is shipped over the Baltimore and Ohio, the West Virginia and Pittsburg, and the Monongahela River railroads.

Coal product of Harrison county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	(*a*)234,597			
1887	154,220	$100,243	$0.65	263
1888	109,515			
1889	174,115	114,427	.66	233
1890	144,403	100,818	.70	305
1891	150,522	108,911	.72	285

a Includes product of Taylor county.

Kanawha county.—Coal produced in 1891, 1,324,788 short tons; spot value, $1,285,164. Compared with 1890, the output of Kanawha county in 1891 shows a decline of 96,328 short tons, with a decrease in value of $80,421. Of the twenty-two producing mines in the county, twenty made reports of their operations, the output of the other two being estimated on the basis of their production in 1890. The Chesapeake and Ohio railway and the Great Kanawha river boats carry the product to market.

Coal product of Kanawha county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	876,785			
1887	1,126,839	$1,408,549	$1.25	2,496
1888	863,600			
1889	1,218,236	1,166,038	.96	2,484
1890	1,421,116	1,365,585	.96	2,756
1891	1,324,788	1,285,164	.97	2,802

McDowell county.—Coal produced in 1891, 1,267,136 short tons; spot value, $856,292.

In "Mineral Resources" for 1888 no product from McDowell county is reported, the first report for this county being made by the Census Office in 1889. The output in that year was 586,529 short tons, and put McDowell county fourth in the State in producing importance. In 1891 the product increased to 956,222 tons, but did not change the relative rank of the county. A further increase of 310,914 tons, or more than 32 per cent., was added to the product in 1891, bringing it up to 1,267,136 short tons, and putting McDowell third in rank. The following table shows the amount and value of the coal product and the number of men employed in and about the McDowell county mines during the three years:

Coal product of McDowell county, West Virginia, for three years.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1889	586,529	$390,232	$0.67½	764
1890	956,222	678,305	.71	1,315
1891	1,267,136	856,292	.67½	1,536

There were more new companies beginning operations in McDowell county in 1891 than in any other county in any State of the Union, and while only a few of these commenced shipping during the year it is probable that nearly all will be in full blast before the close of 1892, and the product for the year largely increased.

Marion county.—Coal produced in 1891, 1,000,047 short tons; spot value, $705,853.

The output of Marion county in 1891 was 544,319 short tons more than in 1890, an increase of nearly 120 per cent. Nearly 70 per cent. of this large increase is due to the operations of the Monongah Coal and Coke Company, which began mining in 1890, but whose product did not reach 75,000 tons in that year, and exceeded 400,000 tons in 1891. The West Fairmont Coal and Coke Company, which also began work in 1890, with an output of less than 4,000 tons, produced more than 80,000 tons in 1891. The Gaston Gas Coal Company increased its product over 50,000 tons, and the Montana Coal and Coke Company over 35,000 tons. The coal is shipped over the Baltimore and Ohio and the Monongahela River railroads.

Coal product of Marion county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	172, 379			
1887	365, 844	$312, 675	$0. 80	590
1888	363. 974			
1889	282, 467	199, 692	.71	333
1890	455, 728	313, 505	.69	865
1891	1, 000, 047	705, 853	.70	1, 408

Mason county.—Coal produced in 1891, 159,990 short tons; spot value, $144,052.

The coal production of Mason county depends very largely upon the condition of the salt-producing industry, as most of the mines are worked merely to supply fuel for the evaporation of salt brines obtained in the immediate vicinity. The reports from the coal mines indicate an increased production of salt. In 1890, out of a total product of 145,314 short tons of coal, 55,265 tons were consumed in salt-making or evaporating. In 1891, out of a total of 159,990 tons, the amount consumed in salt works was 67,340 tons; the total increase in product for the county was 14,676 short tons, of which 12,075 tons was represented as the increase used in salt production. The portion of the product shipped goes over the Ohio River railroad and by Ohio river boats.

Coal product of Mason county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	(*a*)150, 878			
1887	140, 968	$140, 968	$1. 00	368
1888	72, 410			
1889	185, 030	167, 783	.91	363
1890	145, 314	134, 643	.93	320
1891	159, 990	144, 052	.90	311

a Includes product of Putnam county.

From the above table it appears that with an increased output in 1891 there was a decrease in the number of employés. This is in part offset by an increase in the number of working days, being 236 in 1891 against 229 in 1890. It does not, however, indicate an increase of labor employed corresponding to the increase in output, but does indicate an improvement in the earnings of each employé, in that the number of tons mined per day per man in 1890 was 1.98, and in 1891, 2.18.

Marshall county.—Coal produced in 1891, 193,703 short tons; spot value, $154,402.

The output in 1891 was from three mines and shows an increase over the product of 1890 of 70,034 short tons. One new colliery was opened during the year and will probably be in operation during 1892. The coal is shipped by the Baltimore and Ohio and the Ohio River railroads.

Coal product of Marshall county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	(*a*) 251, 333			
1887	92, 368	$70, 200	$0. 76	125
1888	47, 702			
1889	47, 706	35, 956	. 75	72
1890	123, 669	100, 846	. 81½	175
1891	193, 703	154, 402	. 80	190

a The apparent large product in 1886 is due to the inclusion of the product of Ohio county.

Mercer county.—Coal produced in 1891, 1,172,910 short tons; spot value, $861,709.

The product of Mercer county in 1891 was 167,840 short tons larger than in 1890, with an increase in value of $106,695. In any discussion of the production of coal or coke, Mercer and McDowell counties, West Virginia, and Tazewell county, Virginia, should be considered as representing the business of the Flat Top field. This is done in a separate paragraph at the conclusion of the report on West Virginia. The tendency of production in Mercer county since 1886 has been as follows:

Coal product of Mercer county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	328, 733			
1887	575, 885	$437, 673	$0. 76	965
1888	969, 395			
1889	921, 741	594, 885	. 64½	1, 121
1890	1, 005, 870	755, 014	. 75	1, 465
1891	1, 172, 910	861, 709	. 74	1, 510

Mineral county.—Coal produced in 1891, 693,574 short tons; spot value, $581,814.

Mineral county increased its output from 573,601 short tons, valued at $501,391, in 1890, to 693,574 short tons, worth $581,814, a gain of 119,973 in tonnage and in value of $80,423. The coal fields of Mineral county belong to what is known as the Cumberland field and contribute an important part of its product. The Elk Garden mines of the West Virginia Central and Pittsburg railroad are the largest producers, furnishing about 75 per cent. of the total output. The West Virginia Central and Pittsburg and the Baltimore and Ohio railroads are the initial lines of transportation.

Coal product of Mineral county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	361,312			
1887	478,636	$382,909	$0.80	475
1888	456,361			
1889	493,464	394,827	.80	608
1890	573,681	501,391	.87½	620
1891	693,574	581,814	.84	624

Monongalia county.—Returns from this county for 1891 are incomplete. Estimated on the basis of the product of 1890, the output was about 31,000 short tons.

Ohio county.—Coal produced in 1891, 90,600 short tons; spot value, $70,553.

About 60 per cent. of the coal product of Ohio county is used at iron and nail works in the immediate vicinity of the mines. One of these mills, formerly using coal (and consuming about 13,000 tons in 1890), changed to the use of gas in 1891, and the product of the county accordingly fell off, the decrease in tonnage being 12,986. The value of the product of Ohio county is arbitrarily placed, not representing in most cases any value received, and taken at the price charged to the mill expenses or at the average ruling price in the neighborhood. Only one company in the county mined coal for shipment. This mine is at Elm Grove and ships over the Baltimore and Ohio railroad.

Coal product of Ohio county, West Virginia, since 1887.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	131,936	$145,130	$1.10	211
1888	140,019			
1889	143,170	126,909	.88½	204
1890	103,586	100,017	.97	153
1891	90,600	70,553	.78	131

Preston county.—Coal produced in 1891, 140,399 short tons; spot value, $89,829.

The product of Preston county in 1891 was 38,040 short tons less than in 1890. The decrease was largely due to the abandoning of one mine which in 1890 produced about 20,000 tons. Another colliery, producing about 84,000 tons in 1890, lessened its output more than 50 per cent. All of the other mines increased their production.

Coal product of Preston county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	170, 721			
1887	276, 224			348
1888	231, 540			
1889	129, 832	$86, 024	$0. 66	239
1890	178, 439	127, 803	. 72	337
1891	140, 399	89, 829	. 64	304

Putnam county.—Coal produced in 1891, 94,230 short tons; spot value, $112,282.

Putnam county suffered for six months during the year from a strike among the coal operatives and as a result the production fell off 110,948 short tons. The loss to the miners in time was about 400 men made idle for 100 days.

One new mine was opened during 1891 and a decided increase in production in 1892 may be anticipated. The coal is sent over the Kanawha and Michigan railroad and by the Great Kanawha river.

Coal product of Putnam county, West Virginia, since 1887.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	53, 200			200
1888	145, 440			
1889	218, 752	$244, 203	$1. 12	451
1890	205, 178	198, 269	. 97	375
1891	94, 230	112, 282	1. 19	526

Taylor county.—Coal produced in 1891, 101,661 short tons; spot value, $61,488.

The output of Taylor county is from two mines on the line of the Baltimore and Ohio railroad over which the product is shipped. The returns for 1891 show an increase over 1890 of 25,043 short tons in amount, but only $3,329 in value, indicating a sharp decline in the prices realized by producers. The average price realized in 1890 was 76 cents, and 1891 60½ cents per short ton.

Coal product of Taylor county, West Virginia, since 1887.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1887	168,000			225
1888	55,729			
1889	83,012	$52,725	$0.63½	96
1890	76,618	58,159	.76	108
1891	101,661	61,488	.60½	118

Tucker county.—Coal produced in 1891, 358,733 short tons; spot value, $231,301.

The increase in the product of Tucker county in 1891 over that of 1890 was 113,356 short tons, or over 46 per cent. The output of this county in 1886 was only 22,400 short tons, increasing to 24,707 tons in 1887. The remarkable strides made since that time may be seen in the following table:

Coal product of Tucker county, West Virginia, since 1886.

Years.	Total product.	Total value.	Average price per ton.	Total employés.
	Short tons.			
1886	22,400			
1887	24,407	$19,526	$0.80	100
1888	62,517			
1889	173,492	120,574	.69½	229
1890	245,378	186,641	.76	353
1891	358,734	231,301	.64½	550

All of the coal of Tucker county sent to a distance is shipped over the West Virginia Central and Pittsburg railroad.

COAL PRODUCTION IN THE FLAT TOP FIELD.

The Flat Top field embraces the county of Tazewell, in Virginia, and the counties of McDowell and Mercer, in West Virginia. The output of coal in these counties has been considered in the discussion of the production by states. This necessarily separates into three parts the product of a locality which should be considered entire.

The development of this now famous region began in 1881, only ten years prior to the period covered by this report. It was not until April, 1882, however, that the first blast was exploded, and not until 1883 was any coal shipped out of the country. In the latter year the Norfolk and Western railroad completed its New River extension, and then it was when began the industry which to-day makes the Flat Top field a prominent factor in the coal production of the United States.

The following table exhibits the annual output of the Flat Top region since 1883, being the combined products of Tazewell county, Virginia, and McDowell and Mercer counties, West Virginia.

Product of coal in the Flat Top region since 1883.

Years.	Short tons.
1883	105,805
1884	272,173
1885	651,987
1886	924,361
1887	1,169,700
1888	1,376,010
1889	2,292,288
1890	2,699,419
1891	3,137,012
Total for nine years	12,628,755
Average yearly output	1,403,195

To further illustrate the remarkable development of this region the following statement has been obtained from the preceding one, and shows the annual increases in production since the field was opened:

Annual increases in shipments from the Flat Top region.

Years.	Short tons.
1884 over 1883	162,368
1885 over 1884	379,814
1886 over 1885	272,374
1887 over 1886	245,339
1888 over 1887	206,310
1889 over 1888	916,278
1890 over 1889	407,131
1891 over 1890	437,593

The Flat Top field has already made itself a formidable rival of the Connellsville region in the manufacture of coke, but though the coal is valuable for this purpose, it is not its only or even its chief recommendation. As a generator of steam it takes place with the first of fuels, and some of the notable records recently made by the fast ocean steamers have been attained while using Pocahontas or Flat Top coal.

Up to the time of the closing of this report the Pocahontas coal has all been shipped east over the Norfolk and Western, reaching the seaboard at Norfolk, Virginia. The early completion of the Ohio river extension of the Norfolk and Western road will, however, place the coal not only on the Ohio and Mississippi rivers in competition with the product of the Pittsburg region, but also furnish an outlet to the Gulf of Mexico, as well as opening the way for transportation to Chicago and other points of large consumption.

For a comprehensive statement of the growth of the coke-making industry in the Flat Top region the reader is referred to the chapter on that subject by Mr. Joseph D. Weeks.

WYOMING.

Total product in 1891, 2,327,841 short tons; spot value, $3,555,275.

The product of coal in Wyoming in 1890 was 1,870,366 short tons, indicating an increase in 1890 of 457,475 short tons, or nearly 25 per cent. The value advanced from $3,183,669 in 1890, to $3,555,275 in 1891, a gain of $371,606, not so much in proportion to the increase in tonnage, being only a little more than 11 per cent., and showing a decline in the average price from $1.70 to $1.53 per ton.

The following table shows the output of the State from the beginning of mining in 1868 to the close of 1891:

Coal product of Wyoming since 1868.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1868	6,925		1880	527,811	
1869	49,382		1881	628,181	
1870	105,295		1882	707,764	
1871	147,328		1883	779,689	
1872	221,745		1884	902,620	
1873	259,700		1885	807,328	$2,421,984
1874	219,061		1886	829,355	2,488,065
1875	300,808		1887	1,170,318	3,510,954
1876	334,550		1888	1,481,540	4,444,620
1877	342,853		1889	1,388,276	1,748,617
1878	333,200		1890	1,870,366	3,183,669
1879	400,991		1891	2,327,841	3,555,275

It will be seen by the above exhibit that with a few minor exceptions there has been a steady increase in the production of coal in Wyoming since 1868. Among the producing counties Sweetwater ranks first, with a total output in 1891 of 1,202,017 short tons—more than half the entire product of the state. Carbon county, with an output of 432,180 short tons, comes second, and Uinta and Weston counties are nearly tied for third place with 332,327 and 326,155 short tons, respectively. The combined product of Converse, Fremont, Johnson, and Sheridan counties amounted to about 35,000 tons. In the following table is shown the disposition of the product and its value, by counties:

Coal product of Wyoming in 1891, by counties.

Counties.	Loaded at mines for shipment.	Sold to local trade and used by employés.	Used at mines for steam and heat.	Made into coke.	Total amount produced.	Total value.	Average price per ton.	Average number employed.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*			
Carbon	428,833	1,097	2,250		432,180	$648,445	$1.50	609
Converse	25,810	687	1,400		27,897	49,258	1.77	85
Fremont		900			900	2,200	2.44	3
Johnson	800	4,065			4,865	7,714	1.59	8
Sheridan		1,500			1,500	1,500	1.00	2
Sweetwater	1,144,574	8,180	49,263		1,202,017	1,773,414	1.48	1,754
Uinta	325,019	7,129	179		332,327	583,512	1.71	548
Weston	304,365	10,000	7,300	4,490	326,155	489,232	1.50	402
Total	2,229,401	33,558	60,392	4,490	2,327,841	3,555,275	1.53	3,411

Carbon county.—Coal produced in 1891, 432,180 short tons; spot value, $648,180.

Prior to 1891 the principal producing mines of this county were the Carbon mines of the Union Pacific railway; in fact, in the table below, all of the product down to and including 1888 was from these mines.

In 1890 the Hanna mines of the same company began shipping, and in 1891 more than made up the losses in the output from the Carbon mines. All of the producing mines of the county are on the line of the Union Pacific railroad.

Coal product of Carbon county, Wyoming, since 1868.

Years.	Short tons.	Years.	Short tons.
1868	6,560	1880	100,433
1869	30,482	1881	156,820
1870	54,915	1882	200,123
1871	31,748	1883	248,380
1872	59,237	1884	319,883
1873	61,164	1885	226,863
1874	55,880	1886	214,233
1875	61,750	1887	288,358
1876	69,060	1888	338,947
1877	74,343	1889	199,276
1878	62,418	1890	305,969
1879	75,424	1891	432,180

The product of the Carbon mines in 1889 was 178,832 short tons; in 1890, 201,191 short tons, and in 1891, 186,675 short tons.

Converse county.—Coal produced in 1891, 27,897 short tons; spot value, $49,258.

Converse county began production in 1888 with an output of 29,933 short tons. The coal is a lignite, and used to considerable extent in Fort Fetterman, Douglas, and other points along the line of the Fremont, Elkhorn and Missouri Valley railroad.

Coal product of Converse county, Wyoming, since 1888.

Years.	Short tons.	Value.
1888	29,933	....
1889	17,393	$30,955
1890	25,748	44,696
1891	27,897	49,258

Fremont county.—The product in 1891 was 900 short tons, worth $2,200, against 1,400 short tons, valued at $5,750, in 1890. The coal is all used for local consumption.

Johnson county.—Total product in 1891, 4,865 short tons, worth $7,714. The county has as yet no railroad, and the coal is mined for a local demand at Buffalo, and for supplying Fort McKinney, the Government taking from 2,000 to 3,000 tons annually. The coal is transported by wagons from the mines 3 miles to Fort McKinney, and 2½ miles to Buffalo, bringing $3 to $4 per ton delivered.

Sheridan county.—The output in 1891 was 1,500 short tons, valued at $1,500, against 550 tons in 1889 and 650 tons in 1890. There is no railroad in the county, the coal being mined to supply a local demand.

Sweetwater county.—Coal produced in 1891, 1,202,017 short tons; spot value, $1,773,414.

The output of Sweetwater county was 223,190 tons more than in 1890, a gain of about 23 per cent. The value increased $107,346, or something over 6 per cent. The principal mines are the Rock Springs collieries, operated by the Coal Department of the Union Pacific railroad, the output of these mines in 1891 being 993,478. The other producers in 1891 were the Rock Springs Coal Company, the Sweetwater Coal Mining Company, and the Van Dyke Coal and Mining Company, all of Rock Springs, and the Black Butte Mining Company, Black Butte.

The Coal Department of the Union Pacific Railway Company has mined from the Rock Springs field the tonnage given in the following table.

Product of the Rock Springs mines, Wyoming.

Years.	Short tons.	Years.	Short tons.
1868	365	1880	244, 460
1869	16, 933	1881	270, 425
1870	20, 945	1882	287, 510
1871	40, 566	1883	304, 495
1872	34, 677	1884	318, 197
1873	44, 700	1885	328, 601
1874	58, 476	1886	359, 234
1875	104, 664	1887	465, 444
1876	134, 952	1888	662, 277
1877	146, 494	1889	777, 213
1878	154, 282	1890	652, 408
1879	193, 252	1891	993, 478

Prior to 1888 the output of these mines constituted the total product of the county. Since that time the annual production has been as follows:

Coal product of Sweetwater county, Wyoming, since 1888.

Years.	Short tons.	Value.
1888	732, 327	....
1889	857, 213	$1, 025, 067
1890	978, 827	1, 666, 068
1891	1, 202, 017	1, 773, 414

Uinta county.—Coal produced in 1891, 332,327 short tons; spot value, $583,512.

The output of Uinta county in 1891 was 17,951 short tons less than in 1890. There are but two corporations operating in the county, the Coal Department of the Union Pacific railroad at Almy and the Rocky Mountain Coal and Iron Company at Red Canyon. The former has been operating since 1869, the latter beginning production in the year following.

Product of the Union Pacific mines at Almy, Wyoming.

Years.	Short tons.	Years.	Short tons.
1869	1,967	1881	110,157
1870	12,454	1882	117,211
1871	21,171	1883	111,713
1872	22,713	1884	150,880
1873	22,847	1885	164,441
1874	23,006	1886	155,547
1875	41 805	1887	196,913
1876	60,756	1888	160,035
1877	54,643	1889	118,629
1878	59,096	1890	176,131
1879	71,576	1891	143,932
1880	100,234		

Since the date of opening the Rocky Mountain Coal and Iron Company has produced up to January 1, 1891, the following tonnage of coal:

Product of the Rocky Mountain Coal and Iron Company's mines at Almy, Wyoming.

Years.	Short tons.	Years.	Short tons.
1870	16,961	1881	90,779
1871	53,843	1882	94,065
1872	165,118	1883	78,450
1873	130,989	1884	68,471
1874	181,699	1885	70,216
1875	92,589	1886	100,341
1876	69,782	1887	164,510
1877	67,373	1888	209,298
1878	57,404	1889	190,589
1879	60,739	1890	(a) 174,147
1880	82,684	1891	188,395

a Includes 3,349 tons consumed at the mines.

Both properties have been fully described in previous volumes of the "Mineral Resources."

Weston county.—Coal produced in 1891, 326,155 short tons; spot value, $489,232.

The output of Weston county was 126,131 short tons more in 1891 than in 1890. The mines at Cambria, in this county, began production in 1890 with an output of 200,024 short tons. The development of these mines is the most notable achievement in the history of coal-mining in Wyoming. The mines are fully described on page 285 of "Mineral Resources, 1889 and 1890."

Recapitulation.—The following table shows in brief the annual product of each county since 1888, the total product of each to the close of 1891, and the total output of the State for each year:

Total product of coal in Wyoming, by counties.

Years.	Carbon county.	Sweetwater county.	Uinta county.	Weston county.	Converse county.	Other counties.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1868	6, 560	365	....	....	....	....	6, 925
1869	30, 482	16, 933	1, 967	....	....	....	49, 382
1870	54, 915	20, 945	29, 435	....	....	....	105, 295
1871	31, 748	40, 566	75, 014	....	....	....	147, 328
1872	59, 237	34, 677	127, 831	....	....	....	221, 745
1873	61, 164	44, 700	153, 836	....	....	....	259, 700
1874	55, 880	58, 476	104, 705	....	....	....	219, 061
1875	61, 750	104, 664	134, 394	....	....	....	300, 808
1876	69, 060	134, 952	130, 538	....	....	....	334, 550
1877	74, 343	146, 494	122, 016	....	....	....	342, 853
1878	62, 418	154. 282	116, 500	....	....	....	333, 200
1879	75, 424	193, 252	132, 315	....	....	....	400, 991
1880	100, 433	244, 460	182, 918	....	....	....	527, 811
1881	156, 820	270, 425	200, 936	....	....	....	628, 181
1882	200, 123	287, 510	211, 276	....	....	8, 855	707, 764
1883	248, 380	304, 495	190, 163	....	....	36, 651	779, 689
1884	319, 883	318, 197	219, 351	....	....	45, 189	902, 620
1885	226, 863	328, 601	234, 657	....	....	17, 207	807, 328
1886	214, 233	359, 234	255, 888	....	....	....	829, 355
1887	288, 358	465, 444	361, 423	....	....	55, 093	1, 170, 318
1888	338, 947	732, 327	369, 333	....	29, 933	11, 000	1, 481, 540
1889	199, 276	857, 213	309, 218	....	17, 393	5, 847	1, 388, 276
1890	305, 969	978, 827	350, 278	200, 024	25, 748	9, 520	1, 870, 366
1891	432, 180	1, 202, 017	332, 327	326, 155	27, 897	7, 265	2, 327, 841
Total	3, 674, 446	7, 299, 056	4, 346, 319	526, 179	100, 971	196, 627	16, 152, 927

THE MANUFACTURE OF COKE.

By Joseph D. Weeks.

As no statement regarding the manufacture of coke appeared in the volume of "Mineral Resources of the United States for 1889–'90," this report will include detailed statistics for the three years 1889, 1890 and 1891, as well as a consolidated statement concerning the production of coke for the twelve years 1880 to 1891, both inclusive.

In these twelve years the annual production of coke has increased from 3,338,300 short tons in 1880 to 11,508,021 short tons in 1890, an increase of 244 per cent. Each of these years has shown a notable increase of production over the previous one, except the years 1884 and 1891, the highest total, 11,508,021 short tons having been reached in 1890, while 1891 showed a falling off in production of 1,155,333 net tons as compared with 1890, or about 10 per cent. The cause of this remarkable expansion in the production of coke is of course the equally remarkable increase in the make of pig iron. A very large percentage, indeed nearly all, of the coke produced is used in the blast furnace. While charcoal and anthracite are still used as fuels to a considerable extent in the manufacture of pig iron, not only are most of the new furnaces designed for the employment of coke, but coke is in many cases supplanting anthracite in those regions where this fuel is found in great abundance, it having been ascertained that by the use of coke mixed with anthracite the furnace is capable of a much greater production than where anthracite alone is used. Indeed, it is not too much to say that the great expansion of pig-iron production in the last twelve or fifteen years would have been impossible without coke. It is because we have had coking coals in such abundance, making coke of such excellent quality, that our pig-iron industry has so wonderfully developed.

A review of the coke industry for the twelve years covered by this report develops some important features other than this wonderful increase in production. One of the most notable of these is that, notwithstanding the great growth of this industry, the oven exclusively used in this country is the solid wall oven, usually of the beehive form. Twelve years ago considerable coke was made in pits, in ricks or "on the ground." So far as we have been able to learn, less than 3,000 tons of commercial coke was made in this way in 1891. No end of experiments have been made in various sections of the country looking to the use of the flue or retort oven, or what is generally known as the Belgian oven. So far these have all proven failures, and while some little coke was made in Belgian ovens in 1891, it was at plants that were built some years ago. No new construction of flue ovens was in progress at the close of 1891. Even at the works operating Belgian ovens in the last year covered by this report, all new construction was of the solid wall or beehive type. It should be noted, however, that this statement does not apply to 1892, for at two places flue ovens designed to save the by-products are under construction, and while possibly little or no coke will be made in them in 1892, they will be thoroughly tried early in 1893.

Another feature disclosed by an examination of the statistics is that certain extensive and costly experiments looking to the coking of what may be termed inferior coals, either because of their having an inferior coking power or being high in ash and impurities, have been abandoned. It is true that in certain sections having inferior coking coals the demand for coke is such and the distance from supplies of good coke so great that it is more economical to use these inferior cokes, though it requires a much larger amount to do the same work. But in sections of the country where the distance from the great centers of coke production along the Appalachian mountains is not too great the coking of these inferior coals has been practically abandoned. This is especially true of the States of Ohio, Indiana and Illinois.

Another feature disclosed by the inspection of our tables is the wonderful development of certain sections of the country as coke-producers. All through these years the Connellsville region has held its preeminence. In 1880 it produced 2,205,956 short tons of the total 3,338,300 short tons; in 1890 it produced 6,464,156 short tons of the 11,508,021 tons, a decrease in the percentage of the production of this region to the total production, but a wonderful increase in the actual tonnage produced. But though the Connellsville region has thus held its preeminence, two other regions during these years have come into notable prominence, the Alabama region, which is chiefly located in the neighborhood of Birmingham, and the Pocahontas Flat Top region of Virginia and West Virginia. The production of Alabama has increased in the twelve years covered by this report from 60,781 short tons in 1880 to 1,282,496 short tons in 1891, more than twenty times.

The Pocahontas Flat-Top district was not a producer in 1880; indeed, it was not until 1886 that production began in this district, the output in that year being but 658 tons. In 1891 the total production was 312,421 tons, with a probability of a notable increase during the years 1892 and 1893.

In this report, as in previous ones of the series, the word "coke" is used to denote only that coke made from bituminous coal in ovens, pits, ricks, or on the ground, which for convenience we have termed "oven coke." It does not include what may be termed "gas coke," or that coke made in connection with the production of illuminating gas.

The unit of quantity throughout this chapter is the short ton of 2,000 pounds; the year, unless otherwise stated, is the calendar year ending December 31.

Statistics of the production of coke in the United States, 1880 to 1891.—In the twelve years covered by this report the production of coke has increased, as stated above, from 3,338,300 to 11,508,021 tons, the production of 1890, the production of 1891 being 10,352,688 tons. The number of ovens has increased from 12,372 in 1880 to 40,245 in 1891. The amount of coal used in the production of coke has increased from 5,237,741 short tons in 1880 to 18,005,209 tons in 1890, the amount of coal used in 1891 being but 16,344,540 tons. The total value of coke at the ovens has increased from $6,631,267 in 1880 to $23,215,302 in 1890, the total value of coke produced in 1891 being but $20,393,216.

In the following table are consolidated the statistics of coking in the United States for the years from 1880 to 1891. These statistics relate not only to the production of coke, but also to the consumption of coal in the manufacture of coke, and its percentage yield in coke, as well as the number of establishments and the number of ovens built and building at the close of each year.

Statistics of the manufacture of coke in the United States, 1880 to 1891, inclusive.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880...	186	12,372	1,159	5,237,741	3,338,300	$6,631,267	$1.99	63
1881...	197	14,119	1,005	6,546,662	4,113,760	7,725,175	1.88	63
1882...	215	16,356	712	7,577,648	4,793,321	8,462,167	1.77	63
1883...	231	18,304	407	8,516,670	5,464,721	8,121,607	1.49	64
1884...	250	19,557	812	7,951,974	4,873,805	7,242,878	1.49	61
1885...	233	20,116	432	8,071,126	5,106,696	7,629,118	1.49	63
1886...	222	22,597	4,154	10,688,972	6,845,369	11,153,366	1.63	64
1887...	270	26,001	3,584	11,859,752	7,611,705	15,321,116	2.01	64.2
1888...	261	30,059	2,587	12,945,350	8,540,030	12,445,963	1.46	66
1889...	252	34,165	2,115	15,960,973	10,258,022	16,630,301	1.62	64
1890...	253	37,158	1,547	18,005,209	11,508,021	23,215,302	2.00	63
1891...	243	40,245	911	16,344,540	10,352,688	20,393,216	1.97	63

Each one of the items under the headings contained in this table will be discussed under its appropriate title.

Production of coke in the United States in 1889, 1890 and 1891.—As no detailed statement of the production of coke in the United States for the three years 1889, 1890 and 1891 has been given in the previous volume of "Mineral Resources," in the following table are consolidated by states and territories the statistics of production for these years, the statements covering not only production, but certain information regarding ovens, the amount of coal used, the total value of the coke and the value per ton.

Manufacture of coke in the United States, by States and Territories, in 1889.

States and Territories.	Establishments.	Ovens.		Coal used.	Yield of coal in coke.	Coke produced.	Total value of coke.	Value of coke per ton.
		Built.	Building.					
				Short tons.	*Per ct.*	*Short tons.*		
Alabama	19	3, 944	427	1, 746, 277	59	1, 030, 510	$2, 372, 417	$2. 30
Colorado	9	834	50	299, 731	63	187, 638	643, 479	3. 43
Georgia	1	300	....	157, 878	60	94, 727	149, 059	1. 57
Illinois	4	149	....	19, 250	60	11, 583	29, 764	2. 57
Indiana	4	111	....	16, 428	51	8, 301	25, 922	3. 12
Indian Territory	1	78	....	13, 277	50	6, 639	17, 957	2. 70
Kansas	6	68	....	21, 600	64	13, 010	26, 593	1. 91
Kentucky	9	166	100	25, 192	52	13, 921	29, 769	2. 28
Montana	2	90	50	30, 576	46	14, 043	122, 023	8. 69
Missouri	3	9	....	8, 485	62	5, 275	5, 800	1. 10
New Mexico	2	70	....	7, 162	48	3, 460	18, 408	5. 32
Ohio	13	462	....	132, 828	56	75, 124	188, 222	2. 50
Pennsylvania	109	22, 143	567	11, 581, 292	66	7, 659, 055	10, 743, 492	1. 40
Tennessee	12	1, 639	40	626, 016	57	359, 710	731, 496	2. 03
Utah Territory	1	34	....	2, 217	34	761	3, 042	4. 00
Virginia	2	550	250	238, 793	61	146, 528	325, 861	2. 22
Washington	1	30	....	6, 983	55	3, 841	30, 728	8. 00
West Virginia	53	3, 438	631	1, 001, 372	61	607, 880	1, 074, 177	1. 76
Wisconsin	1	50	....	25, 616	62. 5	16, 016	92, 092	5. 75
Total	253	34, 165	2, 115	15, 960, 973	64	10, 258, 022	16, 630, 301	1. 62

Manufacture of coke in the United States, by States and Territories, in 1890.

States and Territories.	Establishments.	Ovens.		Coal used.	Yield of coal in coke.	Coke produced.	Total value of coke.	Value of coke per ton.
		Built.	Building.					
				Short tons.	*Per ct.*	*Short tons.*		
Alabama	20	4, 805	371	1, 809, 964	59	1, 072, 942	$2, 589, 447	$2. 413
Colorado	8	916	30	407, 023	60	245, 756	959, 246	3. 90
Georgia	1	300	....	170, 388	60	102, 233	150, 995	1. 48
Illinois	4	148	....	9, 000	55	5, 000	11, 250	2. 25
Indiana	4	101	....	11, 753	51	6, 013	19, 706	3. 277
Indian Territory	1	78	....	13, 278	50	6, 639	21, 577	3. 25
Kansas	7	68	....	21, 809	56	12, 311	29, 116	2. 365
Kentucky	9	175	115	24, 372	51	12, 343	22, 191	1. 797
Montana	2	140	....	32, 148	45	14, 427	125, 655	8. 71
Missouri	3	10	....	9, 491	65	6, 136	9, 240	1. 51
New Mexico	2	70	....	3, 980	51. 5	2, 050	10, 025	4. 89
Ohio	13	443	1	126, 921	59	74, 633	218, 090	2. 92
Pennsylvania	106	23, 430	74	13, 046, 143	65	8, 560, 245	16, 333, 674	1. 91
Tennessee	11	1, 664	292	600, 387	58	348, 728	684, 116	1. 96
Utah Territory	1	80	....	24, 058	35	8, 528	37, 196	4. 36
Virginia	2	550	250	251, 683	66	165, 847	278, 724	1. 68
Washington	2	30	80	9, 120	64	5, 837	46, 696	8. 00
West Virginia	55	4, 060	334	1, 395, 266	59	833, 377	1, 524, 746	1. 83
Wisconsin	1	70	....	38, 425	65	24, 976	143, 612	5. 75
Wyoming	1	20	....	....	......	....	....	....
Total	253	37, 158	1, 547	18, 005, 209	63	11, 508, 021	23, 215, 302	2. 02

Manufacture of coke in the United States, by States and Territories, in 1891.

States and Territories.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Yield of coal in coke.	Coke produced.	Total value of coke.	Value of coke per ton.
				Short tons.	Per ct.	Short tons.		
Alabama	21	5,068	50	2,144,277	60	1,282,496	$2,986,242	$2.33
Colorado	7	948	21	452,749	61	277,074	896,984	3.24
Georgia	1	300	....	164,875	62.5	103,057	231,878	2.25
Illinois	1	25	....	10,000	52	5,200	11,700	2.25
Indiana	2	84	....	8,688	44	3,798	7,596	2.00
Indian Territory	1	80	....	20,551	46	9,464	30,483	3.22
Kansas	6	72	....	27,181	52	14,174	33,296	2.34
Kentucky	7	303	24	64,390	52	33,777	68,281	2.02
Montana	2	140	....	61,667	47	29,009	258,523	8.91
Missouri	3	10	....	10,377	66	6,872	10,000	1.45
New Mexico	1	Pits.	....	4,000	57.5	2,300	10,925	4.75
Ohio	9	421	....	69,320	56	38,718	76,901	1.99
Pennsylvania	109	25,324	11	10,588,544	66	6,954,846	12,679,826	1.82
Tennessee	11	1,995	....	623,177	58	364,318	701,803	1.92
Utah Territory	1	80	....	25,281	31	7,949	35,778	4.50
Virginia	2	550	250	285,113	58.7	167,516	265,107	1.58
Washington	2	80	....	10,000	60	6,000	42,000	7.00
West Virginia	55	4,621	555	1,716,976	58.7	1,009,051	1,845,043	1.83
Wisconsin	1	120	....	52,904	65	34,387	192,804	5.61
Wyoming	1	24	....	4,470	60	2,682	8,046	3.00
Total	243	40,245	911	16,344,540	63	10,352,688	20,393,216	1.97

The three by years covered these tables were as notable ones in the history of coke making as they were in the history of the production of iron. The number of ovens in the United States increased in these years from 34,165 to 40,245, or 17 per cent; the average yearly production was 10,706,244 tons; the total value of the coke produced was $16,630,301 in 1889, $23,215,302 in 1890, and $20,393,216 in 1891, the average value of the coke per ton in each of these years being $1.62, $2.02, and $1.97 respectively.

Alabama, Colorado, Georgia, Montana, Missouri, Virginia and West Virginia have all shown an increased production in each of these years, but the notable and important increases have been in Alabama, Colorado, Montana, and West Virginia, two in the Appalachian region, and two in the cretaceous fields of the far West.

While there was an increase in production in Pennsylvania from 1889 to 1890 of nearly 1,000,000 tons, an increase greater than the total production of any of the other States except Alabama, and very nearly equal to the total production of that State, there was a decrease of production in Pennsylvania in 1891 of 1,605,399 tons, a decrease nearly 300,000 tons in excess of the production of any other State, and about the same amount, or 300,000 tons in excess of the total reduction in the production of coke in the United States in 1891; showing that while the production of Pennsylvania declined in 1891, that of the other States increased. The causes of the great decline in the production of coke in Pennsylvania in 1891 were two: First, the Connellsville strike early in the year, and second, the closing down of the blast furnaces in the Mahoning and Shenango valleys, under an agreement to restrict production. These two causes more than account for the difference in production.

The increase in the average value of coke per ton in these three years is notable; it increased from \$1.62 in 1889 to \$2 in 1890, and \$1.97 in 1891. While there were some changes in average prices during these three years in most of the States, the important change was in the price of Pennsylvania coke, and chiefly in the price of coke from the Connellsville region. In 1889 the average price of Pennsylvania coke was \$1.40, which was the lowest average in the list, with one exception, that of Missouri coke, of which but little was produced. In 1890 the price of Pennsylvania coke had advanced to \$1.91; Georgia, Kentucky, Missouri, Virginia, and West Virginia cokes all showing an average price below this. In 1891 the price of Pennsylvania coke had dropped to \$1.82 a ton, the price being less than for any district except Missouri and Virginia. In view of the fact that considerable of the coke made in Virginia is used at the works of the party making it, only the cost of production being taken as the value of the coke, the average price given in the table for 1891 for Virginia coke can hardly be regarded as a proper price for comparison with that of other cokes.

Total number of coke works in the United States.—The following table gives the number of establishments manufacturing coke in the United States in each year from 1880 to 1891 by States:

Number of establishments in the United States manufacturing coke on December 31, of each year, from 1880 to 1891.

States and territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
Alabama	4	4	5	6	8	11	14	15	18	19	20	21
Colorado	1	2	5	7	8	7	7	7	7	9	8	7
Georgia	1	1	1	1	1	2	2	2	1	1	1	1
Illinois	6	6	7	7	9	9	9	8	8	4	4	1
Indiana	2	2	2	2	2	2	4	4	3	4	4	2
Indian Territory	1	1	1	1	1	1	1	1	1	1	1	1
Kansas	2	3	3	4	4	4	4	4	6	6	7	6
Kentucky	5	5	5	5	5	5	6	6	10	9	9	7
Missouri	0	0	0	0	0	0	0	1	1	3	3	3
Montana	0	0	0	1	3	2	4	2	1	2	2	2
New Mexico	0	0	2	2	2	2	2	1	1	2	2	1
Ohio	15	15	16	18	19	13	15	15	15	13	13	9
Pennsylvania	124	132	137	140	145	133	108	151	120	109	106	109
Tennessee	6	6	8	11	13	12	12	11	11	12	11	11
Texas	0	0	0	0	0	0	1	0	0	0	0	0
Utah	1	1	1	1	1	1	1	0	0	1	1	1
Virginia	0	0	0	1	1	1	2	2	2	2	2	2
Washington	0	0	0	0	1	1	1	1	3	1	2	2
West Virginia	18	19	22	24	27	27	29	39	52	53	55	55
Wisconsin	0	0	0	0	0	0	0	0	1	1	1	1
Wyoming	0	0	0	0	0	0	0	0	0	0	1	1
Total	186	197	215	231	250	233	222	270	261	252	253	243

The word "establishment" is rather an indefinite one. In some cases proprietors of coke works owning several different banks of ovens will report them all as one establishment, they being all under one general management. In other cases they will be reported as separate establishments. The number differs so much from year to year, even at the same works, as to make this table of but little value for comparison. The decrease in the number of establishments 1890 to 1891, is due to an actual decrease and not to consolidations, there being one less in Colorado, three less in Illinois, two less in Indiana, one less in Kansas, two less in Kentucky, one less in New Mexico, and four less in Ohio.

The number of establishments in the country for each year since 1850 for which there are any returns is as follows:

Number of coke establishments in the United States since 1850.

Years.	Number.	Years.	Number.
1850 (census year)	4	1884, December 31	250
1860 (census year)	21	1885, December 31	233
1870 (census year)	25	1886, December 31	222
1880 (census year)	149	1887, December 31	270
1880, December 31	186	1888, December 31	261
1881, December 31	197	1889, December 31	252
1882, December 31	215	1890, December 31	253
1883, December 31	231	1891, December 31	243

Number of coke ovens in the United States.—The following table shows the number of coke ovens in each state and territory on December 31 of each year from 1880 to 1891, together with the total number of ovens in the United States at the close of each of these years. In addition to the coke made in ovens some has been made in pits and on the ground, but as the number of pits varies greatly at different times no account has been taken of them in this table. It is also evident that no statement could be made regarding the number of piles used in making coke on the ground as coke is usually made in this way only for experimental purposes, and the number of piles would vary with each burning. In a general way it may be said, however, that only at one place in the Allegheny Mountains in Pennsylvania and at two works in New Mexico was coke made with any regularity in pits in 1891. In the earlier years, however, a larger proportion of pit coke was made, as in these years experiments were in progress as to the adaptability of certain coals to the manufacture of coke, and until this was determined ovens were not built. It has been found, however, that the manufacture of coke in pits does not necessarily determine the value of the coal for coking purposes, and hence even in experimental work it is now customary to erect ovens.

Number of coke ovens in the United States on December 31 of each of the years from 1880 to 1891.

States and territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
Alabama	316	416	536	767	976	1,075	1,301	1,555	2,475	3,944	4,805	5,068
Colorado	200	267	344	352	409	434	483	532	602	834	916	948
Georgia	140	180	220	264	300	300	300	300	290	300	300	300
Illinois	176	176	304	316	325	320	335	278	221	149	148	25
Indiana	45	45	37	37	37	37	100	119	103	111	101	84
Indian Territory	20	20	20	20	20	40	40	80	80	78	78	80
Kansas	6	15	20	23	23	23	36	39	58	68	68	72
Kentucky	45	45	45	45	45	33	76	98	132	166	175	303
Missouri	0	0	0	0	0	0	0	4	4	9	10	10
Montana	0	0	0	2	5	2	16	27	40	90	140	140
New Mexico	0	0	0	12	70	70	70	70	70	70	70	a 0
Ohio	616	641	647	682	732	642	560	585	547	462	443	421
Pennsylvania	9,501	10,881	12,424	13,610	14,285	14,553	16,314	18,294	20,381	22,143	23,430	25,324
Tennessee	656	724	861	992	1,105	1,387	1,485	1,560	1,634	1,639	1,664	1,995
Texas	0	0	0	0	0	0	0	0	0	0	0	0
Utah	20	20	20	20	20	20	20	0	0	34	80	80
Virginia	0	0	0	200	200	200	350	350	550	550	550	550
Washington	0	0	0	0	0	2	11	30	30	30	30	80
West Virginia	631	689	878	962	1,005	978	1,100	2,080	2,792	3,438	4,060	4,621
Wisconsin	0	0	0	0	0	0	0	0	50	50	70	120
Wyoming	0	0	0	0	0	0	0	0	0	0	20	24
Total	12,372	14,119	16,356	18,304	19,557	20,116	22,597	26,001	30,059	34,165	37,158	40,245

a Coke was made in pits.

First considering the three years from 1889 to 1891: From the above table it will be seen that the number of coke ovens in these three years increased from 30,059 at the close of 1888 to 40,245 at the close of 1891, practically an increase of 33⅓ per cent. In these years the number of ovens in Alabama has doubled; the increase in Colorado has been about 50 per cent.; in Kentucky there were two and one-third times as many at the close of 1891 as at the close of 1888; in Montana, three and one-half times as many, while the increase in Pennsylvania was only some 25 per cent., and in West Virginia 66⅔ per cent. The notable increases in number of ovens were in Alabama, where the actual increase was 2,593; in Pennsylvania, where it was nearly 5,000, and in West Virginia, where it was 1,829. The increases in numbers of ovens in Kentucky, Montana, Wisconsin and Wyoming in 1891 are important as showing the possibilities of the future, though as yet the total number is by no means large, as compared with the other States named.

The table shows a decrease in Illinois to but little more than one-tenth of the number of ovens in the State in 1888. Indiana shows a decrease of nearly 20 per cent. and Ohio about the same.

At the close of 1891 Alabama had about 12½ per cent. of the total number of ovens, Colorado 2½ per cent., Pennsylvania about 63 per cent., Tennessee nearly 5 per cent., and West Virginia a little over 11 per cent. Comparing the percentage of production of these States with the percentage of ovens, it will be seen that both in production and number of ovens Alabama had, roughly speaking, 12½ per cent. Colorado's percentage of ovens and production is about the same, while Tennessee's production was only about 3¼ per cent. of the total, its oven percentage being almost 5. West Virginia's production percentage was but 9½, while its oven percentage was a little over 11, and Pennsylvania, with 63 per cent. of the ovens, made 68.3 per cent. of all the coke.

As is elsewhere stated, most of the ovens in operation in the United States are of the solid wall type, in which the coal is coked by heat generated in the oven itself, a certain amount of the heat generated at a burning being stored in the walls of the oven. Most of the ovens are of the regular beehive shape; a few are somewhat modified in form, the oven being long and shaped like a muffle. The principle of coking, however, is the same in these long ovens (which are sometimes called Welsh ovens or drag ovens, certain shapes used in this country being also known as the Thomas oven, from its inventor) as in the beehive; that is, the coking of the coal is by the heat generated by the combustion of the coal in the oven itself with such slight heat as may be stored in the walls of the oven.

Though repeated experimental attempts have been made to produce coke from American coals in the flue oven, they have been almost universally a failure for reasons that need not be discussed here. In the term "flue ovens" are included all ovens in which the coking operation is performed in whole or in part by heat applied externally to the inner wall of the oven by means of the waste gases which are burned usually in flues contained in the walls of the oven. Owners of works at which most earnest attempts have been made to use these flue ovens have finally been compelled to abandon them, and the ovens have either been torn down and beehives erected in their stead or all new construction and extensions of these works have been beehive ovens. It is but fair to say, however, that at the present moment considerable attention is again being paid to the advisability of erecting flue or retort ovens. There is a growing demand for tar and ammonia water which the illuminating gas works are not able to supply, especially in view of the fact that the amount of these by-products has been considerably lessened by the use of enriched water gas. At the present writing (in 1892) two works are in process of erection in this country on different plans looking to the saving of the tar and ammonia water, one of these including a benzole plant. Some information as to the results obtained at these works can, no doubt, be given in the next report of this series.

Number of ovens building in the United States.—The following table gives the number of ovens actually in course of construction in the United States at the close of each year from 1880 to 1891. It should be understood that this table does not indicate the increase of the total number of coke ovens during the year; it only gives the number of ovens reported as being in course of construction at the close of each year, and indicates only the rapidity of the extension of the industry at a date when comparatively little oven-building is in progress. It will be noted that the number of ovens in course of construction at the close of 1891 is less than at the close of any year since 1885. One of the most notable features of the table is the small number of ovens in course of construction in Pennsylvania at the close of 1891, a less number than in any other State where any ovens are building, and a very much less number than ever before reported as being in course of construction in Pennsylvania at the close of any year.

Number of coke ovens building in the United States at the close of each of the years from 1880 to 1891.

States and territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
Alabama	100	120	0	122	242	16	1,012	1,362	406	427	371	50
Colorado	50	0	0	0	24	0	0	0	100	50	30	21
Georgia	40	40	44	36	0	0	0	0	0	0	0	0
Illinois	0	0	0	0	0	0	0	0	0	0	0	0
Indiana	0	0	0	0	0	0	18	0	0	0	0	0
Indian Territory	0	0	0	0	0	0	0	0	0	0	0	0
Kansas	0	0	0	0	0	0	0	0	0	0	0	0
Kentucky	0	0	0	0	0	0	2	0	2	100	115	24
Missouri	0	0	0	0	0	0	0	0	0	0	0	0
Montana	0	0	0	0	12	0	0	0	0	50	0	0
New Mexico	0	0	12	28	0	0	0	0	0	0	0	0
Ohio	25	0	0	0	0	0	0	223	12	0	1	0
Pennsylvania	836	761	642	211	232	317	2,558	802	1,565	567	74	11
Tennessee	68	84	14	10	175	36	126	165	84	40	292	0
Virginia	0	0	0	0	0	0	100	300	0	250	250	250
Washington	0	0	0	0	0	0	21	0	100	0	80	0
West Virginia	40	0	0	0	127	63	317	742	318	631	334	555
Wisconsin	0	0	0	0	0	0	0	0	0	0	0	0
Wyoming	0	0	0	0	0	0	0	0	0	0	0	0
Total	1,159	1,005	712	407	812	432	4,154	3,594	2,587	2,115	1,547	911

Production of coke in the several states from 1880 to 1891.—The production of coke in the several States and Territories from 1880 to 1891 is shown in the following table:

Amount of coke produced, in short tons, in the United States, 1880 to 1891, inclusive, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
Alabama	60, 781	109, 033	152, 940	217, 531	244, 009	301, 180
Colorado	25, 568	48, 587	102, 105	133, 997	115, 719	131, 960
Georgia	38, 041	41, 376	46, 602	67, 012	79, 268	70, 669
Illinois	12, 700	14, 800	11, 400	13, 400	13, 095	10, 350
Indiana	0	0	0	0	0	0
Indian Territory	1, 546	1, 768	2, 025	2, 573	1, 912	3, 584
Kansas	3, 070	5, 670	6, 080	8, 430	7, 190	8, 050
Kentucky	4, 250	4, 370	4, 070	5, 025	2, 223	2, 704
Missouri	0	0	0	0	0	0
Montana	0	0	0	0	75	175
New Mexico	0	0	1, 000	3, 905	18, 282	17, 940
Ohio	100, 596	119, 469	103, 722	87, 834	62, 709	39, 416
Pennsylvania	2, 821, 384	3, 437, 708	3, 945, 034	4, 438, 464	3, 822, 128	3, 991, 805
Tennessee	130, 609	143, 853	187, 695	203, 691	219, 723	218, 842
Utah	1, 000	0	250	0	0	0
Virginia	0	0	0	25, 340	63, 600	49, 139
Washington	0	0	0	0	400	311
West Virginia	138, 755	187, 126	230, 398	257, 519	223, 472	260, 571
Wisconsin	0	0	0	0	0	0
Wyoming	0	0	0	0	0	0
Total	3, 338, 300	4, 113, 760	4, 793, 321	5, 464, 721	4, 873, 805	5, 106, 696

States and Territories.	1886.	1887.	1888.	1889.	1890.	1891.
Alabama	375, 054	325, 020	508, 511	1, 030, 510	1, 072, 942	1, 282, 496
Colorado	142, 797	170, 698	179, 682	187, 638	245, 756	277, 074
Georgia	82, 680	79, 241	83, 721	94, 727	102, 233	103, 057
Illinois	8, 103	9, 198	7, 410	11, 583	5, 000	5, 200
Indiana	6, 124	17, 658	11, 966	8, 301	6, 013	3, 798
Indian Territory	6, 351	10, 060	7, 502	6, 639	6, 639	9, 464
Kansas	12, 493	14, 950	14, 831	13, 910	12, 311	14, 174
Kentucky	4, 528	14, 565	23, 150	13, 021	12, 343	33, 777
Missouri	0	2, 970	2, 600	5, 275	6, 136	6, 872
Montana	0	7, 200	12, 000	14, 043	14, 427	29, 009
New Mexico	10, 236	13, 710	8, 540	3, 460	2, 050	2, 300
Ohio	34, 932	93, 004	67, 194	75, 124	74, 633	38, 718
Pennsylvania	5, 406, 597	5, 832, 849	6, 545, 779	7, 659, 055	8, 560, 245	6, 954, 846
Tennessee	368, 139	396, 979	385, 693	359, 710	348, 728	364, 318
Utah	0	0	0	761	8, 528	7, 949
Virginia	122, 352	166, 947	149, 199	146, 528	165, 847	167, 516
Washington	825	14, 625	0	3, 841	5, 837	6, 000
West Virginia	264, 158	442, 031	531, 762	607, 880	833, 377	1, 009, 051
Wisconsin	0	0	500	16, 016	24, 976	34, 387
Wyoming	0	0	0	0	0	2, 682
Total	6, 845, 369	7, 611, 705	8, 540, 030	10, 258, 022	11, 508, 021	10, 352, 688

An inspection of this table indicates that the rank in 1891 of the states which produced over 100,000 tons of coke was as follows: Pennsylvania, Alabama, West Virginia, Tennessee, Colorado, Virginia, Georgia. In all of the years covered by this report Pennsylvania has always ranked first. For most of the years Alabama has occupied a second place, but at times it has dropped as low as the fourth, while West Virginia has assumed the second.

In the twelve years covered by this report the production of Alabama has increased some twenty times; of Colorado, ten times; of Georgia, three times; of Indian Territory, six times; of Kansas, four and a half times; of Kentucky, eight times; of West Virginia, seven times; while Pennsylvania has increased but two and a half times. In 1880 there were but twelve states producing coke; in 1891 there were nineteen. Indiana, Missouri, Montana, New Mexico, Virginia, Washington, Wisconsin, and Wyoming, which were not producers in 1880, made coke in 1891.

In 1891, as compared with 1880, the actual increase in production of coke in the several important producing states has been as follows: The increase in production in Alabama in 1891 over 1880 was 1,221,715 tons; in Colorado, 251,506 tons; in Georgia, 65,016 tons; in Indian Territory, 7,918 tons; in Kansas, 11,104 tons; in Kentucky, 29,527 tons; in Tennessee, 233,709 tons; in West Virginia, 870,296 tons; and in Pennsylvania, 4,133,462 tons. It will thus appear that the states whose increase in tonnage has been the greatest have been those states whose percentage increase in some instances has been the least.

The following table gives the relative rank of the states and territories in the production of coke in the years 1884 to 1891, both inclusive:

Rank of the states and territories in production of coke in 1884 to 1891.

States and Territories.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
Pennsylvania	1	1	1	1	1	1	1	1
Alabama	2	2	2	4	3	2	2	2
West Virginia	3	3	4	2	2	3	3	3
Tennessee	4	4	3	3	4	4	4	4
Colorado	5	5	5	5	5	5	5	5
Georgia	6	6	7	8	7	7	7	7
Virginia	7	7	6	6	6	6	6	6
Ohio	8	8	8	7	8	8	8	8
New Mexico	9	9	10	13	14	18	19	20
Illinois	10	10	11	15	16	13	18	17
Kansas	11	11	9	10	11	11	12	12
Indiana	......	......	13	9	13	14	16	18
Kentucky	12	13	14	12	9	12	11	10
Indian Territory	13	12	12	14	15	15	14	13
Washington	14	14	15	11	10	17	17	16
Montana	15	15	......	16	12	10	10	11
Missouri	......	......	......	17	17	16	15	15
Wisconsin	......	......	......	......	18	9	9	9
Utah	......	......	......	......	......	19	13	14
Wyoming	......	......	......	......	......	......	......	19

Value and average selling price of coke.—In the following table is given the total value of the coke produced in the United States for each year from 1880 to 1891, inclusive:

Total value at the ovens of the coke made in the United States in the years from 1881 to 1891, inclusive, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
Alabama	$183, 063	$326, 819	$425, 940	$598, 473	$609, 185	$755, 645
Colorado	145, 226	267, 156	476, 665	584, 578	409, 930	512, 162
Georgia	81, 789	88, 753	100, 194	147, 166	169, 192	144, 198
Illinois	41, 950	45, 850	29, 050	28, 200	25, 639	27, 798
Indiana						
Indian Territory	4, 638	5, 304	6, 075	7, 719	5, 736	12, 902
Kansas	6, 000	10, 200	11, 460	16, 560	14, 580	13, 255
Kentucky	12, 250	12, 630	11, 530	14, 425	8, 760	8, 499
Missouri						
Montana					900	2, 063
New Mexico			6, 000	21, 478	91, 410	89, 700
Ohio	255, 905	297, 728	266, 113	225, 660	156, 294	109, 723
Pennsylvania	5, 255, 040	5, 898, 579	6, 133, 698	5, 410, 387	4, 783, 230	4, 981, 656
Tennessee	316, 607	342, 585	472, 505	459, 126	428, 870	398, 459
Utah	10, 000		2, 500			
Virginia				44, 345	111, 300	85, 993
Washington						
West Virginia	318, 797	429, 571	520, 437	563, 490	425, 952	485, 588
Wisconsin						
Wyoming						
Total	6, 631, 267	7, 725, 175	8, 462, 167	8, 121, 607	7, 240, 978	7, 627, 641

States and Territories.	1886.	1887.	1888.	1889.	1890.	1891.
Alabama	$993, 302	$775, 090	$1, 189, 679	$2, 372, 417	$2, 589, 447	$2, 986, 242
Colorado	569, 120	682, 778	716, 305	643, 479	959, 246	896, 984
Georgia	179, 031	174, 410	177, 907	149, 059	150, 995	231, 878
Illinois	21, 487	19, 594	21, 038	29, 764	11, 250	11, 700
Indiana	17, 953	51, 141	31, 993	25, 922	19, 706	7, 596
Indian Territory	22, 229	33, 435	21, 755	17, 957	21, 577	30, 483
Kansas	19, 204	28, 575	29, 073	26, 593	29, 116	33, 296
Kentucky	10, 082	31, 730	47, 244	29, 769	22, 191	68, 281
Missouri		10, 395	9, 100	5, 800	9, 240	10, 000
Montana		72, 000	96, 000	122, 023	125, 655	258, 523
New Mexico	51, 180	82, 260	51, 240	18, 408	10, 025	10, 925
Ohio	94, 042	245, 981	166, 330	188, 222	218, 090	76, 901
Pennsylvania	7, 664, 023	10, 746, 352	8, 230, 759	10, 743, 492	16, 333, 674	12, 679, 826
Tennessee	687, 865	870, 900	490, 491	731, 496	684, 116	701, 803
Utah				3, 042	37, 196	35, 778
Virginia	305, 880	417, 368	260, 000	325, 861	278, 724	265, 107
Washington				30, 728	46, 696	42, 000
West Virginia	513, 843	976, 732	905, 519	1, 074, 177	1, 524, 746	1, 845, 043
Wisconsin			1, 500	92, 092	143, 612	192, 804
Wyoming						8, 046
Total	11, 149, 241	15, 218, 741	12, 445, 963	16, 630, 301	23, 215, 302	20, 393, 216

While this table gives the totals of the values as returned in the schedules, the figures do not always represent the same thing. A statement as to the actual selling price of the coke was asked for, and in most cases, including possibly 80 per cent. of all the coke produced, the figures are the actual selling price. In some cases, however, the value is an estimate. Considerable of the coke made in the United States is produced by proprietors of blast furnaces for consumption in their own furnaces, none being sold. The value, therefore, given for this coke would be an estimate based, in some instances where there are coke works in the neighborhood selling coke for the general market, upon the price obtained for this coke; in other cases the cost is estimated at the cost of the coke at the furnace, plus a small percentage for profit on the coking operation, while in still other cases the value given is only the actual cost of the coke at the ovens.

For the more intelligent discussion of the value and selling price of coke the following table showing the average selling price for each of the years 1880 to 1891 in each state and territory is given. These are actual averages found by dividing the total amount received for the coke by the total amount of coke produced.

Average value per short ton at the ovens of the coke made in the United States in the years from 1880 to 1891, inclusive, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
Alabama	$3.01	$3.00	$2.79	$2.75	$2.50	$2.50	$2.65	$2.39	$2.34	$2.30	$2.413	$2.33
Colorado	5.68	5.29	4.67	4.36	3.45	3.88	3.99	4.00	4.00	3.43	3.90	3.24
Georgia	2.15	2.15	2.15	2.20	2.13	2.04	2.17	2.20	2.12	1.57	1.48	2.25
Illinois	3.30	3.10	2.55	2.10	1.96	2.68	2.65	2.13	2.84	2.57	2.25	2.25
Indiana	......	......	......	......	......	......	2.93	2.81	2.68	3.12	3.277	2.00
Indian Territory	3.00	3.00	3.00	3.00	3.00	3.60	3.50	3.33	2.90	2.70	3.25	3.22
Kansas	1.95	1.80	1.70	1.96	2.02	1.65	1.54	1.91	1.96	1.91	2.365	2.34
Kentucky	2.88	2.89	2.83	2.87	3.94	3.14	2.23	2.18	2.04	2.28	1.797	2.02
Missouri	......	......	......	......	......	......	......	3.50	3.50	1.10	1.51	1.45
Montana	......	......	......	......	12.00	11.72	......	10.00	8.00	8.69	8.71	8.91
New Mexico	......	......	6.00	5.50	5.00	5.00	5.00	6.00	6.00	5.32	4.89	4.75
Ohio	2.54	2.49	2.57	2.57	2.49	2.78	2.69	2.65	2.48	2.50	2.92	1.99
Pennsylvania	1.86	1.70	1.55	1.22	1.25	1.25	1.42	1.84	1.26	1.40	1.91	1.82
Tennessee	2.42	2.33	2.52	2.25	1.95	1.31	1.87	2.19	1.27	2.03	1.96	1.92
Utah	10.00	......	10.00	......	......	......	......	......	......	4.00	4.36	4.50
Virginia	......	......	......	1.75	1.75	1.75	2.50	2.50	1.74	2.22	1.68	1.58
Washington	......	......	......	......	......	......	......	......	......	8.00	8.00	7.00
West Virginia	2.30	2.30	2.26	2.19	1.19	1.86	1.94	2.22	1.70	1.76	1.83	1.83
Wisconsin	......	......	......	......	......	......	......	......	3.00	5.75	5.75	5.61
Wyoming	......	......	......	......	......	......	......	......	......	......	......	3.00
Total average	1.99	1.88	1.77	1.49	1.49	1.49	1.63	2.01	1.46	1.62	2.02	1.97

Discussing first the three years especially covered by this report, 1889 to 1891; not only has there been a notable increase in the value of coke produced in these three years as compared with 1888, but the average value of the coke per ton has greatly increased. The value of the production of 1888 was $12,445,963, the total production for that year being 8,540,030 tons, an average of $1.46 a ton. The total value increased in 1889 to $16,630,301 with a production of 10,258,022 tons, or an average of $1.62 per ton. In 1890 the production increased to 11,508,021 tons, the total value being $23,215,302, or $2.02 a ton, the highest average with one exception in the twelve years covered by the table, the average value in 1887 being $2.01. In 1891 the total production dropped to 10,352,688 tons, valued at $20,393,216, or $1.97 a ton.

During the twelve years covered by this report the total value of the coke produced has increased from $6,631,267 in 1880 to $23,215,302 in 1890. As the average value of the coke in these two years was very nearly the same the increase in value becomes practically a measure of the increase in production.

An examination of the tables giving the average value per ton of the coke at the ovens in 1891 shows that the average value of coke ranges from $1.45 in Missouri to $8.91 in Montana. The value of the coke in

Washington territory is next to Montana, the average price being $7 a ton. These high prices are not arbitrary, the character of the coal, the higher price of labor, and other elements of cost rendering the manufacture of coke in these districts not as renumerative as would appear from the high price received.

Coal consumed in the manufacture of coke.—In the following table is given the total number of tons of coal used in the manufacture of coke in the United States for the years 1880 to 1891:

Amount of coal used (short tons) in the manufacture of coke in the United States from 1880 to 1891, inclusive, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.
Alabama	106,283	184,881	261,839	359,699	413,184	507,934
Colorado	51,891	97,508	180,549	224,089	181,968	208,069
Georgia	63,402	68,960	77,670	111,687	132,113	117,781
Illinois	31,240	35,240	25,270	31,370	30,168	21,487
Indiana	....	....	....	....	....	....
Indian Territory	2,494	2,852	3,266	4,150	3,084	5,781
Kansas	4,800	8,800	9,200	13,400	11,500	15,000
Kentucky	7,206	7,406	6,906	8,437	3,451	5,075
Missouri	....	....	....	....	....	....
Montana	....	....	....	....	165	300
New Mexico	....	....	1,500	6,941	29,990	31,889
Ohio	172,453	201,145	181,577	152,502	108,164	68,796
Pennsylvania	4,347,558	5,393,503	6,149,179	6,823,275	6,204,604	6,178,500
Tennessee	217,656	241,644	313,537	330,961	348,295	412,538
Utah	2,000	....	500	....	....	....
Virginia	....	....	....	39,000	99,000	81,899
Washington	....	....	....	....	....	....
West Virginia	230,758	304,823	366,653	411,159	385,588	415,533
Wisconsin	....	....	....	....	....	....
Wyoming	....	....	....	....	....	....
Total	5,237,741	6,546,762	7,577,646	8,516,670	7,951,974	8,071,126

States and Territories.	1886.	1887.	1888.	1889.	1890.	1891.
Alabama	635,120	550,047	848,608	1,746,277	1,809,964	2,144,277
Colorado	228,060	267,487	274,212	299,731	407,023	452,749
Georgia	136,133	158,482	140,000	157,878	170,388	164,875
Illinois	17,806	16,596	13,020	19,250	9,000	10,000
Indiana	13,030	35,600	26,547	16,428	11,753	8,688
Indian Territory	10,242	20,121	13,126	13,277	13,278	20,551
Kansas	23,062	27,604	24,934	21,600	21,809	27,181
Kentucky	9,055	29,129	42,642	25,192	24,372	64,390
Missouri	....	5,400	5,000	8,485	9,491	10,377
Montana	....	10,800	20,000	30,576	32,148	61,667
New Mexico	18,194	22,549	14,628	7,162	3,980	4,000
Ohio	59,332	164,974	124,201	132,828	126,921	69,320
Pennsylvania	8,290,849	8,938,438	9,673,097	11,581,292	13,046,143	10,588,544
Tennessee	621,669	655,857	630,099	626,016	600,387	623,177
Utah	....	....	....	2,217	24,058	25,281
Virginia	200,018	235,841	230,529	238,793	251,683	285,113
Washington	....	....	....	6,983	9,120	10,000
West Virginia	425,002	698,327	863,707	1,001,372	1,395,266	1,716,976
Wisconsin	....	....	1,000	25,616	38,425	52,904
Wyoming	....	....	....	....	....	4,470
Total	10,688,972	11,859,752	12,945,350	15,960,973	18,005,209	16,344,540

In regard to this table it is to be noted that in most cases the statement as to the amount of coal used in the production of coke is an estimate. At but few works is the coal weighed before being charged into the ovens. A great deal of the coke made in the United States is from "run of mine," that is, all of the product of mining, lump, nut, and slack, as it comes to the mouth of the pit in the mine car is charged into the ovens, and if no coal is sold as coal, it is comparatively easy to ascertain from the amounts paid for mining what is the amount of coal charged into the ovens. But even in such cases considerable difficulty arises from the fact that mining is paid for by the measured bushel or ton of so many cubic feet, while our statistics are by weight, and the measured bushel or ton is often not the equivalent of the weighed bushel or ton. It is also true that in certain districts where the men are paid by the car, the car contains even of measured tons more than the men are paid for. Under such circumstances it is not to the interest of the operator to weigh the coal as it is charged into the oven.

Further, in many districts coke-making is simply for the purpose of utilizing the slack coal produced in mining or that which falls through the screen at the tipple when lump coal is sold. In such cases, the slack is rarely, if ever, weighed as it is charged into the ovens, so that any statement as to the amount of coal used at such works will be an estimate. At some works the coal is often weighed for a brief period, and the coke being weighed as it is sold, a percentage of yield is ascertained which is used in statements as to the amount of coal used and the yield of this coal in coke.

Great care has been exercised, in view of these facts, to reach a satisfactory estimate as to the amount of coal used in the production of coke, as given in the table immediately preceding, and the percentage yield of coal in coke as shown in the table next subsequent. Analyses of coals from most of the districts in the United States have been secured. These analyses, checked by personal knowledge as to wastefulness of the methods of coking in each district, have enabled the writer to reach a conclusion as to whether the returns made were approximately correct or not. Where it has been judged that they were incorrect, correspondence has usually led to a revision of the same. It is sometimes the custom of coke manufacturers who do not weigh the coal charged into the ovens to estimate that the yield of coke is equal to the percentage of the fixed carbon and ash in the coal. A report from a certain coke works showed a yield of 77 per cent. This was equal to the average amount of fixed carbon and ash in the coal. Further inquiry developed the fact that at other mines in this district, using the same character of coal, the yield as reported varied from 50 to 66 per cent. Upon the attention of the party making the return showing 77 per cent being called to these facts, the yield was reduced to 63 per cent. As coke is sold by weight, it has always been assumed that the production of coke was accurate, and where the coal was not weighed, yield of coal in coke being ascertained, a calculation could be made which would show approximately the amount of coal used.

But even under these conditions it is believed that more coal was actually used in the production of coke in each of the years covered by the above table than is shown.

The amount of coal necessary to produce a ton of coke, assuming that the above tables are approximately correct, was as follows:

Coal required to produce a ton of coke in tons or pounds.

	Tons.	Pounds.
1880	1.57	3,140
1881	1.59	3,180
1882	1.58	3,160
1883	1.55	3,100
1884	1.63	3,260
1885	1.58	3,160
1886	1.56	3,120
1887	1.56	3,120
1888	1.51	3,032
1889	1.55	3,100
1890	1.58	3,160
1891	1.58	3,160

It is believed that the amount of coal used is greater than that reported. This would increase the amount of coal given above as necessary to produce a ton of coke.

In the following table is shown the percentage of yield of coal in the manufacture of coke for the years 1880 to 1891. The statements made above must be kept in mind in examining this table. By the "yield" is of course meant the percentage of the constituents of the coal that remained as coke, and in the coke after the process of coking.

While these tables show an average of something like 63 per cent for most of the years, it is believed that even this is a little too high. Probably the actual yield of coal in coke throughout the United States, if the actual weight of coal charged into the ovens and the actual weight of the coke drawn had been taken, would not have exceeded 60 or 61 per cent.

Percentage yield of coal in the manufacture of coke in the United States in the years 1880 to 1891, inclusive, by States and Territories.

States and Territories.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Alabama	57	59	58	60	60	59	59	59	60	59	59	60
Colorado	49	50	57	60	64	63	62.6	64	65.6	63	60	61
Georgia	60	60	60	60	60	60	60	50	60	60	60	62.5
Illinois	41	42	45	43	43	48	46	55½	56.9	60	55	52
Indiana							47	50	45	51	51	44
Indian Territory	62	62	62	62	62	62	62	50	57	50	50	46
Kansas	64	64.4	65	62.9	62¼	53⅔	54.2	54	59	64	56	52
Kentucky	60	60	59	60	64	53	50	50	54	52	51	52
Missouri								55	52	62	65	66
Montana					46	58½		66⅔	60	46	45	47
New Mexico			66⅔	57¼	57½	56¼	56	61	58	48	51.5	57.5
Ohio	58	59	57	58	58	57	59	56	54	56	59	56
Pennsylvania	65	64	64	65	62	64.6	65.2	65¼	68	66	65	66
Tennessee	60	60	60	62	63	53	59	61	61	57	58	58
Texas							50					
Utah	50		50							34	35	31
Virginia				64½	64¼	60	61.1	70.8	64.7	61	66	58.7
Washington										55	64	60
West Virginia	60	61	63	63	62	63	62	63.3	61.6	61	59	58.5
Wisconsin									50	62.5	65	65
Wyoming												60
Total average	63	63	63	64	61	63	64	64.2	66	64	63	63

The great difference in the yield in the different States is worthy of notice. The highest average shown is 66 per cent., in Pennsylvania and Missouri. Wisconsin, whose coke is made from Pennsylvania coal, shows an average very nearly the same, that is, 65 per cent. Georgia shows an average of 62.5 per cent., which is evidently high; Alabama an average of 60 per cent. The lowest average is in Utah, where the yield is but 31 per cent. It should be constantly borne in mind that these averages, as a rule, are probably excessive, except, possibly, in some of the States where the production is very small and where the coal is weighed before charging.

Amount and value of coal per ton of coke.—For the first time in the years covered by this report we have statistics of the amount and value of coal used in coking, and whether it was "run of mine" or slack. In the following two tables will be found a statement as to the total amount and value of coal used in the manufacture of coke in the United States and as to the amount and value of coal per ton of coke for the years 1889 and 1891:

Amount and value of coal used in the manufacture of coke in the United States in 1889, and amount and value of same per ton of coke.

States and Territories.	Coal used.	Total value of coal.	Value of coal per ton.	Amount of coal used per ton of coke.	Value of coal to a ton of coke.
	Short tons.			*Short tons.*	
Alabama	1,746,277	$1,692,990	$0.97	1.69	$1.64
Colorado	299,731	385,378	1.28	1.6	2.05
Georgia	157,878	142,090	.90	1.66	1.49
Illinois	19,250	11,650	.61	1.66	1.01
Indiana	16,428	17,596	1.07	1.98	2.12
Indian Territory	13,277	3,319	.25	2.00	.50
Kansas	21,600	9,011	.42	1.56	.66
Kentucky	25,192	9,560	.38	1.8	.68
Montana	30,576	90,910	2.97	2.17	6.44
Missouri	8,485	3,118	.37	1.6	.59
New Mexico	7,162	9,486	1.32	2.07	2.73
Ohio	132,828	137,625	1.04	1.76	1.83
Pennsylvania	11,581,292	7,160,899	.62	1.51	.94
Tennessee	626,016	516,599	.83	1.74	1.44
Utah	2,217	1,419	.64	2.91	1.86
Virginia	238,793	258,875	1.08	1.63	1.76
Washington	6,983	15,712	2.25	1.82	4.10
West Virginia	1,001,372	680,261	.67	1.64	1.10
Wisconsin	25,616	62,759	2.45	1.6	3.92
Total	15,960,973	11,209,257	.70	1.55	1.09

Amount and value of coal used in the manufacture of coke in the United States in 1891 and amount and value of same per ton of coke.

States and Territories.	Coal used.	Total value of coal.	Value of coal per ton.	Amount of coal per ton of coke.	Value of coal to a ton of coke.
	Short tons.			*Short tons.*	
Alabama	2,144,277	$2,186,707	$1.00	1.67	$1.67
Colorado	452,749	573,052	1.26	1.63	2.05
Georgia	164,875	148,388	.90	1.6	1.44
Illinois	10,000	1,500	.15	1.92	.29
Indiana	8,688	2,172	.25	2.28	.57
Indian Territory	20,551	5,138	.25	2.17	.54
Kansas	27,181	13,820	.51	1.91	.97
Kentucky	64,390	16,278	.25	1.91	.48
Missouri	10,377	4,143	.40	1.51	.60
Montana	61,667	128,864	2.09	2.12	4.43
New Mexico	4,000	6,600	1.65	1.72	2.84
Ohio	69,320	56,056	.81	1.79	1.43
Pennsylvania	10,588,544	7,318,697	.69	1.52	1.05
Tennessee	623,177	525,571	.84	1.71	1.45
Utah	25,281	19,198	.76	3.18	2.42
Virginia	285,113	227,995	.80	1.70	1.36
Washington	10,000	22,500	2.25	1.66	3.74
West Virginia	1,716,976	1,084,428	.63	1.74	1.10
Wisconsin	52,904	158,712	3.00	1.54	4.62
Wyoming	4,470	....	....	1.66	....
Total	16,344,540	12,499,819	.765	1.58	1.21

These tables indicate that the value per ton of the coal used in the manufacture of coke in 1889 was 70 cents. This value increased in 1891 to 76.5 cents. The selling price of coke also increased in these years from $1.62 in 1889 to $1.97 in 1891. In 1889 the amount of coal used to a ton of coke was 1.55 tons; in 1891, 1.58 tons. The average value of coal per ton of coke, therefore, would be $1.09 in 1889 and $1.21 in 1891. This table affords an interesting study as to the great variation in the price of coal per ton of coke in the different States.

Condition in which coal was charged into ovens.—For the first time in connection with this series of reports the condition of the coal charged into the ovens has been ascertained; that is, whether it was used as "run of mine" or slack, washed or unwashed. The results shown in the following table are somewhat of a surprise, as it was generally supposed that a much larger percentage of slack was used. When it is noticed that such a large proportion of coal used for coke is from Alabama and Pennsylvania mines, at which the object of mining is to produce coal for coke and not for sale as coal, the proportion of "run of mine" will not seem so great.

The headings of the following table explain themselves. It is only necessary to state that the "run of mine" washed includes that run of mine coal which is crushed before being washed.

Character of coal used in the manufacture of coke in 1891.

States and Territories.	Run of mine, unwashed.	Run of mine, washed.	Slack, unwashed.	Slack, washed.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	1, 943, 469	0	192, 238	8, 570	2, 144, 277
Colorado	90, 000	0	362, 749	0	452, 749
Georgia	106, 131	0	0	58, 744	164, 875
Illinois	0	0	10, 000	0	10, 000
Indiana	0	0	0	8, 688	8, 688
Indian Territory	0	0	9, 500	11, 051	20, 551
Kansas	0	0	27, 181	0	27, 181
Kentucky	11, 000	0	3, 500	49, 890	64, 390
Missouri	0	0	10, 377	0	10, 377
Montana	0	34, 000	0	27, 667	61, 667
New Mexico	4, 000	0	0	0	4, 000
Ohio	5, 200	0	64, 120	0	69, 320
Pennsylvania	9, 470, 646	256, 807	558, 106	302, 985	10, 588, 544
Tennessee	184, 556	0	377, 914	60, 707	623, 177
Utah	3, 752	0	21, 529	0	25, 281
Virginia	107, 498	0	177, 615	0	285, 113
Washington	0	0	10, 000	0	10, 000
West Virginia	276, 259	0	1, 116, 060	324, 657	1, 716, 976
Wisconsin	0	52, 904	0	0	52, 904
Wyoming	0	0	4, 470	0	4, 470
Total	12, 202, 511	343, 711	2, 945, 359	852, 959	16, 344, 540

Of the total amount of coal used 77 per cent. was "run of mine" and 23 per cent. slack. But 7 per cent. of the total was washed.

Imports and exports of coke.—The following table gives the quantities and value of coke imported and entered for consumption in the United States from 1869 to 1891, inclusive. In the statement is included not only that coke which is entered for consumption through the custom-houses, but the withdrawals from warehouses for consumption. In the reports of the Treasury Department the quantities are long tons. These have been reduced to short tons to make the table consistent with the other tables in this chapter.

Coke imported and entered for consumption in the United States, 1869 to 1891, inclusive.

Fiscal year ending June 30—	Quantity.	Value.	Years ending—	Quantity.	Value.
	Short tons.			*Short tons.*	
1869	....	$2, 053	June 30, 1881	15, 210	$64, 987
1870	....	6, 388	1882	14, 924	53, 244
1871	....	19, 528	1883	20, 634	113, 114
1872	9, 575	9, 217	1884	14, 483	36, 278
1873	1, 091	1, 366	1885	20, 876	64, 814
1874	634	4, 588	Dec. 31, 1886	28, 124	84, 801
1875	1, 046	9, 648	1887	35, 320	100, 312
1876	2, 065	8, 657	1888	35, 201	107, 914
1877	4, 068	16, 686	1889	28, 608	88, 008
1878	6, 616	24, 186	1890	20, 808	101, 767
1879	6, 035	24, 748	1891	50, 753	223, 184
1880	5, 047	18, 406			

The coke imported into the United States goes chiefly to the Pacific coast, where it is used in smelting argentiferous lead ores of the Rocky Mountain region. The coke imported is chiefly English and Welsh. Some coke from Nova Scotia is imported into New England.

The exports of coke, which have always been insignificant, seem to have ceased entirely.

ALABAMA.

The three years especially discussed in this report, viz, 1889, 1890, and 1891, were uneventful as to the manufacture of coke in Alabama, except as to the notable increase in production. The number of ovens increased during these three years from 2,475 at the close of 1888 to 5,068 in 1891, an increase of more than 100 per cent. The coke produced increased from 508,511 tons in 1888 to 1,282,496 tons in 1891, an increase of more than 250 per cent. The amount of coke made in 1889 was double the amount made in 1888.

Of the twenty-one establishments in Alabama at the close of 1891 seventeen, with a total of 4,431 ovens, were in the Warrior district; two, with a total of 567 ovens, in the Cahaba, and two, with a total of 70 ovens, in the Coosa district. One works was idle in each of these districts, so that the coke made was made at eighteen works with 4,892 ovens. It should be noted in this connection that by "number of establishments" is meant the number of firms producing coke and not the total number of banks of ovens in the state. The Tennessee Coal, Iron and Railroad Company have ovens at several different places, and the same is true of the Sloss Iron and Steel Company. The total number of blocks or banks of ovens, therefore, in Alabama is considerably in excess of twenty-one.

The amount of coal used in the production in 1891 of the 1,282,496 tons of coke was 2,144,277 tons, showing a yield of about 60 per cent. Of this coal 1,943,469 tons is reported as "run of mine," 192,238 tons as unwashed slack, and 8,570 tons as washed slack. To make a ton of coke 1.67 tons of coal were required. The value of the coal is reported at $1 a ton, making the total value of coal to a ton of coke $1.67. As is stated elsewhere, it must be noted that this value per ton is the value reported. Different works take different views as to the value placed upon coal used in coking, some estimating its value at cost, others at what the coal would sell for as coal in the market.

The following are the statistics of the manufacture of coke in Alabama from 1880 to 1891, inclusive:

Statistics of the manufacture of coke in Alabama, 1880 to 1891, inclusive.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*		*Per ton.*	*Per cent.*
1880	4	316	100	106,283	60,781	$183,063	$3.01	57
1881	4	416	120	184,881	109,033	326,819	3.00	59
1882	5	536	....	261,839	152,940	425,940	2.79	58
1883	6	767	122	359,699	217,531	598,473	2.75	60
1884	8	(a)976	242	413,184	244,009	609,185	2.50	60
1885	11	1,075	16	507,934	301,180	755,645	2.50	59
1886	14	(a)1,301	1,012	635,120	375,054	993,302	2.65	59
1887	15	1,555	1,362	550,047	325,020	775,090	2.39	59
1888	18	2,475	406	848,608	508,511	1,189,579	2.34	60
1889	19	3,944	427	1,746,277	1,030,510	2,372,417	2.30	59
1890	20	4,805	371	1,809,964	1,072,942	2,589,447	2.41	59
1891	21	5,068	50	2,144,277	1,282,496	2,986,242	2.33	60

a One establishment made coke on the ground.

COLORADO.

Colorado is still the most important coke producing state outside of those which draw their supplies from the coal beds of the Appalachian field. It is the only one of the states of the Far West that is a large producer of coke, though Montana has rapidly increased its product in each of the three years especially covered by this report. There has been a marked increase in the production of coke of Colorado since 1888, the production of 1891 being nearly 100,000 tons in excess of the production of 1888, the total for the last-named year being 179,682 tons and for 1891 277,074 tons. The number of ovens also shows a notable increase, having grown from 602 in 1888 to 948 in 1891, an increase of more than 50 per cent. During these years, however, there has been a decrease in the average value of coke at the ovens, the value in 1888 having been $4 a ton, in 1889 $3.43, in 1890 $3.90, dropping in 1891 to $3.24.

The largest part of the coke produced in this state is from what has been termed the Trinidad or El Moro district, this district producing 176,859 tons of the total of 277,074 tons. There were produced in what may be termed the Crested Butte district 94,785 tons, the remainder having been produced in the San Juan district.

The growth of the coke industry in this state during the twelve years covered by this report is remarkable. The production for 1880 was 25,568 tons. This had arisen in 1891 to 277,074 tons, an increase of more than 1,000 per cent. Indeed, the indications at the present time are that Colorado will be the chief coke-producing section of the Rocky Mountain territory and of the coal fields further west for years to come, at least. Of the 452,749 tons of coal made into coke in Colorado in 1891, 362,749 tons were unwashed slack, 90,000 tons being "run of mine." Indeed, coking in Colorado is almost exclusively for the purpose of consuming the slack produced in the operation of mining coal for the market.

The amount of coal required to make a ton of coke was 1.63 tons. This was valued at $1.26 per ton, making the cost of coal to the ton of coke $2.05.

The following are the statistics of the manufacture of coke in Colorado for the years 1880 to 1891, inclusive.

Statistics of the manufacture of coke in Colorado, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*		*Per ton.*	*Per cent.*
1880	1	200	50	51,891	25,568	$145,226	$5.68	49
1881	2	267	0	97,508	48,587	267,156	5.29	50
1882	5	344	0	180,549	102,105	476,665	4.67	57
1883	7	352	0	224,089	133,997	584,578	4.36	60
1884	8	409	24	181,968	115,719	409,930	3.45	64
1885	7	434	0	208,069	131,960	512,162	3.88	63
1886	7	483	0	228,060	142,797	569,120	3.99	62.6
1887	7	532	0	267,487	170,698	682,778	4.00	64
1888	7	602	100	274,212	179,682	716,305	4.00	65.6
1889	9	834	50	299,731	187,638	643,479	3.43	63
1890	8	916	30	407,023	245,756	959,246	3.90	60
1891	7	948	21	452,749	277,074	896,984	3.24	61

GEORGIA.

There has been but little change in the status of coke-making in Georgia in the last three years, except a slight increase in production. There is the same number of works and of ovens. The table shows some fluctuations in the value and a little in the yield of coal, but Georgia's coke production has but little influence on the general market.

The statistics of the production of coke in this state, 1880 to 1891, are as follows:

Statistics of the manufacture of coke in Georgia, 1880 to 1891, inclusive.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	1	140	40	63,402	38,041	$81,789	$2.15	60
1881	1	180	40	68,960	41,376	88,753	2.15	60
1882	1	220	44	77,670	46,602	100,194	2.15	60
1883	1	264	36	111,687	67,012	147,166	2.20	60
1884	1	300	....	132,113	79,268	169,192	2.13	60
1885	2	300	....	117,781	70,669	144,198	2.04	60
1886	2	300	....	136,133	82,680	179,031	2.17	60
1887	2	300	....	158,482	79,241	174,410	2.20	50
1888	1	290	....	140,000	83,721	177,907	2.12	60
1889	1	300	....	157,878	94,727	149,059	1.57	60
1890	1	300	....	170,388	102,233	150,995	1.48	60
1891	1	300	....	164,875	103,057	231,878	2.25	62.5

ILLINOIS.

The attempts to make coke on a large scale in Illinois have been practically abandoned, at least for the present and until some more satisfactory way of dealing with the coals of the character of those of Illinois has been developed. Extraordinary efforts have been made in this State to establish a coke industry, chiefly with a view to utilizing the large amount of slack coal that now goes to waste. The chief difficulty in coking is due to the impurities in the coal. No methods that have yet been employed on a large scale have produced a coke free enough from these impurities and good enough in other repects to make it a blast-furnace fuel. A washing plant of a kind never before used in Illinois is being erected for the purpose of treating the slack coal of this state on an extensive scale. If this separating plant is successful in removing the sulphur, which is the impurity that reduces the value of the coke made from the coals of this state, no doubt further attempts to coke these coals will be made.

The following are the statistics of the manufacture of coke in Illinois for the years from 1880 to 1891:

Statistics of manufacture of coke in Illinois, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	6	176	....	31,240	12,700	$41,950	$3.30	41
1881	6	176	....	35,240	14,800	45,850	3.10	42
1882	7	304	....	25,270	11,400	29,050	2.55	45
1883	7	316	....	31,170	13,400	28,200	2.10	43
1884	9	325	....	30,168	13,095	25,639	1.96	43
1885	9	320	....	21,487	10,350	27,798	2.68	48
1886	9	335	....	17,806	8,103	21,487	2.65	46
1887	8	278	....	16,596	9,198	19,594	2.13	55.5
1888	8	221	....	13,020	7,410	21,038	2.84	56.9
1889	4	149	....	19,250	11,583	29,764	2.57	60
1890	4	148	....	9,000	5,000	11,250	2.25	55
1891	1	25	....	10,000	5,200	11,700	2.25	52

This table shows a great fluctuation. In 1880 there were six establishments in the state producing coke with 176 ovens, the amount of coke produced being 12,700 tons. In 1884 the number of establishments was nine, the number of ovens 325, the amount of coke produced 13,095 tons. In 1890 the number of establishments had dropped to four, the number of ovens to 148, the coke produced to 5,000 tons, the smallest total production in any of the twelve years, though in 1891 the number of establishments had dropped to one and the number of ovens to 25. The production in 1891, however, was 200 tons greater than in 1890.

INDIANA.

Indiana is another state like Illinois, in which persistent attempts to produce coke on a large scale have been practically failures, though for the last six years some coke has been produced in each year, the production going as high as 17,658 tons in 1887 and dropping to 3,798 tons in 1891. There is an abundance of coal in Indiana that is good coking coal. This mixed with the noncoking block coals ought to produce in some one of the many flue ovens that are used in Europe a coke that would be valuable for many purposes, if not for blast-furnace use, while the saving of the by-products would make the manufacture of coke a financial success.

The statistics of the manufacture of coke from 1886 to 1891, both inclusive are given in the following table. No coke was made in Indiana from 1879 to 1885, both inclusive.

Statistics of manufacture of coke in Indiana from 1886 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1886	4	100	18	13,030	6,124	$17,953	$2.93	47
1887	4	119	....	35,600	17,658	51,141	2.81	50
1888	3	103	....	26,547	11,956	31,993	2.68	45
1889	4	111	....	16,428	8,301	25,922	3.12	51
1890	4	101	....	11,753	6,013	19.706	3.277	51
1891	2	84	....	8,688	3,798	7,596	2.00	44

INDIAN TERRITORY.

The coke works of the Osage Coal and Mining Company, located at McAlester, still continues the only one in the Indian Territory. The development of this works during the twelve years covered by this report is shown in the following table. The number of ovens has increased from twenty to eighty; the coke produced, from 1,546 to 9,464 tons in 1891, the largest production in any one year, except in 1887, when 10,060 tons were produced. The report as to the yield of coal in coke shows a gradual lessening of the yield. The probability is that the report for 1891, which shows a yield of 46 per cent., is much nearer the actual facts than that shown in previous years.

The statistics of the manufacture of coke in the Indian Territory from 1880 to 1891 are as follows:

Statistics of the manufacture of coke in the Indian Territory, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	1	20	....	2,494	1,546	$4,638	$3.00	62
1881	1	20	....	2,852	1,768	5,304	3.00	62
1882	1	20	....	3,266	2,025	6,075	3.00	62
1883	1	20	....	4,150	2,573	7,719	3.00	62
1884	1	20	....	3,084	1,912	5,736	3.00	62
1885	1	40	....	5,781	3,584	12,902	3.60	62
1886	1	40	....	10,242	6,351	22,229	3.30	62
1887	1	80	....	20,121	10,060	33,435	3.33	50
1888	1	80	....	13,126	7,502	21,755	2.90	57
1889	1	78	....	13,277	6,639	17,957	2.70	50
1890	1	78	....	13,278	6,639	21,577	3.25	50
1891	1	80	....	20,551	9,464	30,483	3.22	46

KANSAS.

The production of coke in Kansas is chiefly for domestic purposes and the smelting of lead, most of the coke in the state being made by the lead smelters for their own use. The production has shown but little fluctuation since 1886, the amount produced that year being 12,493 tons. In none of these six years has the production been less than 12,311 tons or greater than 14,950 tons, the amount being practically what is necessary to keep the lead smelters in operation.

There was a slight increase in the number of ovens in 1891, and an increase of about 2,000 tons in the production, as compared with 1890. The yield of coal in coke in 1891 is reported as 52 per cent., which is probably nearer the actual facts than the percentages given in previous years.

The statistics of the manufacture of coke in Kansas from 1880 to 1891 are as follows:

Statistics of the manufacture of coke in Kansas, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	2	6	....	4,800	3,070	$6,000	$1.95	64
1881	3	15	....	8,800	5,670	10,200	1.80	64.4
1882	3	20	....	9,200	6,080	11,460	1.70	65
1883	4	23	....	13,400	8,430	16,560	1.96	62.9
1884	4	23	....	11,500	7,190	14,580	2.02	62.5
1885	4	23	....	15,000	8,050	13,255	1.65	53⅔
1886	4	36	....	23,062	12,493	19,204	1.54	54.2
1887	4	39	....	27,604	14,950	28,575	1.91	54
1888	6	58	....	24,934	14,831	29,073	1.96	59
1889	6	68	....	21,600	13,910	26,593	1.91	64
1890	7	68	....	21,809	12,311	29,116	2.365	56
1891	6	72	....	27,181	14,174	33,296	2.34	52

KENTUCKY.

Kentucky is rapidly assuming a position of considerable importance as a coke-producing state, chiefly by reason of the recent developments in Bell county, in the southeastern part of the state, in the neighborhood of Middlesborough and Pineville. The coke from this section is among the best cokes of the South and is giving most excellent results in the blast furnace. The mines are well located and will permit of an almost indefinite expansion of production.

There are four districts in this state in which coke is made: The first, the Cincinnati district, which includes the ovens on the Ohio River in Kentucky opposite Cincinnati; the second, the Louisville district, which includes the ovens near that city; (at both of these places slack coal from the coal yards is all that is used, the coal being brought from the Upper Ohio); the third district, the western district, which has been thoroughly described in previous volumes of Mineral Resources, and the fourth, the southeastern, as noted above. It is only the latter two districts that are of importance, and it is only the southeastern that is growing with any rapidity. Practically, all of the increase in the last three years has been in this district.

The statistics of the manufacture of coke in Kentucky from 1880 to 1891 are as follows:

Statistics of the manufacture of coke in Kentucky, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	45	....	7,206	4,250	$12,250	$2.88	60
1881	5	45	....	7,406	4,370	12,630	2.89	60
1882	5	45	....	6,906	4,070	11,530	2.83	59
1883	5	45	....	8,437	5,025	14,425	2.87	60
1884	5	45	....	3,451	2,223	8,760	3.94	64
1885	5	33	....	5,075	2,704	8,489	3.14	53
1886	6	76	2	9,055	4,528	10,082	2.23	50
1887	6	98	....	29,129	14,565	31,730	2.18	50
1888	10	132	2	42,642	23,150	47,244	2.04	54
1889	9	166	100	25,192	13,021	29,769	2.28	52
1890	9	175	303	24,372	12,343	22,191	1.797	51
1891	7	115	24	64,390	33,777	68,281	2.02	52

It is possible that a portion of the production for 1889, 1890, and 1891 should be credited to Tennessee. Some of the ovens are on or very near the boundary line between Kentucky and Tennessee, a part of the coal coked being from mines in both states. It is difficult, therefore, to say to which state the coke should be credited, as the report gave Kentucky as the location of the ovens we have included the figures in the above table.

MISSOURI.

About the same statement can be made regarding the production of coke in Missouri as is made regarding Kansas. The three works at which coke is made in this state are all in connection with zinc works, the coke being made especially for zinc smelting. At some of the works, if not all, the coke is twenty-four-hour coke. The value given for the coke must be regarded as simply an estimate, representing about the cost of manufacture. It is believed that the yield given in the years 1889, 1890 and 1891 is too high. The probability is that the figure for 1888 is nearer correct, though for well-made coke even this is too high However, as the coke is burned but twenty-four hours, it may be that the yield is greater than would be the result of longer burning.

The statistics of the production of coke in Missouri from 1887, when coking began in this state, to 1891, are as follows:

Statistics of the manufacture of coke in Missouri, 1887 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1887	1	4	....	5,400	2,970	$10,395	$3.50	55
1888	1	4	....	5,000	2,600	9,100	3.50	52
1889	3	9	....	8,485	5,275	5,800	1.10	62
1890	3	10	....	9,491	6,136	9,240	1.51	65
1891	3	10	....	10,377	6,872	10,000	1.45	66

MONTANA.

Montana is rapidly assuming a position of some prominence as a coke-producer in the Rocky Mountain states. Quite a number of deposits of coal well adapted to coke-making have been found in the coal field near the entrance, or at least not far distant from the entrance, of the Yellowstone park, the two fields from which coke is made being known as the Gardner and the Bozeman fields. A full description of the coal deposits from which this coke is made has been given in previous volumes of Mineral Resources, and need not be repeated here. It can be said of the coke in a general way that it averages from 9 to 17 per cent. in ash, with a slight trace of sulphur, and finds a ready market at Butte, Anaconda, Helena, and other places in its immediate neighborhood. Coke is made only when coal contracts leave a surplus. One of the works whose production is reported did not run to more than half its capacity in 1891, the coal contracts preventing it. At this works, also, the coal used was from a vein giving a high percentage of ash. The one worked at the close of the year runs as low as 9 per cent. in ash.

A study of the table will show the remarkable development in the production of coke in this state since 1887, the production in that year being but 7,200 tons while in 1891 it was 29,009 tons. The high selling price as well as the low percentage of yield are noticeable. The coal in this district is a cretaceous coal, high in volatile constituents.

The statistics of the manufacture of coke in Montana from 1883, when ovens were first reported, to 1891 are as follows:

Statistics of the manufacture of coke in Montana, 1883 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1883	1	2	0	0	0	0	0	0
1884	3	5	12	165	75	$12.00	$900	46
1885	2	2	0	300	175	11.72	2,063	58.5
1886	4	16	0	0	0	0	0	0
1887	2	27	0	10,800	7,200	10.00	72,000	66⅔
1888	1	40	0	20,000	12,000	8.00	96,000	60
1889	2	90	50	30,576	14,043	8.69	122,023	46
1890	2	140	0	32,148	14,427	8.71	125,655	45
1891	2	140	0	61,037	29,009	8.91	258,523	47

NEW MEXICO.

The coke industry in New Mexico has never assumed any importance A small amount is produced from year to year for use in the silver smelters of the state. The seventy ovens built in this state in 1884 have been entirely wrecked, so that in 1891 all of the coke made was made on the ground. The statistics of the manufacture of coke in New Mexico from 1882, when coke ovens were first reported, until 1891 are as follows:

Statistics of the manufacture of coke in New Mexico, 1882 to 1891.

Years.	Establishments.	Ovens built. (*a*)	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1882	2	0	12	1,500	1,000	$6.00	$6,000	66⅔
1883	2	12	28	6,941	3,905	5.50	21,478	57¼
1884	2	70	0	29,990	18,282	5.00	91,410	57¼
1885	2	70	0	31,889	17,940	5.00	89,700	56¼
1886	2	70	0	18,194	10,236	5.00	51,180	56
1887	1	70	0	22,549	13,710	6.00	82,260	61
1888	1	70	0	14,628	8,540	6.00	51,240	58
1889	2	70	0	7,162	3,460	5.32	18,408	48
1890	2	70	0	3,980	2,050	4.89	10,025	51.5
1891	1	0	0	4,000	2,300	4.75	10,925	57.5

a At one works there are ten stone pits, with an average capacity of 10 tons each.

OHIO.

There was a notable falling off in the production of coke in Ohio from 1890 to 1891, the production of 1891 being the smallest, with one exception (1886), of any of the twelve years covered by this report.

The production of coke in this state has been divided into two districts, the Cincinnati district, including the ovens near that city, and the Ohio district, which includes all the ovens in the remainder of the State.

Cincinnati district.—All of the coke made in this district is from the dust and screenings of the coal yards at Cincinnati and from the coal boats and barges that bring coal from the Upper Ohio, chiefly from Pittsburg and the Kanawha region of West Virginia.

The largest block of ovens in this district is that at North Bend, on the Ohio river, a short distance below Cincinnati, which, when in operation, use slack from Pittsburg. These ovens were not operated at all in 1891, hence the great falling off in production shown in the following table, the production of 1890 having been 43,278 tons, the largest production reported. This dropped in 1891 to 9,080 tons. Two coke works in Cincinnati, that have for some years made coke from screenings, have abandoned its manufacture. The number of works has, therefore, dropped from five to three. The yield of coal in coke for 1891, as given in the table, viz., 67.6 per cent., is evidently too high, as is the yield given in the report for 1890. While the coal used is chiefly Pittsburg and Kanawha, which should give the same results in the ovens of Cincinnati as are given in the ovens of Pittsburg and the Kanawha district, the methods of burning the coke at Cincinnati are not so economical as those employed in the ovens located in the districts from which this coal comes, and consequently the yield, instead of being in excess of the yield in the home districts, should be below. The yield is probably less than 60 per cent.

The statistics of the manufacture of coke in the Cincinnati district from 1880 to 1891 are as follows:

Statistics of the manufacture of coke in the Cincinnati district, Ohio, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	4	32	0	16,141	10,326	$4.09	$42,255	64
1881	4	32	0	20,607	13,237	4.11	54,439	64
1882	4	32	0	19,687	12,545	3.78	47,437	64
1883	5	57	0	33,978	20,106	3.28	65,990	59
1884	5	57	0	32,134	18,840	3.24	61,072	59
1885	5	82	0	17,480	10,962	3.27	35,873	63
1886	5	82	0	17,015	10,566	2.99	31,633	62.1
1887	5	150	20	56,733	32,894	2.91	95,754	56
1888	6	156	12	63,217	35,868	2.67	95,618	57
1889	5	146	0	75,892	45,108	2.68	120,899	59
1890	5	150	0	68,266	43,278	3.97	171,848	63
1891	3	130	0	13,403	9,080	3.47	31,529	67.6

Ohio district—This district includes all of the ovens coking Ohio coal, and comprises the ovens of the Cherry Valley Iron Works, at Leetonia; the Federal Valley Coal Company, in the Hocking Valley, and the coke works in the vicinity of Steubenville and Bridgeport. The production in this district has not varied greatly in the last four years, the highest production being in 1890, when it was 31,355 tons, and the lowest production being in 1891, when it was 29,638 tons.

Great fluctuations, however, in the production of coke in this district in the entire twelve years covered by the report will be noted. The range has been from 24,366 tons in 1886 to 106,232 in 1881. These fluctuations show the efforts that have been made to produce coke on a commercial scale in Ohio as well as, to an extent, the fluctuations in value of pig iron.

The following table gives the statistics of the production of coke in the Ohio district for the years 1880 to 1891:

Statistics of the manufacture of coke in the Ohio district, Ohio, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	11	584	25	156,312	90,270	$213,650	$2.37	57
1881	11	609	0	180,438	106,232	243,289	2.39	59
1882	12	615	0	161,890	91,677	218,676	2.39	57
1883	13	625	0	118,524	67,728	159,670	2.36	57
1884	14	675	0	76,030	43,869	95,222	2.17	58
1885	8	560	0	51,316	28,454	73,850	2.60	55
1886	10	478	0	42,317	24,366	40,899	1.68	57¾
1887	10	435	203	108,251	60,110	130,227	2.12	55½
1888	9	391	0	60,984	31,326	70,712	2.25	51
1889	8	316	0	56,936	30,016	67,323	2.24	52.7
1890	8	293	1	58,655	31,355	46,242	1.47	53.4
1891	6	291	0	55,917	29,638	45,372	1.53	53

Total production of coke in Ohio.—In the following table the statistics of the production of coke in the several districts of Ohio for the years 1880 to 1891 are consolidated:

Statistics of the manufacture of coke in Ohio, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	15	616	25	172,453	100,596	$255,905	$2.54	58
1881	15	641	0	201,045	119,469	297,728	2.49	59
1882	16	647	0	181,577	103,722	266,113	2.57	57
1883	18	682	0	152,502	87,834	225,660	2.57	58
1884	19	732	0	108,164	62,709	156,294	2.49	58
1885	13	642	0	68,796	39,416	109,723	2.78	57
1886	15	560	0	59,332	34,932	94,042	2.69	59
1887	15	585	223	164,974	93,004	245,981	2.65	56
1888	15	547	12	124,201	67,194	166,330	2.48	54
1889	13	462	0	132,828	75,124	188,222	2.50	56
1890	13	443	1	126,921	74,633	218,090	2.92	59
1891	9	421	0	69,320	38,718	76,901	1.99	56

Of the 69,320 tons of coal used in the production of coke in this state in 1891, but 5,200 tons was run of mine, 64,120 tons being unwashed slack. The amount of coal used to a ton of coke was 1.79 tons, worth 80 cents a ton or $1.43 per ton of coke produced.

PENNSYLVANIA.

Of the 10,258,022 tons of coke produced in the United States in 1889, Pennsylvania made 7,659,055 tons, or 74.6 per cent.; of the 11,508,021 tons made in 1890, Pennsylvania's make was 8,560,245 tons, giving the same percentage as in 1889; while of the 10,352,688 tons produced in 1891, Pennsylvania made only 6,954,846 tons or only 67.4 per cent. This decline both in product and percentage, in 1891 was due, as has already been stated, to the great strike in the Connellsville region and the stoppage of the blast furnaces of the Shenango and Mahoning valleys for some months early in 1891 to restrict the production of pig iron. The great reduction of the production of coke in Pennsylvania in 1891 was in the Connellsville region, the make of the region, which was 5,930,428 tons in 1889 and 6,464,156 tons in 1890, having fallen to 4,760,665 tons in 1891.

The statistics of the production of coke in Pennsylvania by districts for 1889, 1890, and 1891 are given in the following tables. The names of the districts, which are in every case geographical, indicates their location:

Coke production in Pennsylvania in 1889, by districts.

Districts.	Establishments.	Number of ovens.	Number of ovens building.	Coal used.	Coke produced.	Value of coke at ovens.	Average price per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per ct.*
Allegheny Mountain	16	1,069	20	564,112	354,288	$601,964	$1.69	63.5
Allegheny Valley	4	198	0	13,105	6,569	10,538	1.62	50
Beaver	3	90	0	3,100	1,853	3,848	2.07	60
Blossburg	2	407	0	31,806	18,422	47,765	2.59	58
Broad Top	5	589	0	152,090	91,256	186,718	2.05	60
Clearfield-Center	6	671	0	195,473	120,734	215,112	1.78	61.7
Connellsville	29	14,458	430	8,832,371	5,930,428	7,974,633	1.34	67
Greensburg	2	50	16	32,070	20,459	21,523	1.05	63.8
Irwin	4	696	0	373,913	243,448	351,304	1.44	65
Pittsburg	17	600	21	233,571	141,324	283,402	2.00	60.5
Reynoldsville-Walston	8	1,747	0	514,461	313,011	436,857	1.39½	60.8
Upper Connellsville	13	1,568	80	635,220	417,263	609,828	1.46	65.6
Total	109	22,143	567	11,581,292	7,659,055	10,743,492	1.40	66

Coke production in Pennsylvania in 1890, by districts.

Districts.	Establishments.	Number of ovens.	Number of ovens building.	Coal used.	Coke produced.	Value of coke at ovens.	Average price per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per ct.*
Allegheny Mountain	16	1,171	0	633,974	402,514	$730,048	$1.81	63.5
Allegheny Valley	3	148	0	33,049	18,733	40,204	2.14	56.6
Beaver	3	90	0	4,010	2,148	4,564	2.12	53.5
Blossburg	2	407	0	41,785	23,196	62,804	2.70	55.5
Broad Top	5	482	16	247,823	157,208	314,416	2.00	63
Clearfield Center	7	701	0	331,104	212,286	391,957	1.85	64
Connellsville	28	15,865	30	9,748,449	6,464,156	12,537,370	1.94	66
Greensburg	2	58	0	44,000	30,261	44,290	1.46	68.7
Irwin	4	661	0	270,476	172,329	256,458	1.488	63.7
Pittsburg	14	541	0	149,230	93,984	171,465	1.82	63
Reynoldsville-Walston	8	1,737	0	652,966	406,184	771,996	1.90	62
Upper Connellsville	14	1,569	28	889,277	577,246	1,008,102	1.746	64.9
Total	106	23,430	74	13,046,143	8,560,245	16,333,674	1.91	65

Coke production in Pennsylvania in 1891, by districts.

Districts.	Establishments.	Number of ovens.	Number of ovens building.	Coal used.	Coke produced.	Value of coke at ovens.	Average price per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per ct.*
Allegheny Mountain	16	1,201	0	708,523	448,067	$782,175	$1.74	63
Allegheny Valley	3	148	0	21,833	11,314	25,909	2.29	52
Beaver	3	88	0	4,224	2,332	6,663	2.85	55
Blossburg	2	407	0	46,084	24,351	66,195	2.72	53
Broad Top	5	448	0	146,008	90,728	197,048	2.17	62
Clearfield-Center	7	666	0	293,542	183,911	339,082	1.84	63
Connellsville	33	17,551	0	7,083,705	4,760,665	8,903,454	1.87	67
Greensburg	2	58	0	38,188	22,441	36,627	1.63	59
Irwin	4	696	0	323,099	197,082	266,061	1.35	61
Pittsburg	13	590	11	154,054	94,160	201,458	2.14	61
Reynoldsville-Walston	7	1,747	0	769,100	470,479	744,098	1.58	61
Upper Connellsville	14	1,724	0	1,000,184	649,316	1,111,056	1.71	65
Total	109	25,324	11	10,588,544	6,954,846	12,679,826	1.82	66

In each of these three years the production of each of the important coking districts of this state outside of the Connellsville has shown a marked increase. The Allegheny Mountain district, which includes the ovens along the line of the Pennsylvania railroad from Gallitzin eastward over the crest of the Alleghenies to beyond Altoona, increased from 354,228 tons in 1889 to 448,067 tons in 1891; the Clearfield-Center district, located chiefly in the two counties from which it derives its name, from 120,734 tons in 1889 to 183,911 tons in 1891; the Reynoldsville-Walston district, in the northwestern part of the state, from 313,011 tons in 1889 to 470,479 tons in 1891; and the Upper Connellsville, sometimes called the Latrobe, from 417,263 tons in 1889 to 649,316 tons in 1891.

A comparison of these tables with the table of total production of the United States shows that six districts in the State produced over 100,000 tons of coke in 1891; just the number of States exclusive of Pennsylvania that produced this amount. The Allegheny Mountain, Reynoldsville-Walston and Upper Connellsville districts each produced more coke in 1891 than any of the States, with the exception of Alabama, Pennsylvania, and West Virginia.

Of the coal consumed in the manufacture of coke in the State in 1891, 9,470,646 tons were "run of mine," 256,807 tons "run of mine" washed, 558,106 unwashed slack, and 302,985 washed slack. In round numbers, three-fourths of all of the "run of mine," five-sevenths of all of the washed "run of mine," 29 per cent. of all of the unwashed slack and three-sevenths of the washed slack coked in the United States were coked in Pennsylvania ovens. It required 1.52 tons of coal to make a ton of coke. This was worth 69 cents a ton of coal or $1.05 for the amount of coal required to make a ton of coke.

In the following table is given the statistics of the production of coke in Pennsylvania for the years 1881 to 1891:

Statistics of the manufacture of coke in Pennsylvania, 1881 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1881	132	10,881	761	5,393,503	3,437,708	$5,898,579	$1.70	64
1882	137	12,424	642	6,149,179	3,945,034	6,133,698	1.55	64
1883	140	13,610	211	6,823,275	4,438,464	5,410,387	1.22	65
1884	145	14,285	232	6,204,604	3,822,128	4,783,230	1.25	62
1885	133	14,553	317	6,178,500	3,991,805	4,981,656	1.25	64.6
1886	108	16,314	2,558	8,290,849	5,406,597	7,664,023	1.42	65.2
1887	151	18,294	802	8,938,438	5,832,849	10,746,352	1.84	65¼
1888	120	20,381	1,565	9,673,097	6,545,779	8,230,759	1.26	68
1889	109	22,143	567	11,581,292	7,659,055	10,743,492	1.40	66
1890	106	23,430	74	13,046,143	8,560,245	16,333,674	1.91	65
1891	109	25,324	11	10,588,544	6,954,846	12,679,826	1.82	66

An inspection of this table will show the growth of the coke industry in Pennsylvania in these eleven years. The number of ovens has increased 2½ times, and the production of coke increased in about the same proportion.

The Connellsville district.—The Connellsville district, which still remains the most important coke-producing center in the United States, and one of the most important in the world, has been so thoroughly described in previous volumes of "Mineral Resources" as to require only the briefest reference here. It may be well to say, however, that the Connellsville coal basin is in the southwestern part of Pennsylvania, some 50 or 60 miles from Pittsburg. It is a slender prong, separated from the upper coal measures, and may be regarded as extending from south of Latrobe, on the Pennsylvania railroad, in a southwesterly direction, to the Virginia line, forming a basin some 3 miles wide and 50 miles long, almost without a fault, the beds yielding from 8 to 10 feet of workable coal. The same trough that contains the Connellsville coal extends northwesterly from Latrobe, but the Connellsville region proper is regarded as extending no farther north than the vicinity of Latrobe. The district north of the Connellsville proper has been designated in these reports as the "Upper Connellsville:" it is known locally as the "washed-coal district."

In this district there are approximately 55,000 to 60,000 acres of coking coal still unworked. This refers to the Connellsville seam alone. There are in this district several other seams of coal lying under the Connellsville seam that will be available to make a coke much above the average of cokes when the Connellsville vein is exhausted.

The following are the statistics of the manufacture of coke in the Connellsville region from 1880 to 1891:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	67	7,211	731	3,367,856	2,205,946	$3,948,643	$1.79	$65\frac{1}{2}$
1881	70	8,208	654	4,018,782	2,639,002	4,301,573	1.63	$65\frac{2}{3}$
1882	72	9,283	592	4,628,736	3,043,394	4,473,789	1.47	$65\frac{3}{4}$
1883	74	10,176	101	5,355,380	3,552,402	4,049,738	1.14	$66\frac{1}{3}$
1884	76	10,543	200	4,829,054	3,192,105	3,607,078	1.13	$66\frac{1}{10}$
1885	68	10,471	48	4,683,831	3,096,012	3,776,388	1.22	$66\frac{1}{10}$
1886	36	11,324	1,895	6,305,460	4,180,521	5,701,086	1.36	$66\frac{3}{10}$
1887	73	11,923	98	6,182,846	4,146,989	7,437,669	1.79	67
1888	38	12,818	1,320	7,191,708	4,955,553	5,884,081	1.19	69
1889	29	14,458	430	8,832,371	5,930,428	7,974,633	1.34	67
1890	28	15,865	30	9,748,449	6,464,156	12,537,370	1.94	66
1891	33	17,551	0	7,083,705	4,760,665	8,903,454	1.87	67

Prices of Connellsville coke.—There has been a remarkable uniformity in the prices of Connellsville coke in 1891. Early in the year the strike in the Connellsville region made all quotations nominal, but it can be fairly said that all through 1891 furnace coke ruled at $1.90 per ton, free on board at Connellsville; foundry coke at $2.30, and crushed coke at $2.65. These prices were shaded somewhat towards the close of the year. The average value for the entire year, as shown by a preceding table, was $1.87 a ton.

The following table gives the ruling prices of blast-furnace coke free on board at the ovens for the past eleven years:

Monthly prices of Connellsville blast-furnace coke free on board at ovens.

Months.	1881.	1882.	1883.	1884.	1885.
January	$1.50–$1.75	$1.70–$1.80	$1.15–$1.20	$1.00	$1.10
February	1.50– 1.75	1.70– 1.80	1.20– 1.10	1.00	1.10
March	1.50– 1.75	1.70– 1.75	1.05	1.00	1.10
April	1.60– 1.75	1.70– 1.75	1.05	1.10	1.20
May	1.60– 1.65	1.65– 1.70	.95– 1.05	1.10	1.20
June	1.60– 1.65	1.50– 1.65	.90	1.10	1.20
July	1.50– 1.60	1.35– 1.50	.90	1.10	1.20
August	1.60	1.35	.90	1.10	1.20
September	1.60	1.25– 1.35	1.00	1.10	1.20
October	1.60– 1.65	1.25	1.00	1.10	1.20
November	1.60– 1.65	1.25– 1.35	1.00	1.10	1.20
December	1.60– 1.70	1.15– 1.35	1.00	1.10	1.20

Monthly prices of Connellsville blast-furnace coke free on board at ovens—Continued.

Months.	1886.	1887.	1888.	1889.	1890.	1891.
January	$1.20	$1.50	$1.75	$1.25	$1.75	$1.90
February	1.20	2.00	1.75	1.25	1.75	1.90
March	1.35	2.00	$1.25–1.50	1.25	2.15	1.90
April	1.35	2.00	1.00	1.15	2.15	1.90
May	1.50	2.00	1.00	1.10	2.15	1.90
June	1.50	2.00	1.00	1.10	2.15	1.90
July	1.50	2.00	1.00	$1.00–1.10	2.15	1.90
August	1.50	2.00	1.00	1.00	2.15	1.90
September	1.50	2.00	1.00	1.25–1.50	2.15	1.85
October	1.50	2.00	1.00	1.50	2.15	1.85
November	1.50	2.00	1.25	1.75	2.15	1.80
December	1.50	2.00	1.25	1.75	2.15	1.80

The Upper Connellsville district.—This district, as stated in previous reports, includes that portion of the trough or basin in which the Connellsville coke is found that is located northerly from a point just below Latrobe. The coal differs somewhat from that found in the lower part of the basin, and, as stated previously, the district is known as the "washed-coal district." It is one of the most important coking districts in the amount of product in the country. Its product among the districts of Pennsylvania is surpassed only by the Connellsville.

In this district 1,000,184 tons of coal were used in the production of coke in 1891. Of this 618,755 tons were "run of mine" unwashed, 256,807 tons "run of mine" washed, 70,957 tons unwashed slack and nut, and 53,665 unwashed slack.

The following are the statistics of the manufacture of coke in the Upper Connellsville region for the years 1880 to 1891:

Statistics of the manufacture of coke in the Upper Connellsville district, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	8	757	0	319,927	229,433	$1.73	$397,945	59
1881	10	986	0	588,924	343,728	1.60	548,362	58
1882	11	1,118	0	650,174	375,918	1.43	536,503	58
1883	11	1,118	0	668,882	389,053	1.08	422,174	58
1884	11	1,118	0	496,894	294,477	1.06	311,665	59
1885	11	1,168	40	555,735	319,297	1.08	346,168	57
1886	12	1,337	29	691,331	442,968	1.29	572,073	64.1
1887	16	1,442	87	717,274	470,233	1.79	840,144	65.6
1888	16	1,977	0	657,966	441,966	1.40	617,189	68
1889	13	1,568	80	635,220	417,263	1.46	609,828	65.6
1890	14	1,569	28	889,277	577,246	1.746	1,008,102	64.9
1891	14	1,724	0	1,000,184	649,316	1.71	1,111,056	65

Allegheny Mountain district.—This district is now the fourth in importance in Pennsylvania, it having been surpassed in production in 1891 by the Reynoldsville-Walston. It includes not only the ovens along the Pennsylvania railroad, comprising those on both slopes of the Alleghenies in Cambria and Blair counties, but the ovens in Somerset county as well.

The following are the statistics of the manufacture of coke in the Allegheny Mountain district of Pennsylvania for the years 1880 to 1891:

Statistics of the manufacture of coke in the Allegheny Mountain district of Pennsylvania, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	8	291	0	201,345	127,525	$2.27	$289,929	63
1881	9	371	0	225,563	144,430	2.28	329,198	64
1882	10	481	0	284,544	179,580	2.10	377,286	63
1883	10	532	0	200,343	135,342	1.78	240,641	68
1884	12	614	0	241,459	156,290	1.30	203,213	65
1885	11	523	82	327,666	212,242	1.30	286,539	65
1886	10	579	14	351,070	227,369	1.64	374,013	64.8
1887	10	694	150	461,922	297,724	2.25	671,437	64.4
1888	12	950	145	521,047	335,689	1.43	479,845	64.4
1889	16	1,069	20	564,112	354,288	1.69	601,964	63.5
1890	16	1,171	0	633,974	402,514	1.81	730,048	63.5
1891	16	1,201	0	708,523	448,067	1.74	782,175	63

Most of the coal used at the ovens in this district is "run of mine"—611,643 tons of the 708,523 tons.

Clearfield-Center district.—This district, formerly known as the Snow Shoe, has shown a remarkable increase in production in the twelve years covered by this report from 100 tons in 1880 to 212,286 tons in 1890 and 183,911 tons in 1891. The increase in the three years specially covered by this report has been notable—from 115,338 tons in 1888 to the amounts in 1890 and 1891 given above. About half of the coal used in the district is "run of mine," though many of the ovens were built originally to use slack. The quality of the coke has proven so good that it has been found profitable to use a large proportion of "run of mine."

The statistics of the manufacture of coke in the Clearfield-Center district for the years 1880 to 1891 are as follows:

Statistics of manufacture of coke in the Clearfield-Center district, Pennsylvania, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	1	0	0	200	100	$2.00	$200	50
1881	2	50	0	20,025	13,350	1.70	22,695	67
1882	1	50	0	25,000	17,160	1.60	27,406	69
1883	1	60	0	26,500	18,696	1.50	28,844	71
1884	1	60	0	33,000	23,431	1.40	32,849	71
1885	2	245	0	69,720	48,103	1.46	70,331	69
1886	3	299	20	84,870	55,810	1.70	94,877	66
1887	6	523	10	154,566	97,852	2.02	198,095	63.3
1888	6	601	0	172,999	115,338	1.51	174,220	66.6
1889	6	671	0	195,473	120,734	1.78	215,112	61.7
1890	7	701	0	331,104	212,286	1.85	391,957	64
1891	7	666	0	293,542	183,911	1.84	339,082	63

The Broad Top district.—In this district are included all the ovens in what is known as the "Broad Top coal fields," the ovens being situated in Bedford and Huntingdon counties.

The statistics of the manufacture of coke in the Broad Top region, Pennsylvania, for the years 1880 to 1891, are as follows:

Statistics of the manufacture of coke in the Broad Top region, Pennsylvania, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	188	105	92,894	51,130	$2.40	$123,748	55
1881	5	188	105	111,593	66,560	2.51	167,074	59
1882	5	293	50	170,637	105,111	2.05	215,079	62
1883	5	343	110	220,932	147,154	1.84	271,692	66
1884	5	453	0	227,954	151,959	1.74	264,569	66
1885	5	537	0	190,836	112,073	1.65	185,656	58
1886	5	562	100	171,137	108,294	1.73	187,321	63.3
1887	5	581	0	262,730	164,535	2.11	347,061	62.6
1888	5	591	0	196,015	119,469	2.40	286,655	61
1889	5	589	0	152,090	91,256	2.05	186,718	60
1890	5	482	16	247,823	157,208	2.00	314,416	63
1891	5	448	0	146,008	90,728	2.17	197,048	62

The fluctuations in the production of coke in this district in the last three years are notable, 91,256 tons in 1889; 157,208 tons in 1890, the largest production of any year but one in the twelve years covered by the above table; 90,728 tons in 1891, the lowest production since 1881. All of the coal used in this district in coking is reported to be "run of mine."

Pittsburg district.—Practically all the coal used in this district is slack, mostly from the several levels of the Monongahela River, which is brought to Pittsburg by barges. The Pittsburg seam of coal at Pittsburg does not make a good coke. It contains too much volatile matter and makes a spongy coke. The district includes the ovens at and near Pittsburg. The ovens in Washington county that use slack from the mines of that county are also included in the Pittsburg district.

The statistics of the manufacture of coke in the Pittsburg district, Pennsylvania, for the years 1880 to 1891, are as follows:

Statistics of the manufacture of coke in the Pittsburg district, Pennsylvania, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Value of coke at ovens, per ton.	Total value of coke at ovens.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	21	534	0	194,393	105,974	$2.40	$254,500	55
1881	21	538	0	178,509	96,310	2.15	206,965	54
1882	21	557	0	114,956	64,779	2.07	134,378	61
1883	20	542	0	119,310	66,820	1.89	126,020	56
1884	20	535	0	97,367	53,857	1.87	99,911	55
1885	17	416	4	91,101	46,930	1.55	72,509	51.5
1886	18	730	0	228,874	138,646	1.88	221,617	60.6
1887	20	880	235	366,184	177,097	1.78	315,546	48.4
1888	22	980	0	428,899	264,156	1.33	350,818	62
1889	17	600	21	233,571	141,324	2.00	283,402	60.5
1890	14	541	0	149,230	93,984	1.82	171,465	63
1891	13	590	11	154,054	94,160	2.14	201,458	61

There has been a notable decrease in production since 1888. Unless coke is scarce and high in price it does not pay to produce at some works in this district.

Beaver district.—A small amount of coke is made in this district each year for use in local manufactories. The demand fluctuates greatly at times.

The following are the statistics of the manufacture of coke in the Beaver district, Pennsylvania, for the years 1880 to 1891:

Statistics of the manufacture of coke in the Beaver district, Pennsylvania, 1880 to 1891.

Years.	Estab-lish-ments.	Ovens built.	Ovens build-ing.	Coal used.	Coke pro-duced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	106	....	8,013	4,880	$10,150	$2.08	61
1881	5	106	....	6,887	4,333	9,013	2.08	63
1882	5	106	....	11,699	7,960	15,124	1.90	68
1883	5	107	....	19,510	12,395	21,062	1.70	64
1884	4	89	....	2,250	1,390	2,168	1.56	62
1885	4	89	....	686	438	696	1.59	63
1886	3	87	....	698	411	646	1.57	59
1887	3	65	....	25,207	13,818	24,137	1.75	55
1888	4	145	....	262	175	260	1.48	66.6
1889	3	90	....	3,100	1,853	3,848	2.07	60
1890	3	90	....	4,010	2,148	4,564	2.12	53.5
1891	3	88	....	4,224	2,332	6,663	2.85	55

Allegheny Valley district.—This district includes the coke works of Armstrong and Butler counties and one of those in Clarion county, the other ovens in the latter county being included in the Reynoldsville-Walston district.

All of the 21,883 tons of coal used in this district in 1891 was unwashed slack, the ovens having been built for the sole purpose of using slack.

The statistics of the manufacture of coke in the Allegheny Valley district for the years 1880 to 1891 are as follows:

Statistics of the manufacture of coke in the Allegheny Valley district, Pennsylvania, 1880 to 1891, inclusive.

Years.	Estab lish-ments.	Ovens built.	Ovens build-ing.	Coal used.	Coke pro-duced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	5	97	0	45,355	23,470	$49,068	$2.10	52
1881	5	109	0	55,676	29,650	64,664	2.18	53
1882	6	159	0	76,000	41,897	80,294	1.92	55
1883	6	159	0	64,810	34,868	62,982	1.81	54
1884	7	209	0	55,110	31,430	54,859	1.75	57
1885	5	208	0	28,630	15,326	30,151	1.97	53.5
1886	5	208	0	51,580	28,948	44,422	1.54	56
1887	5	288	88	77,666	44,621	84,913	1.90	57.1
1888	5	376	0	37,792	21,719	36,008	1.66	57.5
1889	4	198	0	13,105	6,569	10,538	1.62	50
1890	3	148	0	33,049	18,733	40,204	2.14	56.6
1891	3	148	0	21,833	11,314	25,909	2.29	52

Reynoldsville-Walston district.—This district continues to hold its position as one of the most important coking districts in the United States. In production it was surpassed in 1891 in Pennsylvania only by the

Connellsville and Upper Connellsville districts, and outside of Pennsylvania its production was surpassed in 1891 only by the states of Alabama and West Virginia.

This district includes all of the ovens on the Rochester and Pittsburg railroad, as well as those on the low-grade division of the Allegheny Valley road and the Dagus mines of the New York, Lake Erie and Western. A full description of the district will be found in previous volumes of "Mineral Resources."

The following are the statistics of the manufacture of coke in the Reynoldsville-Walston district for the years 1880 to 1891:

Statistics of the manufacture of coke in the Reynoldsville-Walston district, Pennsylvania, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per cent.
1880	3	117	0	45,055	28,090	$46,359	$1.65	62
1881	4	125	2	99,489	44,260	80,785	1.85	44
1882	5	177	0	87,314	44,709	80,339	1.80	51
1883	6	229	0	76,580	37,044	65,584	1.77	48
1884	7	321	0	159,151	78,646	113,155	1.44	49
1885	8	600	143	183,806	114,409	153,795	1.345	62
1886	9	783	500	271,037	161,828	217,834	1.35	59.7
1887	11	1,492	134	507,320	316,107	592,728	1.88	62.3
1888	9	1,636	100	404,346	253,662	320,203	1.26	62.7
1889	8	1,747	0	514,461	313,011	436,857	1.395	60.8
1890	8	1,737	0	652,966	406,184	771,996	1.90	62
1891	7	1,747	0	769,100	470,479	744,098	1.58	61

The increase in production in this district in the twelve years covered by the report will be noticed.

Blossburg district.—In this district are included the two establishments making coke from the coal of the Blossburg coal field. All of the coal used is washed slack.

The following are the statistics of the manufacture of coke in the Blossburg, Pennsylvania, district from 1880 to 1891:

Statistics of the manufacture of coke in the Blossburg district, Pennsylvania, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	Short tons.			Per cent.
1880	1	200	0	72,520	44,836	$134,500	$3.00	62
1881	1	200	0	88,055	56,085	168,250	3.00	64
1882	1	200	0	100,119	64,526	193,500	3.00	64
1883	2	344	0	71,028	44,690	122,450	2.74	63
1884	2	344	32	62,365	39,043	93,763	2.40	63
1885	2	296	0	46,489	26,975	59,423	2.17	58
1886	2	405	0	136,136	81,801	174,532	2.13	60
1887	2	406	0	182,623	103,873	234,622	2.26	56.9
1888	2	407	0	62,063	38,052	81,400	2.14	61
1889	2	407	0	31,806	18,422	47,765	2.59	58
1890	2	407	0	41,785	23,196	62,804	2.70	55.5
1891	2	407	0	46,084	24,351	66,195	2.72	53

This is a district in which production shows a decreasing tendency.

TENNESSSEE.

But little can be added to what has been said in previous volumes of "Mineral Resources" as to coking in Tennessee. There has been but little change in yearly production since 1886, the range in these years being from 348,728 tons to 396,979 tons. There have been no new districts opened except the one that laps over from Kentucky in the northeastern part of the state. There was somewhat of an increase in ovens in 1891, which may lead to an increased production in 1892. In no state is there so much intelligent study and experimenting to produce a good coke from a coal somewhat inferior in chemical qualities as in Tennessee. Some very good results have been attained by first disintegrating the coal. The coke has been stronger, brighter, less inclined to go into a braise, and a much better blast-furnace fuel, the fuel consumption at furnaces using coke made from the disintegrated coal being much less than when coal from the same mine not disintegrated was used.

The following are the statistics of the manufacture of coke in Tennessee for the years 1880 to 1891:

Statistics of the manufacture of coke in Tennessee, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	6	656	68	217,656	130,609	$316,607	$2.42	60
1881	6	724	84	241,644	143,853	342,585	2.38	60
1882	8	861	14	313,537	187,695	472,505	2.52	60
1883	11	992	10	330,961	203,691	459,126	2.25	62
1884	(*a*)13	1,105	175	348,295	219,723	428,870	1.95	63
1885	12	1,387	36	412,538	218,842	398,459	1.82	53
1886	12	1,485	126	621,669	368,139	687,865	1.87	59
1887	11	1,560	165	655,857	396,979	870,900	2.19	61
1888	11	1,634	84	630,099	385,693	490,491	1.27	61
1889	12	1,639	40	626,016	359,710	731,496	2.03	57
1890	11	1,664	292	600,387	348,728	684,116	1.96	58
1891	11	1,995	0	623,177	364,318	701,803	1.92	58

a One establishment made coke in pits.

Of the 623,177 tons of coal used in coke making in this State in 1891 245,263 tons were "run of mine," and 377,914 tons unwashed slack.

VIRGINIA.

But one of the two coke works in Virginia draws any portion of its supplies of coal from Virginia coal mines. The coke works at Pocahontas, in the Flat-Top region, gets most of its coal from Virginia; the mines, however, are on the line between Virginia and West Virginia, and some of the coal used is mined in the latter State. The ovens at Lowmoor, in Alleghany county, which are on the Chesapeake & Ohio railroad just east of the West Virginia line, draw their entire coal supplies from the New River coal fields of West Virginia. As the coke is made in Virginia, its production is credited to this State.

The following are the statistics of the manufacture of coke in Virginia from 1883 to 1891:

Statistics of the manufacture of coke in Virginia, 1883 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1883	1	200	0	39,000	25,340	$44,345	$1.75	65
1884	1	200	0	99,000	63,600	111,300	1.75	64.25
1885	1	200	0	81,899	40,139	85,993	1.75	60
1886	2	350	100	200,018	122,352	305,880	2.50	61.2
1887	2	350	300	235,841	166,947	417,368	2.50	70.8
1888	2	550	0	230,529	140,199	260,000	1.74	64.7
1889	2	550	250	238,793	146,528	325,861	2.22	61
1890	2	550	250	251,683	165,847	278,724	1.68	66
1891	2	550	250	285,113	167,516	265,107	1.58	58.7

WASHINGTON.

Some coke is still being made from the coal of the Wilkeson coal field near Tacoma. These coals, like all of those in Colorado and Montana and westward, are cretaceous, and still preserve at many places the lignite characteristics. At some places they have been altered locally in character, and are true coking coals. The coke made in Washington is a fair fuel, but does not equal that brought from Europe at a high cost. It is all made from unwashed slack and commands a good price for local uses.

The following are the statistics of the manufacture of coke in Washington for the years 1884 to 1891, the only years in which coke has been made:

Statistics of the production of coke in Washington, 1884 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1884	1	0	0	700	400	$1,900	$4.75	57.5
1885	1	2	0	544	311	1,477	4.75	57
1886	1	11	21	1,400	825	4,125	5.00	58.9
1887	1	30	0	22,500	14,625	102,375	7.00	65
1888	3	30	100	0	0	0	0	0
1889	1	30	0	6,983	3,841	30,728	8.00	55
1890	2	30	80	9,120	5,837	46,696	8.00	64
1891	2	80	0	10,000	6,000	42,000	7.00	60

WEST VIRGINIA.

The division of West Virginia into districts is precisely the same as that followed in previous volumes of "Mineral Resources." These districts are known as the Kanawha, the New River, the Flat Top, the Northern, and the Upper Potomac. The first two are compact and continuous. They include the ovens along the line of the Chesapeake and Ohio railroad from Quinnimont to the Kanawha valley. The Flat-Top region includes the ovens in the Pocahontas Flat-Top district, which are located in West Virginia. The ovens in this district which are located in Virginia are reported under that State. This Flat-Top district is in reality a part of the New River district. The fourth district, the Northern, which may also be called the Upper Monongahela district, is a scattered one, including the ovens in Preston, Taylor, Harrison, and Marion counties, and in previous volumes those in Wheeling, West Virginia. Most of the coke made in Wheeling in previous years has been used in glass manufacture. The advent of natural gas has entirely stopped the production of coke in Ohio county, in which Wheeling is situated. The fifth district, the Upper Potomac, includes the ovens along the line of the West Virginia Central and Pittsburg railway, in what may be called the Upper Potomac basin. These districts, their coals, cokes, etc., have been so thoroughly described in previous volumes of "Mineral Resources" as to make unnecessary any description here.

Production of West Virginia by districts.—In the following table will be found consolidated the statistics of the production of coke in West Virginia in the three years especially covered by this report, viz, 1889, 1890 and 1891, by districts:

Production of coke in West Virginia in 1889, by districts.

Districts.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke produced.	Average price of coke, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
Kanawha	6	474	0	109,466	63,678	$117,340	$1.84	58
New River	12	773	0	268,185	157,186	351,132	2.23	58.6
Flat Top	16	1,433	431	387,533	240,386	405,635	1.68	64
Northern	17	674	200	210,083	128,685	171,511	1.33	62.5
Upper Potomac	2	84	0	26,105	17,945	28,559	1.58	69
Total	53	3,438	631	1,001,372	607,880	1,074,177	1.76	60

Production of coke in West Virginia in 1890, by districts.

Districts.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke produced.	Average price of coke, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
Kanawha	6	474	0	182,340	104,076	$196,583	$1.88	57
New River	12	773	4	275,458	174,295	377,847	2.16	63
Flat Top	17	1,584	252	566,118	325,576	571,239	1.75	57.5
Northern	18	1,051	50	276,367	167,459	260,574	1.55	60
Upper Potomac	2	178	28	94,983	61,971	118,503	1.91	65
Total	55	4,060	334	1,395,266	833,377	1,524,746	1.82	59

Production of coke in West Virginia in 1891, by districts.

Districts.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke produced.	Average price of coke, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
Kanawha	6	474	0	241,427	134,715	$276,420	$2.05	56
New River	13	787	102	309,073	193,711	426,630	2.20	62
Flat Top	19	1,889	358	537,847	312,421	545,367	1.70	58
Northern	15	1,081	56	517,615	291,605	462,677	1.58	56
Upper Potomac	2	390	39	111,014	76,599	133,949	1.75	69
Total	55	4,621	555	1,716,976	1,009,051	1,845,043	1.83	58.7

In these three years the number of establishments has increased by two, the number of ovens 1,183 and the production has increased 375,843 tons, more than 50 per cent. In this increased production all districts have shared, as the following table more graphically shows:

Production of coke in the several districts of West Virginia, 1889, 1890 and 1891.

Years.	Kanawha.	New River.	Flat Top.	Northern.	Upper Potomac.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1889	63,678	157,186	240,386	128,685	17,945	607,880
1890	104,076	174,295	325,576	167,459	61,971	833,377
1891	134,715	193,711	312,421	291,605	76,599	1,009,051

Kanawha district.—In this district are included all of the ovens from Ansted down the Kanawha, all drawing their coal from the formations described in the volume of "Mineral Resources" for 1886.

The statistics of the manufacture of coke in the Kanawha district from 1880 to 1891 are as follows:

Statistics of the manufacture of coke in the Kanawha district, West Virginia, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	4	18	0	6,789	4,300	$9,890	$2.30	63⅓
1881	4	18	0	11,516	6,900	16,905	2.45	60
1882	5	(*a*) 138	0	40,782	26,170	62,808	2.40	64
1883	5	(*a*) 147	0	58,735	37,970	88,090	2.32	64⅔
1884	6	(*a*) 177	15	60,281	39,000	76,070	1.95	64⅔
1885	7	(*b*) 181	63	65,348	37,551	63,082	1.68	57
1886	7	302	170	89,410	54,329	117,649	2.17	60.7
1887	7	548	0	153,784	96,721	201,418	2.08	63
1888	9	572	8	141,641	84,052	146,837	1.75	59
1889	6	474	0	109,466	63,678	117,340	1.84	58
1890	6	474	0	182,340	104,076	196,583	1.88	57
1891	6	474	0	241,427	134,715	276,420	2.05	56

a Eighty of these ovens are Coppée, the balance beehive.
b Sixty of these ovens are Coppée, the balance beehive.

Most of the coal used in this district—206,415 tons, of a total of 241,427 tons—is unwashed slack; the remainder is "run of mine."

New River district.—The New River coking district includes the ovens along the line of the Chesapeake and Ohio railroad from Quinnimont to Nuttallburg. It has been so frequently described in these reports as to require no description at this time.

The statistics of the manufacture of coke in the New River district from 1880 to 1891 are as follows:

Statistics of the manufacture of coke in the New River district, West Virginia, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	6	468	40	159,032	98,427	$239,977	$2.44	62
1881	6	499	0	219,446	136,423	334,652	2.45	62
1882	6	518	0	233,361	148,373	352,415	2.38	64
1883	6	546	0	264,171	167,795	384,552	2.29	64
1884	8	547	12	219,839	135,335	274,988	2.03	62
1885	8	519	0	244,769	156,007	325,001	2.08	63¾
1886	8	513	5	203,621	127,006	281,778	2.22	62
1887	11	518	50	253,373	159,836	401,164	2.51	63
1888	12	743	0	334,695	199,831	390,182	1.95	60
1889	12	773	0	268,185	157,186	351,132	2.23	58.6
1890	12	773	4	275,458	174,295	377,847	2.16	63
1891	13	787	102	309,073	193,711	426,630	2.20	62

Pocahontas Flat-Top district.—This district was very thoroughly described in "Mineral Resources" for 1888. It was known in its early history as the Pocahontas, from the mining town where the first important developments were made, and then as the Flat-Top, from the great Flat-Top mountain in which the measures are found, but which is now known accurately as the Pocahontas Flat-Top field, but called usually the Flat-Top.

This field is located, so far as the measures have been worked, in the counties of Tazewell, in southwest Virginia, and Mercer and McDowell, in southeastern West Virginia.

This field can be divided roughly into—

(1) The Pocahontas district, including the workings at and near the town of Pocahontas, Virginia.

(2) The Bluestone district, including the workings on the Bluestone, near Bramwell, in Mercer county, West Virginia, on the southeast slope of Flat-Top mountain.

(3) The Elkhorn district, including the workings in McDowell county, West Virginia, on the northeast slope of the Flat-Top mountain, on the headwaters of the Elkhorn.

The statistics of the manufacture of coke in the Flat-Top district for the years 1886 and 1891 are as follows:

Statistics of the manufacture of coke in the Flat-Top district of West Virginia from 1886 to 1891, inclusive.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1886	2	10	38	1,075	658	$1,316	$2.00	61.2
1887	5	348	642	76,274	51,071	100,738	1.97	67
1888	13	882	200	164,818	103,947	183,938	1.77	63
1889	16	1,433	431	387,533	240,386	405,635	1.685	64
1890	17	1,584	252	566,118	325,576	571,239	1.75	57.5
1891	19	1,889	358	537,847	312,421	545,367	1.70	58

The Northern district.—There has been a notable increase in the production of coke in the district which, for want of a better name, the writer has called the "Northern" district. The amount of coke produced has increased from 138,097 tons in 1888 to 291,605 tons in 1891, or more than double. This has been due to the great developments that have taken place in the new coking district on the Upper Monongahela on the new line of railroad between Fairmount and Clarksburg. Indeed, the probabilities of growth in this section of West Virginia are greater than those in any other district. The coke produced is a most excellent fuel, and though it is made largely from washed slack, it is rapidly finding for itself a place in the markets of the country. In their endeavers to find this market the coke producers are greatly aided by the liberal policy of the Baltimore and Ohio Railroad Company, as the New River district is aided by the Chesapeake and Ohio and the Pocahontas Flat-Top by the Norfolk and Western.

The statistics of the production of coke in the Northern district of West Virginia from 1880 to 1891 are as follows:

Statistics of the manufacture of coke in the Northern district, West Virginia, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	8	145	0	64,937	36,028	$68,930	$1.91	55
1881	9	172	0	73,863	43,803	78,014	1.78	59
1882	11	222	0	92,510	55,855	105,214	1.88	60
1883	13	269	0	88,253	51,754	90,848	.76	59
1884	13	281	100	78,468	49,139	74,894	1.52	63
1885	12	278	0	105,416	67,013	97,505	1,45	63.5
1886	12	275	104	131,896	82,165	113,100	....	62.3
1887	15	646	0	211,330	132,192	268,990	2.03	62.5
1888	17	567	110	213,377	138,097	175,840	1.27	64.7
1889	17	674	200	210,083	128,685	171,511	1.33	62.5
1890	18	1,051	50	276,367	167,459	260,574	1.55	60
1891	15	1,081	56	517,615	291,605	462,677	1.58	56

Upper Potomac district.—The Upper Potomac district includes the ovens along the line of the West Virginia Central and Pittsburg railroad running south from near Cumberland. Coke has not been made in this district in recent years until 1887, though coke from the neighborhood of Cumberland was used in the first successful coke blast furnace run continuously in the United States. In the five years covered by this report the production of coke has risen from 2,211 tons in 1887 to 76,599 tons in 1891. The increase in number of ovens in 1891 over 1888 will be noticed. This gives promise of a still greater output in 1892.

Statistics of the manufacture of coke in the Upper Potomac district of West Virginia, 1887 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1887	1	20	50	3,565	2,211	$4,422	$2.00	62
1888	1	28	0	9,176	5,835	8,752	1.50	64
1889	2	84	0	26,105	17,945	28,559	1.58	69
1890	2	178	28	94,983	61,971	118,503	1.91	65
1891	2	390	39	111,014	76,599	133,549	1.75	69

Statistics of the production of coke in West Virginia.—Consolidating the statistics of the five different districts given below, the following is a statement of the product of coke in West Virginia for the years 1880 to 1891.

Statistics of the manufacture of coke in West Virginia, 1880 to 1891.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	18	631	40	230,758	138,755	$318,797	$2.30	60
1881	19	689	0	304,823	187,126	429,571	2.30	61
1882	22	878	0	366,653	230,398	520,437	2.26	63
1883	24	962	9	411,159	257,519	563,490	2.19	63
1884	27	1,005	127	385,588	223,472	425,952	1.91	62
1885	27	978	63	415,533	260,571	485,588	1.86	63
1886	29	1,100	317	425,002	264,158	513,843	1.94	62
1887	39	2,080	742	698,327	442,031	976,732	2.21	63.3
1888	51	2,764	318	854,531	525,927	896,797	1.70½	61.5
1889	53	3,438	631	1,001,372	607,880	1,074,177	1.76	60
1890	55	4,060	334	1,395,266	833,377	1,524,746	1.82	59
1891	55	4,621	555	1,716,976	1,009,051	1,845,043	1.83	52

WISCONSIN.

All the coke made in Wisconsin is from Connellsville (Pennsylvania) coal, and the coke is standard Connellsville. Its production, therefore, is not of so much interest as the production of coke for developing certain regions. It is an interesting product, however, as showing that coal can be carried to a distance and successfully made into coke.

Statistics of the manufacture of coke in Wisconsin.

Years.	Establishments.	Ovens built.	Ovens building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1888	1	50	....	1,000	500	$1,500	$3.00	50
1889	1	50	....	25,616	16,016	92,092	5.75	62.5
1890	1	70	....	38,425	24,976	143,612	5.75	65
1891	1	120	....	52,904	34,387	192,804	5.61	65

WYOMING.

Coke was made at but one works in Wyoming in 1891, that of the Cambria Mining Company, located at Cambria, Weston county. The coal occurs probably in the lowest portion of the Dakota measures of the Colorado cretaceous and almost upon the topmost rocks of the Jurassic. The vein is 6½ to 7½ feet in thickness, with good roof and floor. Regarding the character of the coal, it has been classed all the way from lignite to a high-grade coking bituminous coal. This difference in classification may be due to the fact that the samples upon which judgment was based were taken from different parts of the vein in which there may have been actual variations caused by partial metamorphism by heat.

All of the coal used in coking was unwashed slack, which does not give as good a result as washed slack. When the latter is used the coke is of fine texture and very strong. It is dense and capable of sustaining any weight ordinarily required of coke used as this is in silver smelting. As at present produced, however, the coke is very high in ash.

The statistics of the production of coke in Wyoming for the year 1891 are as follows:

Statistics of the production of coke in Wyoming for 1891.

Number of establishments	1
Number of ovens built	24
Number of ovens building	0
Amount of coal used ... short tons	4,470
Coke produced ... short tons	2,682
Total value of coke at ovens	$8,046
Value of coke, per ton	$3.00
Yield of coal in coke ... per cent	60

PETROLEUM.

By Joseph D. Weeks.

FEATURES OF PRODUCTION AND MARKET FOR 1891.

The notable features in connection with petroleum in its production in 1891 were:

1. The development of the McDonald field in Pennsylvania with its enormous production.
2. The greatly increased total production of the entire country as compared with previous years, the total being by many millions of barrels the greatest ever known.
3. The removal of the premium paid on Pennsylvania oils from certain districts, making all one price, and the consequent notably rapid, though temporary, increase in prices.
4. The low average price of oil during the year, the average price being the lowest of any year, with one exception, in the history of the industry.

The notable work in the McDonald field, which is situated in Washington county, Pennsylvania, may be said to have begun in July, 1891, though the remarkable production was comprised within the four months, August, September, October, and November, the production of October being over 41,000 barrels a day. It is estimated that the total production of the McDonald field for the last six months of 1891 was over 6,000,000 barrels, making this field as to size and production of individual wells, as well as its production of oil, within this brief space of time, the most notable field in this country if not in the world.

The total production of petroleum in the United States as given below for 1891 was 54,291,980 as compared with 45,822,672 barrels in 1890. The production for 1889 was 35,163,513 barrels, the greatest total production prior to this date being something over 30,000,000 barrels in 1882. It will thus be seen that in the last ten years the production of the United States has increased on an average 10,000,000 barrels a year. Of course the chief increase in production in these years has been in the Pennsylvania and New York districts, the production in these districts in 1891 being 33,009,236 barrels. The production of Pennsylvania and New York in 1890 was 28,458,208. The production of 1890 in these States was exceeded by that of 1882 when the production was 30,053,500 barrels. There was also a notable increase in production in West Virginia in 1891, the production being 2,406,218 barrels as compared with 492,578 barrels in 1890 and 544,113 barrels in 1889. Lima, Ohio, showed an increase of about 1,200,000 barrels. The increased production of Colorado is also notable, it having increased from 368,842 in 1890 to 665,482 in 1891.

As has been stated in previous volumes of Mineral Resources, a premium was paid on "fresh" oil from certain districts of Pennsylvania because of its greater yield in the lighter oils, which commanded remunerative prices in these years and perhaps for other reasons.

On the morning of August 7, 1891, the weak feeling in the price of Pennsylvania oil, which had been manifest for some time, merged into a perfect panic. The first sales that day were 58 cents a barrel, but it rapidly dropped to 50 cents. This was the lowest that oil had sold since July 6, 1882, when prices declined to 49¼ cents as the result of the big production of Cherry Grove. On the morning of August 8, the National Transit Company notified their patrons that all premiums would be withdrawn. The effect was apparent at once. The first sales of the day were made at 60 cents, 10 cents above the sales of the previous day. Prices advanced steadily until at the close of business oil ruled at 70 cents. Though the session was only of two hours' duration, 527,000 barrels of oil sold in this brief time.

Notwithstanding this fluctuation the average prices, as will be seen in the statement published elsewhere, were lower in 1891, with one exception, than ever before known in the history of the trade.

LOCALITIES IN WHICH PETROLEUM IS FOUND.

In a general way it can be said no new producing districts were developed in 1891, though hitherto unknown localities and fields were developed in fields that were heretofore well known. The phenomenal McDonald field is simply a new pool discovered in the Allegheny and Washington districts of western Pennsylvania. The Wildwood field, which would have been a very important discovery had it not been overshadowed by the McDonald, is but a short distance from Pittsburg and may be regarded as an extension of the Butler field. Several other new localities were also discovered in the Butler field, but these are simply extensions of well-known fields or new discoveries in the same. This is equally true of all the other States, with possibly the exception of Indiana, though even here the most that can be said is that districts in which drilling had been done prior to 1891, and in which oil had been discovered, were somewhat extended, more wells were put down and there was greater production. It still remains true in a general way that no new producing fields were found in 1891.

While petroleum has been found in nearly every State and Territory, the localities in which it is produced in quantity are but few. These are the well-known oil regions of western Pennsylvania and New York, the districts of West Virginia, the Macksburg and Lima fields in Ohio, the Florence district of Colorado, and the oil fields of southern California. Practically, all the petroleum produced in the United States is from the districts named, though a few barrels are produced in Indiana, Kentucky, Illinois, Kansas, and Texas.

Not only are the localities named above the chief petroleum producing districts in the United States, but the indications are, that with the possible exception of Wyoming, they will continue so to be. The Indiana field has some promise, but will probably never be a producer of much importance. The Kentucky and other Southern oil fields, which at one time it was supposed would be factors in the oil production of the United States, give, at the present time, no such indications. The Illinois field is an exceedingly small one, with but little promise for the future, while the Kansas and Texas fields will, at the best, probably produce only a few thousand barrels each year of a high-grade lubricating oil. However, there have been so many surprises in petroleum that these statements must be regarded as only setting forth the present indications.

TOTAL PRODUCTION AND VALUE OF CRUDE PETROLEUM PRODUCED IN THE UNITED STATES IN 1891.

In the following table is given a statement of the total production and total value of all crude petroleum produced in the United States in 1891, by States and important districts:

Total production and value of crude petroleum produced in the United States in 1891.

	Barrels.	Value.
New York	1,585,030	$1,061,970
Pennsylvania:		
Pennsylvania	31,330,021	20,991,114
Franklin	65,185	215,111
Smith's Ferry	29,000	34,510
	31,424,206	21,240,735
West Virginia:		
West Virginia	2,404,218	1,610,826
Burning Springs	2,000	2,000
	2,406,218	1,612,826
Ohio:		
Macksburg	400,024	268,016
Eastern	22,859	15,316
Lima	17,315,978	5,281,373
Mecca-Belden	1,440	12,000
	17,740,301	5,576,705
Indiana	136,634	54,787
Kentucky	9,000	9,000
Missouri	25	84
Kansas	1,400	9,800
Colorado	665,482	559,005
California	323,600	401,264
Texas	54	227
Indian Territory	30	150
Total	54,291,980	30,526,553

From the above table it appears that the production of crude petroleum in the United States in 1891 was 54,291,980 barrels. Of this amount 33,009,236 barrels were produced in Pennsylvania and New

York, or 60.8 per cent.; Ohio produced 17,740,301 barrels, or 32.7 per cent.; West Virginia 2,406,218 barrels, or 4.4 per cent.; Colorado 665,482 barrels, or 1.2 per cent. The production of the other States is so small that the percentages need not be calculated.

In the year 1889, by reason of the detailed investigation by the Census, it was possible to give a division of the product of petroleum into the uses to which the greater part of the oil was put, the division being illuminating, lubricating, and fuel oils. It has not been possible in 1891 to make more than a very rough approximation to this division.

In 1889 most of the oil from Lima, Ohio, was used for fuel purposes. Now, a large portion of that consumed is first deprived of its illuminating oil; that is, a certain percentage of illuminating oil is taken from the crude and what remains is sold for fuel purposes. It is also true that in 1891, and to a greater extent in 1892, a considerable quantity of Pennsylvania and West Virginia oils, not a large percentage of production, however, was used for fuel purposes. In a general way it may be said that the New York oil, 1,585,030 barrels, all of the oil in Pennsylvania reported as Pennsylvania oil, that is, 31,330,021 barrels, the 29,000 barrels of Smith's Ferry oil, the 2,404,218 barrels of West Virginia oil, the 400,024 barrels of Macksburg oil, and the 22,859 barrels of eastern Ohio, aggregating 35,771,152 barrels, and known in a general way as Pennsylvania oil, because it is of the same character as the oils of Pennsylvania that are used for illuminating purposes, can be classed as illuminating oils. To this amount should be added the oil produced in Colorado, a portion of the oil produced in California, and all of the oil produced in Kentucky, making a total in these States of 774,482 barrels.

This makes a total of 36,545,634 barrels of oil, a large proportion of which was used for illuminating purposes.

It should be understood that by illuminating oil is meant that crude usually sold to refineries for illuminating oil, though in connection with this refining, there is produced a certain amount of the lighter products, such as benzine, as well as a certain amount of lubricating oils, and also of residuum, which may be used as fuel. Under the classification of fuel oils is included the production of those districts the oil of which is used chiefly for fuel purposes, though a small portion may be used in the manufacture of illuminating oils. Lubricating oils include only those oils known as natural lubricators.

The lubricating oils include all of the production of the Franklin district in Pennsylvania, amounting to 65,185 barrels, the production of Burning Springs, West Virginia, amounting to 2,000 barrels, the Mecca-Belden district of Ohio, amounting to 1,440 barrels, the Missouri production of 25 barrels, Kansas production of 1,400 barrels, the Texas production of 54 barrels, and Indian Territory, 30 barrels, making a total of 70,134 barrels.

The remainder of the oil produced is chiefly fuel oil. In this would be included the production of Lima, Ohio, 17,315,978 barrels; of Indiana, 136,634 barrels, and of California, 223,600 barrels, making a total of 17,676,212 barrels.

To recapitulate, of the 54,291,980 barrels produced in the United States in 1891, 36,545,634 barrels can roughly be classed as illuminating oil, 70,134 barrels as lubricating, and 17,676,212 barrels as fuel oil.

The total value of the 54,291,980 barrels of crude petroleum produced in the United States in 1891 was $30,526,553. This is an average of 56.22 cents per barrel. The value of the oil ranged from 30½ cents in Lima, Ohio, to $8.33⅓ per barrel in the Mecca-Belden district, which is the highest price of illuminating oil produced.

TOTAL PRODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES 1889, 1890, AND 1891.

In the following table will be found a statement of the total production of crude petroleum of all grades in the United States in 1889, 1890, and 1891. These more recent years are grouped thus for convenience.

Production of petroleum in the United States from 1889 to 1891.

[Barrels of 42 gallons.]

States.	1889.	1890.	1881.
Pennsylvania and New York	21, 487, 435	28, 458, 208	33. 009, 236
Ohio	12, 471, 466	16, 124, 656	17, 740, 301
West Virginia	544, 113	492, 578	2, 406, 218
Colorado	316, 476	368. 842	665, 482
California	303, 220	307, 360	323, 600
Indiana	33, 375	63, 496	136, 634
Kentucky	5, 400	6, 000	9, 000
Illinois	1, 460	....	....
Kansas	500	1, 200	1, 400
Texas	48	54	54
Missouri	20	278	25
Indian Territory	....	....	30
Total	35, 163, 513	45, 822, 672	54, 291, 980

PRODUCT OF CRUDE PETROLEUM IN THE UNITED STATES FROM 1859 TO 1891.

In the following table will be found consolidated the statistics of the production of petroleum in the United States from the beginning of operations in these fields, so far as the same could be ascertained:

Product of crude petroleum in the United States from 1859 to 1891. (a)

[Barrels of 42 gallons.]

Years.	Pennsylvania and New York.	Ohio.	West Virginia.	Colorado.	California.	Indiana.
1859	2,000					
1860	500,000					
1861	2,113,609					
1862	3,056,690					
1863	2,611,309					
1864	2,116,109					
1865	2,497,700					
1866	3,597,700					
1867	3,347,300					
1868	3,646,117					
1869	4,215,000					
1870	5,260,745					
1871	5,205,234					
1872	6,293,194					
1873	9,893,786					
1874	10,926,945					
1875	8,787,514	*b* 200,000	*b* 3,000,000		*b* 175,000	
1876	8,968,906	31,763	120,000		12,000	
1877	13,135,475	29,888	172,000		13,000	
1878	15,163,462	38,179	180,000		15,227	
1879	19,685,176	29,112	180,000		19,858	
1880	26,027,631	38,940	179,000		40,552	
1881	27,376,509	33,867	151,000		99,862	
1882	30,053,500	39,761	128,000		128,636	
1883	23,128,389	47,632	126,000		142,857	
1884	23,772,209	90,081	90,000		262,000	
1885	20,776,041	650,000	91,000		325,000	
1886	25,798,000	1,782,970	102,000		377,145	
1887	22,356,193	5,018,015	145,000	76,295	678,572	
1888	16,488,668	10,010,868	119,448	297,612	690,333	
1889	21,487,435	12,471,466	544,113	316,476	303,220	33,375
1890	28,458,208	16,124,656	492,578	368,842	307,360	63,496
1891	33,009,236	17,740,301	2,406,218	665,482	323,600	136,634
Total	429,755,990	64,377,499	8,226,357	1,724,707	3,914,222	233,505

a Some oil was produced in other States, but no record has been secured other than that contained in note *b*.

b Includes all production prior to 1876.

Product of crude petroleum in the United States from 1859 to 1891—Continued.

[Barrels of 42 gallons.]

Years.	Kentucky and Tennessee.	Illinois.	Kansas.	Texas.	Missouri.	Indian Territory.	Total United States.
1859							2,000
1860							500,000
1861							2,113,609
1862							*a*3,056,690
1863							2,611,309
1864							2,116,109
1865							2,497,700
1866							3,597,700
1867							3,347,300
1868							3,646,117
1869							4,215,000
1870							5,260,745
1871							5,205,234
1872							6,293,194
1873							9,893,786
1874							10,926,945
1875							*b*12,162,514
1876							9,132,669
1877							13,350,363
1878							15,396,868
1879							19,914,146
1880							26,286,123
1881							27,661,238
1882	*c*160,933						30,510,830
1883	4,755						23,449,633
1884	4,148						24,218,438
1885	5,164						21,847,205
1886	4,726						28,064,841
1887	4,791						28,278,866
1888	5,096						27,612,025
1889	5,400	1,460	500	48	20		35,163,513
1890	6,000		1,200	54	278		45,822,672
1891	9,000		1,400	54	25	30	54,291,980
Total	210,013	1,460	3,100	156	323	30	508,447,362

a In addition to this amount, it is estimated that for want of a market some 10,000,000 barrels ran to waste in and prior to 1862 from the Pennsylvania fields; also a large amount from West Virginia and Tennessee.
b Including all production prior to 1876 in Ohio, West Virginia, and California.
c This includes all the petroleum produced in Kentucky and Tennessee prior to 1883.

From the above table it appears that the enormous total of 508,447,362 barrels of commercial crude petroleum have been produced in the United States since the beginning of operations at Titusville in Pennsylvania in 1859. Of this by far the largest amount has come from the New York and Pennsylvania oil districts, the total production of these districts being 429,755,990 barrels, or 84.5 per cent. The total of Ohio's production was 64,377,499 barrels, or 12.7 per cent. In West Virginia 8,226,357 barrels were produced, or 1.6 per cent. The next two States in amount of production were California and Colorado, the former producing 3,914,222 barrels, and the latter 1,724,707 barrels. All the other states produced a total of 448,587 barrels.

STOCKS OF CRUDE PETROLEUM.

It has been impossible to ascertain accurately the total stocks of crude petroleum in the United States at the close of 1891. The total stocks carried in the Pennsylvania oil regions and those of New York and West Virginia that are tributary to Pennsylvania December 31, 1891, were 16,002,857 barrels. This includes not only the pipe-line stocks but a certain percentage for stocks at wells. The stocks of oil in the Franklin district, which produces a heavy oil different in character from that of other districts, are also included. In the Macksburg, Ohio, field the stocks reported were 454,232 barrels. The Macksburg oil is somewhat similar in character to that of Pennsylvania, New York, and West Virginia. This would make a total stock of oil of this character of 16,457,089 barrels.

The stocks of oil in the Lima district, which produces oil of a different character from the districts above mentioned, are stated to be in the neighborhood of 25,000,000 barrels. Accurate figures could not be secured. This would make the total stocks in these districts 41,457,089 barrels. The probability is that the total stocks were in the neighborhood of 42,000,000 barrels, not including stocks of crude carried at refineries.

EXPORTS.

In the following table is given the exports of crude petroleum and its products from the United States from 1864 to 1891 compared with the product in the United States:

Quantity of crude petroleum produced in, and the quantity and value of petroleum products exported from, the United States during the fiscal years 186 to 1884, and calendar years 1885 to 1891.

Years ended—	Production.		Exports.											
	Barrels (of 42 gallons) produced.	Gallons produced.	Mineral, crude (including all natural oils without regard to gravity).		Mineral, refined or manufactured.						Residuum (tar, pitch, and all other from which the light bodies have been distilled).		Total.	
					Naphthas, benzine, gasoline, etc.		Illuminating.		Lubricating (heavy paraffin, etc.).					
			Gallons.	*Value.*	*Gallons.*	*Value.*	*Gallons.*	*Value.*	*Gallons.*	*Value.*	*Gallons (a)*	*Value.*	*Gallons.*	*Value.*
June 30, 1864..	2,478,709	104,105,778	9,980,654	$3,864,187	438,197	$154,091	12,791,518	$6,764,411	....	....	....	....	23,210,368	$10,782,689
1865..	2,424,905	101,846,010	12,293,897	6,868,513	480,947	173,943	12,722,005	9,520,957	....	....	....	....	25,496,849	16,563,413
1866..	3,165,700	132,959.400	16,057,943	6,015,921	673,477	188,825	34,255,921	18,626,141	....	....	....	....	50,987,341	24,830,887
1867..	3,591,900	150,859,800	7,344.248	1,864.001	224,576	34,175	62,686.657	22,509,466	....	....	....	....	70,255,481	24,407,642
1868..	3,613,709	151,775,778	10,029,659	1,564,933	1,517,268	267,873	67,999,961	19,977,870	....	....	....	....	79,456,888	21,810,676
1869..	4,046,558	169,955,436	13,425,566	2,994,404	2,673,094	445,770	84,403,492	27,636,137	b 134,532	$51,122	....	....	100,636,684	31,127,433
1870..	4,411,016	185,262,672	10,403,314	2,237,292	5,422,604	564,864	97,902,505	29,864,193	b 6,871	2,611	....	....	113,735,294	32,668,960
1871..	5,558,775	233,468,550	9,859,038	1,971,847	7,209,592	746,797	132,608,955	34,138,736	b 59,632	22,660	b 155,474	$14,770	149,892,691	36,894,810
1872..	5,842,497	245,384,874	13,559,768	2,307,111	8,092,635	932,160	122,539,575	30,566,108	541,419	211,287	438,186	41,724	145,171,583	34,058,390
1873..	7,242,343	304,178,406	18,439.407	3,010,050	9,743,593	1,487,439	158,102,414	37,195,735	748,699	277,966	781,074	79,506	187,815,187	42,050,756
1874..	11,188,741	469,927.122	17,776,419	2,099,696	9,737,457	1,038,622	217,220,504	37,560,995	1,244,305	404,243	1,827,798	142,299	247,806,483	41,245,815
1875..	10,083,828	423,520,776	14,718,114	1,406,018	11,758,940	1,141.440	191,551,933	27,030,361	1,173,473	313,646	2,752,848	187,103	221,955,308	30,078,568
1876..	8,823,142	370,571,964	20,520,397	2,220,268	14,780,236	1,442,811	204,814,673	28,755,638	963,442	303,863	2,581,404	193,206	243,660,152	32,915,786
1877..	10,822,871	454,560,582	26,819,202	3,756,729	15,140,183	1,816,682	262,441,844	55,401,132	1,601,065	497,540	3,196,620	317,355	309,198,914	61,789,438
1878..	14,738,262	619,007,004	26,936,727	2,694,018	16,416,621	1,411,812	289,214,541	41,513,676	2,304,624	639,381	3,968,790	316,087	338,841,303	46,574,974
1879..	16,917,606	710,539,452	25,874,488	2,180,413	15,054,361	1,258,780	331,586,442	35,999,862	2,487.681	655,468	3,307,038	210,726	378,310,010	40,305,249
1880..	22,382,509	940,065,378	28,297,997	1,927,207	18,411,044	1,192,229	367,325,823	31,783,575	5,162.835	1,039,124	4,767,000	276,490	423,964,699	36,218,625
1881..	25,805,363	1,083,825,246	39,984,844	3,065,464	17,292,310	1,693,975	332.283,045	34,317,695	4,852,203	1,054,064	3,247,860	184,411	397,660,262	40 315,609
1882..	28,650,181	1,203,307,602	41,304,997	3,129,511	20,213,098	1,809,143	498,213,033	44,588,854	6,508,100	1,492,396	3,715,362	212,802	559,954,590	51,232,706
1883..	26,662,908	1,119,837,936	52,712,306	3,914,941	17,070,537	1,802,286	419,821,081	36,926,574	10,182,342	2,326,632	6,145,356	442,646	505,931,622	44,913,079
1884..	23,744,924	997,286,808	67,186,329	5,302,974	15,045,411	1,072,651	415,615,693	38,195,349	10,515,535	2,179,595	5,297,124	352,679	513,660,092	47,103,248
Dec. 31, 1885..	20,776,041	872,593,722	81,435,609	6,040,685	14,739,469	1,160,999	445,531,386	39,439,034	13,327,584	2,690,258	7,319,130	311,656	562,353,178	49,642,632
1886..	25,798,000	1,083,516,000	76,342,480	5,068,409	14,474,951	1,264,736	485,120,680	39,012,922	13,948,367	2,689,464	1,993,824	119,673	591,880,302	48,155,204
1887..	21,478,883	902,113,086	80,650,286	5,141,833	12,382,203	1,049,043	485,242,107	37,007,336	20,582,613	3,559,280	2,989,098	141,350	601,846,307	46,898,842
1888..	16,491,084	692,625,528	77,609,452	5,461,305	13,481,706	1,083,429	454,985,784	37,229,551	24,510,437	4,215,449	1,870,596	116,009	572,457,975	48,105,743
1889..	21,487,435	902,472,270	85,189,658	6,134,002	13,984,407	1,208,116	551,769,666	41,215,192	27,903,267	4,638,724	1,858,458	97,265	680,705,456	53,293.299
1890..	28,458,208	1,195,244,736	95,450,653	6,744,235	12,937,433	1,134,799	523,295,090	38,640,638	30,162,522	4,763,347	2,222,472	120,070	664,068,170	51,403,089
1891..	53,936,318	2,267,425,146	96,722,807	5,365,579	11,424,993	868,137	531,445,099	34,879,759	32,210,264	4,999,978	1,002,540	61,382	673,805.703	46,174,835

a Barrels reduced to gallons, at the rate of 42 gallons to the barrel.

b Estimated.

PENNSYLVANIA AND NEW YORK.

The total production of petroleum in the Pennsylvania and New York oil regions in 1891 was 33,009,236 barrels, as compared with 28,458,208 barrels in 1890. This, as elsewhere pointed out, is 60.8 per cent. of the total production.

As has been previously stated, it is well-nigh impossible to accurately separate the production of New York from Pennsylvania. The total production of Allegany and Cattaraugus counties, New York, is given at 1,585,030 barrels, which would make the total production of Pennsylvania 31,424,206 barrels. Of this amount 65,185 barrels were heavy oil from the Franklin district and 29,000 barrels from the Smith's Ferry district, which differs somewhat from the oils most largely produced in this State.

In the following table is given a statement of the production of crude petroleum in New York and Pennsylvania in 1891:

Production of crude petroleum in New York and Pennsylvania in 1891, by districts and and months.

[Barrels of 42 gallons.]

Districts.	January.	February.	March.	April.	May.	June.
Allegany, N. Y.	106,951	85,457	98,886	100,211	93,065	100,897
Bradford, Pa	518,674	439,831	478,498	478,242	460,652	468,375
Middle district	139,911	118,239	135,376	124,195	138,935	139,103
Clarendon and Warren	32,424	39,123	39,146	30,375	34,650	23,213
Tiona	48,116	41,822	45,979	52,006	56,816	44,743
Tidioute and Titusville	78,588	67,629	73,770	69,941	66,788	71,719
Grand Valley	19,669	16,006	18,971	17,163	17,527	17,118
Tarkill and Egypt	107,599	94,186	97,435	99,258	90,263	96,302
Second Sand	20,116	19,149	20,288	22,857	21,232	21,979
Holliday Run	5,770	4,854	5,537	5,521	6,059	5,040
Bullion	13,970	12,860	15,031	13,388	11,908	12,552
Lower district	628,755	526,323	544,578	542,459	538,458	546,028
Washington, Pa	241,395	201,059	221,400	210,760	208,452	208,756
Beaver county	87,930	80,081	81,691	91,518	79,371	88,942
Greene county	161,394	78,976	7,024	8,799	10,119	12,332
Allegheny county	609,722	454,111	469,385	462,438	446,357	451,372
	2,820,984	2,279,706	2,352,995	2,329,131	2,280,652	2,308,471
Franklin district	6,680	5,197	4,599	5,950	5,587	6,100
Smith's Ferry district (*a*)	2,417	2,417	2,417	2,417	2,417	2,417
Total	2,830,081	2,287,320	2,360,011	2,337,498	2,288,656	2,316,988

Districts.	July.	August.	September.	October.	November.	December.	Total.
Allegany, N. Y.	96,655	93,349	89,720	88,658	75,230	92,495	1,121,574
Bradford, Pa	456,516	449,891	429,207	429,358	396,275	446,899	5,452,418
Middle district	139,880	132,782	125,780	120,667	106,598	115,140	1,536,606
Clarendon and Warren	14,833	25,183	20,378	34,471	32,526	33,905	360,227
Tiona	40,915	50,345	40,735	46,015	39,452	46,786	553,730
Tidioute and Titusville	72,170	69,919	69,122	68,831	65,573	63,237	837,287
Grand Valley	17,125	16,690	15,901	15,833	13,721	13,230	198,954
Tarkill and Egypt	95,028	92,234	95,970	....	....	....	868,275
Second Sand	21,034	22,297	20,764	29,711	22,324	27,104	268,855
Holliday Run	5,514	4,836	4,420	....	....	....	47,551
Bullion	12,828	12,013	12,913	....	....	....	117,463
Lower district	544,040	550,287	551,902	651,837	616,671	711,201	6,952,539
Washington, Pa	254,040	261,721	320,652	298,187	279,024	291,832	2,997,278
Beaver county	80,695	86,008	74,826	68,745	61,800	61,616	943,223
Greene county	14,838	7,380	10,069	11,585	9,182	10,115	341,813
Allegheny county	415,057	591,411	946,609	1,704,724	2,108,747	1,657,325	10,317,258
Total	2,281,168	2,466,346	2,828,968	3,568,622	3,827,123	3,570,885	32,915,051
Franklin district	5,504	4,635	6,178	4,873	4,723	5,159	65,185
Smith's Ferry district (*a*)	2,417	2,417	2,416	2,416	2,416	2,416	29,000
Total	2,289,089	2,473,398	2,837,562	3,575,911	3,834,262	3,578,460	33,009,236

a Smith's Ferry production, which was very regular, is averaged at 2,416.67 barrels per month.

The districts mentioned in the above table have been so frequently described in previous volumes of "Mineral Resources" that but little need be said regarding them now.

As compared with 1889 there has been a falling off in the Bradford and Allegany district from 7,158,363 barrels to 6,573,992 barrels. The lower district shows an increase of nearly 2,000,000 barrels, the increase being due largely to the developments in Butler county. The production of Washington county declined from 3,848,145 barrels in 1889 to 2,997,278 barrels in 1891. Beaver county increased from 602,736 in 1889 to 943,223 barrels in 1891. Greene county shows a decrease of 50,000 barrels, while Allegheny, owing to the developments in the McDonald field, increased from 541,092 barrels in 1889 to 10,317,258 barrels in 1891. The increase in production in Allegheny county over that of 1889 was equivalent to the total increased production of the entire country for the same period.

In the following table is given the total production of crude petroleum in the Pennsylvania and New York oil fields for the twenty-one years from 1871 to 1891.

The total production of crude petroleum in the Pennsylvania and New York oil fields from 1871 to 1891, by months and years, is as follows:

Total product of crude petroleum in the Pennsylvania and New York oil fields from 1871 to 1891, by months and years.

[Barrels.]

Years.	January.	February.	March.	April.	May.	June.	July.
1871	418, 407	372, 568	400, 334	385, 980	408, 797	410, 340	456, 475
1872	583, 575	462, 985	461, 590	462, 090	537, 106	491, 130	517, 762
1873	632, 617	608, 300	665, 291	641, 520	776, 364	793, 470	867, 473
1874	1, 167, 243	835, 492	883, 438	778, 740	895, 745	921, 750	1, 038, 447
1875	852, 159	719, 824	789, 539	675, 060	696, 508	696, 210	788, 361
1876	712, 225	668, 885	718, 177	701, 490	735, 351	723, 600	763, 623
1877	842, 890	783, 216	901, 697	972, 810	1, 127, 594	1, 130, 790	1, 189, 005
1878	1, 203, 296	1, 094, 856	1, 208, 380	1, 195, 890	1, 264, 862	1, 217, 250	1, 283, 865
1879	1, 369, 921	1, 261, 935	1, 499, 315	1, 530, 450	1, 644, 922	1, 675, 650	1, 637, 767
1880	1, 904, 113	1, 870, 008	2, 015, 992	2, 015, 700	2, 228, 931	2, 158, 440	2, 248, 430
1881	2, 244, 090	1, 913, 128	2, 274, 532	2, 205, 780	2, 393, 293	2, 377, 860	2, 372, 678
1882	2, 353, 551	2, 131, 332	2, 482, 170	2, 402, 790	2, 486, 572	2, 825, 940	3, 258, 162
1883	1, 948, 319	1, 756, 188	1, 830, 674	1, 816, 530	1, 962, 052	1, 977, 900	2, 020, 394
1884	1, 825, 838	1, 880, 650	2, 052, 262	2, 065, 860	2, 381, 854	1, 862, 190	2, 059, 950
1885	1, 652, 176	1, 437, 884	1, 638, 133	1, 780, 290	1, 771, 371	1, 767, 210	1, 775, 804
1886	1, 748, 958	1, 604, 848	1, 928, 448	1, 938, 360	2, 178, 773	2, 335, 380	2, 418, 961
1887	1, 990, 851	1, 827, 924	2, 007, 196	1, 960, 860	1, 993, 517	1, 912, 860	1, 899, 525
1888	1, 155, 937	1, 290, 718	1, 338, 877	1, 349, 403	1, 473, 362	1, 450, 703	1, 394, 847
1889	1, 542, 806	1, 332, 482	1, 628, 661	1, 635, 933	1, 821, 776	1, 811, 485	1, 954, 168
1890	2, 108, 248	2, 055, 424	2, 313, 189	2, 328, 870	2, 378, 382	2. 370, 001	2, 524, 206
1891	2, 830, 081	2, 287, 320	2, 360, 011	2, 337, 498	2, 288, 656	2, 316, 988	2, 289, 089

Total product of crude petroleum in the Pennsylvania and New York oil fields from 1871 to 1891, by months and years—Continued.

[Barrels.]

Years.	August.	September.	October.	November.	December.	Total.
1871	462, 582	461, 940	485, 243	464, 610	477, 958	5, 205, 234
1872	549, 909	500, 430	442, 432	638, 610	645, 575	6, 293, 194
1873	936, 138	954, 270	942, 493	991, 470	1, 084, 380	9, 893, 786
1874	931, 519	840, 630	919, 739	861, 060	858, 142	10, 926, 945
1875	718, 766	698, 940	731, 073	700, 200	720, 874	8, 787, 514
1876	782, 223	780, 600	809, 162	786, 480	787, 090	8, 968, 906
1877	1, 273, 759	1, 214, 910	1, 269, 326	1, 173, 420	1, 256, 058	13, 135, 475
1878	1, 341, 928	1, 315, 710	1, 369, 797	1, 348, 950	1, 318, 678	15, 163, 462
1879	1, 892, 302	1, 856, 700	1, 836, 378	1, 710, 480	1, 769, 356	19, 685, 176
1880	2, 341, 027	2, 346, 300	2, 385, 636	2, 274, 420	2, 238, 634	26, 027, 631
1881	2, 331, 727	2, 193, 420	2, 323, 171	2, 266, 830	2, 480, 000	27, 376, 509
1882	3, 104, 495	2, 620, 380	2, 297, 658	2, 192, 940	1, 897, 510	30, 953, 500
1883	1, 879, 437	1, 913, 370	2, 076, 659	1, 958, 340	1, 988, 526	23, 128, 389
1884	2, 099, 165	1, 948, 260	1, 961, 866	1, 811, 700	1, 822, 614	23, 772, 209
1885	1, 705, 961	1, 712, 790	1, 874, 105	1, 761, 660	1, 898, 657	20, 776, 041
1886	2, 413, 206	2, 418, 540	2, 408, 111	2, 222, 790	2, 181, 625	25, 798, 000
1887	1, 848, 877	1, 779, 930	1, 843, 291	1, 125, 450	1, 288, 602	*a*21, 478, 883
1888	1, 382, 077	1, 273, 080	1, 354, 518	1, 442, 405	1, 582, 741	16, 488, 668
1889	1, 964, 227	1, 867, 610	1, 959, 169	1, 913, 871	2, 055, 247	21, 487, 435
1890	2, 514, 968	2, 584, 949	2, 750, 698	2, 575, 941	2, 626, 035	*b*29, 130, 910
1891	2, 473, 398	2, 837, 562	3, 575, 911	3, 834, 262	3, 578, 460	33, 009, 236

a Not including 877,310 barrels dump oil and oil shipped by private lines.
b Pipe line runs.

For some years previous to and including 1887 the total production as given in the above table is simply the total of pipe line runs, it being difficult in these years to get any information as to what is known as dump oil, or oil sent to market without passing through the pipe lines. The statistics of early years, as indeed all of the figures up to the close of 1887, are those given in Stowell's Petroleum Reporter.

Since 1887 the figures of production given in the above table are not the same as pipe line runs, but represent more nearly the actual production of the field. As, however, the pipe line runs are of great importance to the trade these runs for 1891 are given below by lines and months. In this table are included the pipe line runs of that portion of the oil field located in Pennsylvania and New York and that portion of West Virginia tributary to the southwestern Pennsylvania field.

By runs are meant the amounts of oil which the pipe line receives from the wells. If all oil was sent from the wells by pipe lines the pipe line runs would indicate the total production of petroleum less the amount of oil remaining in tanks at the wells. In other words, on the basis that all oil was shipped from the wells by pipe lines the total production of the year would be the shipments plus the stock of oil on hand at wells at the close of the year minus the same well stocks at the beginning of the year.

Pipe line runs in Pennsylvania and New York, in 1891, by lines and months.

[Barrels.]

Months.	National transit.	Tide water.	Octave.	Southwest.	Franklin.	Western Atlantic.
January	1,327,790	165,826	3,256	1,035,370	6,681	226,783
February	1,126,957	141,321	2,382	745,835	5,197	178,113
March	1,213,608	154,850	2,762	708,524	4,599	188,019
April	1,202,908	160,467	2,899	691,772	5,949	180,827
May	1,162,105	149,828	3,285	659,248	5,587	175,441
June	1,181,707	156,209	3,419	681,899	6,100	169,748
July	1,165,643	149,178	3,094	657,833	5,504	170,322
August	1,172,521	146,159	3,270	807,377	4,635	166,263
September	1,138,140	138,493	3,305	1,200,026	6,178	159,620
October	1,129,173	142,318	3,071	1,882,935	4,873	150,480
November	1,037,311	129,722	2,868	2,290,858	4,723	237,394
December	1,188,308	143,504	2,916	1,956,217	5,159	170,203
Total	14,046,171	1,777,875	36,527	13,317,894	65,185	2,173,213

Months.	Chas. Miller.	Eureka.	Elk.	Emery.	Mellon.	Total.
January	13,971					2,779,677
February	11,840	93,847				2,305,492
March	12,033	216,503				2,500,898
April	13,882	212,192				2,470,896
May	12,513	218,397	32,510	20,051		2,438,965
June	12,340	206,941	31,721			2,450,084
July	12,961	209,968	32,801	21,635	40,076	2,469,015
August	11,627	218,137	34,665	23,196	66,523	2,654,373
September	11,797	201,352	31,316	19,097		2,909,324
October	11,377	205,702	33,530	22,387	65,710	3,651,556
November	10,120	194,851	29,468	22,114	81,633	4,041,062
December	9,239	206,523	31.984	27,496	86,143	3,827,692
Total	143,700	2,184,413	257,995	155,976	340,085	34,499,034

Average daily production of petroleum in the Pennsylvania and New York oil fields.—To the mind of the dealer in petroleum the feature regarding production that is most prominent is the average daily production. As usually given this only includes the average daily receipts published by the pipe lines or runs, as they are usually termed. In the following table we give these for 1891 and several years previous, the total production including some oil that is not reported in the daily returns:

Average daily product of crude petroleum in the Pennsylvania and New York oil fields each month for the years 1871–1891, by months and years.

[Barrels.]

Years.	January.	February.	March.	April.	May.	June.
1871	13,497	13,306	12,914	12,866	13,187	13,678
1872	18,825	15,965	14,890	15,403	17,326	16,371
1873	20,407	21,725	21,461	21.384	25,044	26,449
1874	37,653	29,839	28,598	25,958	28,895	30,725
1875	27,489	25,708	25,469	22,502	22,468	23,207
1876	22,975	23,065	23,167	23,383	23,721	24,120
1877	27,190	27,979	29,087	32,427	36,374	37,693
1878	38,816	39,102	38,980	39,863	40,802	40,575
1879	44,191	43,515	48,365	51,015	53,062	55,855
1880	61,423	64,552	65,032	67,190	71,901	71,948
1881	72,390	68,326	73,372	73,526	77,203	79,262
1882	75,921	76,119	80,070	80,093	80,212	94,198
1883	62,849	62,721	59,054	60,551	63.292	65,930
1884	58,898	64,850	66,202	68,862	76,834	62,073
1885	53,296	51,353	52,843	59,343	59,141	58,907
1886	56,418	57,316	62,208	64,612	70,283	77,846
1887	64,221	65,283	64,716	65,372	64,307	63,762
1888	37,228	44,508	43,190	44,980	47,528	48,357
1889	49,768	47,589	52,537	54,531	58,767	60,382
1890	68,008	73,408	74,619	77,629	76,722	79,000
1891	91,293	81,690	76,129	77,917	73,828	77,233

Average daily product of crude petroleum in the Pennsylvania and New York oil fields each month for the years 1871–1891, by months and years—Continued.

[Barrels.]

Years.	July.	August.	September.	October.	November.	December.	Yearly averages.
1871	14,725	14,922	15,398	15,653	15,487	15,418	14,261
1872	16,702	17,739	16,681	4,272	21,287	20,825	17,194
1873	27,983	30,198	31,809	30,403	33,049	34,980	27,106
1874	33,337	30,049	28,021	29,669	28,702	27,682	29,937
1875	25,431	23,186	23,298	23,583	23,340	23,254	24,075
1876	24,633	25,233	26,020	26,102	26,216	25,390	24,505
1877	38,335	41,089	40,497	40,946	39,114	40,518	35,988
1878	41,415	43,288	43,857	44,187	44,965	42,538	41,544
1879	56,057	61,042	61,890	59,238	57,016	57,076	54,206
1880	72,530	75,517	78,210	76,956	75,814	72,214	71,114
1881	76,538	75,217	73,114	74,941	75,561	80,000	75,004
1882	105,102	100,145	87,346	74,118	73,098	61,210	82,338
1883	65,174	60,627	63,779	66,989	65,278	64,146	63,365
1884	66,450	67,715	64,942	63,286	60,390	58,794	65,129
1885	57,284	55,031	57,093	60,455	58,722	61,247	56,921
1886	78,031	78,426	80,618	77,681	74,093	70,375	70,679
1887	61,275	59,641	59,321	61,822	37,515	41,568	58,846
1888	44,995	44,661	42,436	43,694	48,080	51,057	45,058
1889	63,037	63,362	62,254	63,199	63,796	66,298	58,869
1890	81,426	81,128	86,165	88,732	85,865	84,710	79,810
1891	73,842	79,787	94,585	115,352	127,809	115,434	90,436

[Yearly average is the total product divided by the number of days in the year, *not* an average of monthly averages.]

It will be seen from this table, as has elsewhere been stated, that the year 1891 was a phenomenal one in production. In but two months of this year did the average daily production fall below 75,000 barrels, while in three months it rose above 115,000 barrels, the three months of October, November, and December showing, respectively, an average daily production of 115,352 barrels, 127,809 barrels, and 115,434 barrels. These were the notable days of the wonderful McDonald output. The only approach to these figures in previous years was in July and August of 1882, when Cherry Grove was the sensation. The average daily production for the entire year 1891 was 90,436 barrels, the nearest approach to this in any previous year being in 1882, when the average daily production for the year was 82,338 barrels, or some 8,098 barrels less.

Pipe-line runs and production.—We have several times referred in this report to the fact that pipe-line runs and production were not the same, though they are usually assumed to be, the pipe-line runs being near enough to production for the practical purposes of buying and selling. As has been stated, there is more or less dump oil and other oils that are not included in the pipe-line runs. This oil, that may possibly be termed outside oil, is not included in any statement of the receipts by pipe lines.

In the following table is given the total of the pipe-line runs in Pennsylvania and New York from 1888 to 1891, both inclusive, by months:

Pipe-line runs in Pennsylvania and New York from 1888 to 1891, by months.

[Barrels.]

Months.	1888.	1889.	1890.	1891.
January	1,126,035	1,513,012	2,082,894	2,779,675
February	1,240,092	1,307,652	2,026,151	2,211,645
March	1,211,086	1,608,755	2,272,251	2,284,395
April	1,320,936	1,629,203	2,279,807	2,258,706
May	1,433,469	1,794,129	2,311,840	2,220,567
June	1,422,960	1,804,671	2,286,048	2,243,184
July	1,370,080	1,945,668	2,417,991	2,259,047
August	1,365,992	1,961,426	2,399,272	2,436,235
September	1,253,149	1,860,140	2,452,888	2,707,973
October	1,311,643	1,968,513	2,627,249	3,445,854
November	1,416,448	1,898,626	2,475,615	3,846,211
December	1,550,902	2,499,158	2,542,925	3,621,169
Total	16,022,792	21,790,953	28,174,931	32,314,661

In the following table is given the total production for Pennsylvania and New York for the same years:

Production of petroleum in Pennsylvania and New York from 1888 to 1891, by months.

[Barrels.]

Months.	1888.	1889.	1890.	1891.
January	1,155,937	1,542,806	2,095,460	2,830,082
February	1,290,718	1,332,482	2,022,446	2,287,320
March	1,338,877	1,628,661	2,286,287	2,360,011
April	1,349,404	1,635,933	2,280,691	2,337,497
May	1,473,362	1,821,776	2,331,293	2,288,656
June	1,450,703	1,811,485	2,315,649	2,316,988
July	1,394,847	1,945,168	2,450,235	2,289,089
August	1,382,077	1,964,227	2,434,147	2,473,398
September	1,273,080	1,867,610	2,475,144	2,837,562
October	1,354,518	1,959,169	2,673,350	2,575,911
November	1,442,405	1,913,871	2,517,425	3,834,262
December	1,582,741	2,055,247	2 576,081	3,578,460
Total	16,488,668	21,487,435	28,458,208	33,009,236

Tabulating these two tables by totals for the years 1888, 1889, 1890, and 1891, we have the following:

Comparison of production and pipe-line runs of Pennsylvania and New York, 1888 to 1891.

[Barrels.]

	Total production.	Pipe-line runs.
1888	16,488,668	16,002,729
1889	21,487,435	(*a*)21,790,953
1890	28,458,208	28,174,931
1891	33,009,236	32,314,661

(*a*) Includes considerable West Virginia oil.

In the above table it will be noted that in every case the production is in excess of the pipe-line runs except for the year 1889 when the runs are some 300,000 barrels in excess of the production. This arises from the fact that considerable West Virginia oil was included in the pipe-line runs for that year. It should be noted, however, that the discrepancies are not very great in percentages. The difference between pipe-line runs and production in 1888 was 485,939 barrels, or about 3 per cent.; the difference for 1890 is 283,277 barrels, or about 1 per cent., and the difference for 1891 694,575 barrels, or a little more than 2 per cent. The relation between runs and production in 1889 is not considered in view of the fact that, as stated above, the runs for that year include quite an amount of West Virginia oil.

Shipments of petroleum from Pennsylvania and New York.—In the following table will be found a statement of the number of barrels of crude petroleum and refined petroleum reduced to its equivalent shipped out of the Pennsylvania and New York oil regions either by pipe line or railroad from 1871 to 1891, inclusive. In some years, especially in the earlier ones covered by this table, a considerable portion of the oil was shipped as refined. In this table that is reduced to its equivalent in crude, a barrel of refined is regarded as being produced from $1\frac{1}{3}$ barrels of crude.

Shipments of crude petroleum and refined petroleum, reduced to crude equivalent, out of the Pennsylvania and New York oil fields from 1871 to1891, by months and years.

[Barrels.]

Years.	January.	February.	March.	April.	May.	June.	July.
1871	437,691	347,718	383,890	389,147	587,375	501,754	541,137
1872	476,966	407,606	276,220	428,512	510,417	529,228	591,238
1873	573,124	527,440	668,374	708,191	768,176	696,414	814,449
1874	843,663	501,220	518,246	803,409	899,027	815,413	940,281
1875	453,095	327,776	693,918	729,581	681,679	745,986	904,537
1876	677,289	519,193	623,762	603,037	647,150	921,862	1,228,539
1877	743,461	484,904	913,919	903,526	1,234,324	1,391,124	1,096,951
1878	775,791	774,234	741,512	846,632	960,894	1,135,119	1,330,454
1879	663,998	702,729	973,879	1,136,188	1,331,469	1,369,314	1,625,035
1880	1,650,409	1,395,151	1,613,371	842,268	1,095,259	975,083	1,231,611
1881	1,061,617	915,028	1,276,746	1,348,398	1,563,436	1,729,697	1,925,532
1882	1,657,067	1,787,909	1,718,956	1,678,134	1,827,356	2,172,685	2,402,970
1883	1,357,815	1,250,824	1,641,899	1,908,379	1,995,634	1,747,789	1,634,407
1884	1,686,961	1,723,261	1,873,890	1,643,336	1,899,329	1,827,553	1,740,021
1885	1,804,028	1,895,021	1,887,034	1,823,726	2,097,099	2,034,025	1,961,152
1886	1,991,561	2,032,794	2,055,750	2,070,468	2,032,672	2,117,489	2,418,961
1887	2,312,067	1,995,757	2,332,324	1,938,278	2,328,564	2,165,439	2,000,173
1888	2,265,109	2,163,957	1,979,753	1,928,435	1,773,994	1,956,115	2,098,531
1889	2,388,609	2,272,060	2,263,009	2,236,004	2,256,120	2,268,280	2,949,597
1890	2,637,339	2,146,108	2,148,977	2,317,410	2,474,966	2,486,205	2,640,668
1891	2,421,419	2,143,612	2,429,664	2,155,511	2,072,139	2,122,086	2,260,176

Years.	August.	September.	October.	November.	December.	Total.
1871	528,134	551,075	505,071	480,977	410,822	5,664,791
1872	621,954	541,607	607,468	477,945	430,786	5,899,947
1873	864,768	952,955	1,010,852	959,589	955,443	9,499,775
1874	793,865	1,014,570	543,341	546,117	602,348	8,821,500
1875	882,089	1,109,392	871,917	671,066	871,902	8,942,938
1876	1,203,402	1,154,549	524,190	871,496	1,190,983	10,164,452
1877	1,425,943	1,563,797	1,268,971	1,205,634	600,019	12,832,573
1878	1,655,651	1,434,225	1,747,390	1,281,410	992,688	13,676,002
1879	1,808,239	1,627,120	1,662,269	1,453,645	1,532,585	15,886,475
1880	1,394,129	1,252,635	1,665,933	1,226,030	1,335,613	15,677,494
1881	2,214,877	2,131,950	2,080,467	2,066,906	1,969,581	20,284,239
1882	2,047,545	1,992,171	2,089,428	1,404,640	1,121,453	21,900,317
1883	2,086,478	2,325,574	2,215,421	2,065,602	1,749,547	21,979,369
1884	2,000,371	2,292,087	2,510,283	2,078,261	2,382,244	23,657,597
1885	2,049,099	2,116,659	2,050,150	1,857,080	2,138,253	23,713,326
1886	2,059,299	2,157,323	2,441,848	2,724,796	2,550,891	26,653,852
1887	2,220,768	2,342,227	2,573,008	2,462,082	2,608,341	27,279,028
1888	2,223,263	2,289,486	1,558,115	2,503,491	2,397,782	25,138,031
1889	2,625,825	2,567,459	2,747,284	2,393,131	2,671,518	29,638,898
1890	2,538,224	2,648,418	2,725,341	2,662,898	2,889,525	30,116,075
1891	2,496,255	2,701,361	2,799,214	2,601,435	2,781,531	28,984,403

These shipments are for later years pipe-line deliveries. It will be noted that there is but little difference in the shipments of the last three years. It will also be observed that the shipments do not equal the production.

These figures of shipments must not be taken as showing the actual consumption of oil. To them must be added, in order to ascertain what becomes of the oil produced in the oil regions, all of the sediment, the dump oil, or oil that does not pass through the pipe line, as well as the amount of oil destroyed by fire and disposed of in other ways than by refining or direct consumption. There is also a certain amount of loss by evaporation and otherwise. This is provided for by the pipe lines in receiving the oil from the producers, a certain number of gallons per barrel being allowed for such loss. Forty-four gallons are generally delivered by the producer to the pipe line as a barrel, but certificates are issued for barrels of 42 gallons only.

Prices of crude petroleum in Pennsylvania.—In the following table from Stowell's Petroleum Reporter are given the monthly and yearly averages of pipe-line certificates or price of crude petroleum at primary markets from 1860 to 1891, in barrels of 42 gallons.

These averages, it is to be understood, are not true averages, that is, in price and quantity sold at that price, but they are the averages of the prices obtained from day to day. It is probable that the true average prices are slightly under the averages usually obtained by averaging the prices. These averages, however, under the circumstances, are the only ones that can be ascertained and do not vary much from the average of the prices. It is also to be noted, as is stated elsewhere, that certain oils in Pennsylvania and New York were at a premium for a portion of the year, the premium on oils of certain districts being removed in August, all oil after this date being subject to the certificate price.

Monthly and yearly average prices of pipe-line certificates of crude petroleum at wells from 1860 to 1891.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly.
1860	$19.25	$18.00	$12.62½	$11.00	$10.00	$9.50	$8.62½	$7.50	$6.62½	$5.50	$3.75	$2.75	$9.59
1861	1.00	1.00	1.00	0.62½	0.50	0.50	0.50	0.25	0.20	0.10	0.10	0.10	0.49
1862	0.10	0.15	0.22½	0.50	0.85	1.00	1.25	1.25	1.25	1.75	2.00	2.25	1.05
1863	2.25	2.50	2.62½	2.87½	2.87½	3.00	3.25	3.37½	3.50	3.75	3.85	3.95	3.15
1864	4.00	4.37½	5.50	6.56	6.87½	9.50	12.12½	10.12½	8.87½	7.75	10.00	11.00	8.06
1865	8.25	7.50	6.00	6.00	7.37½	5.62½	5.12½	4.62½	6.75	8.12½	7.25	6.50	6.59
1866	4.50	4.40	3.75	3.95	4.50	3.87½	3.00	3.75	4.50	3.39	3.10	2.12½	3.74
1867	1.87½	1.85	1.75	2.07½	2.35	1.90	2.62½	3.15	3.40	3.55	2.50	1.87½	2.41
1868	1.95	2.00	2.55	2.82⅛	3.75	4.50	5.12½	4.57½	4.00	4.12½	3.75	4.35	3.62½
1869	5.75	6.95	6.00	6.70	5.35	4.95	5.37½	5.57½	5.50	5.50	5.80	5.12½	5.63¾
1870	4.52½	4.52½	4.45	4.22½	4.40	4.17½	3.77½	3.15	3.25	3.27½	3.22	3.40	3.84
1871	3.82½	4.38	4.25	4.01	4.60	3.85½	4.79	4.66	4.65	4.82½	4.25	4.00	4.34
1872	4.02½	3.80	3.72½	3.52½	3.80	3.85	3.80	3.58½	3.25	3.15	3.83½	3.32½	3.63
1873	2.60	2.20	2.12½	2.30	2.47½	2.22½	2.00	1.42½	1.15	1.20	1.25	1.00	1.87
1874	1.20	1.40	1.60	1.90	1.62½	1.32½	1.02½	0.95	0.95	0.85	0.55	0.61½	1.15
1875	1.03	1.52½	1.75	1.36½	1.40	1.26½	1.09	1.13	1.33	1.32½	1.44	1.55	1.36
1876	1.80	2.60	2.01	2.02½	1.90½	2.01¾	2.24½	2.71⅜	3.81	3.37½	3.11	3.73	2.56¼
1877	3.53¼	2.70	2.67½	2.58	2.24	1.94⅝	2.07½	2.51	2.38	2.56¾	1.91	1.80	2.42
1878	1.43	1.65¼	1.59	1.37½	1.35¼	1.14	0.98¾	1.01	0.86⅝	0.82⅛	0.89⅜	1.16	1.19
1879	1.03	0.98	0.86¼	0.78½	0.76	0.68⅜	0.69⅞	0.67⅛	0.69⅜	0.88⅛	1.05⅝	1.18⅛	0.85⅞
1880	1.10¼	1.03⅛	0.88¾	0.78	0.80	1.00	1.06¼	0.91	0.96	0.96⅞	0.91⅞	0.91⅝	0.94½
1881	0.95½	0.90⅜	0.83⅜	0.86¼	0.81⅞	0.81¼	0.76⅞	0.78⅛	0.97⅛	0.91¼	0.85¼	0.84⅜	0.85⅞
1882	0.83⅛	0.84½	0.81⅜	0.78⅜	0.71½	0.54⅜	0.57⅞	0.58⅝	0.72⅛	0.93¾	1.14	0.96	0.78⅛
1883	0.93¾	1.01	0.97⅝	0.94⅜	1.00⅛	1.16⅜	1.05⅞	1.08	1.12½	1.11⅛	1.14½	1.14¾	1.05¾
1884	1.11	1.04⅜	0.98⅛	0.94	0.85⅝	0.68⅝	0.63½	0.81⅞	0.78	0.71⅛	0.72½	0.74⅜	0.83½
1885	0.70⅞	0.72⅜	0.80⅜	0.78½	0.79	0.82	0.92½	1.00¼	1.00¾	1.05½	1.04⅜	0.89⅝	0.87⅞
1886	0.88⅜	0.79⅞	0.77¼	0.74⅛	0.70	0.66½	0.66	0.62⅛	0.63⅜	0.65⅛	0.71⅝	0.70⅝	0.71¼
1887	0.70	0.64⅝	0.63⅜	0.64⅞	0.64⅛	0.62⅝	0.59¼	0.60⅛	0.67	0.70⅞	0.73⅞	0.80¾	0.66¾
1888	0.91¼	0.91⅝	0.93⅝	0.82⅝	0.86¾	0.75⅞	0.80⅝	0.90⅛	0.93⅝	0.90⅝	0.85⅜	0.89¼	0.87⅝
1889	0.86⅝	0.89¼	0.90⅞	0.88	0.83⅛	0.83⅞	0.95⅛	0.99½	0.99⅛	1.01⅜	1.08½	1.04⅛	0.94⅛
1890	1.05¾	1.05⅛	0.90	0.82⅝	0.88⅞	0.89¼	0.89⅛	0.89¼	0.81⅞	0.80⅛	0.72⅜	0.67¼	0.86¾
1891	0.74¼	0.78⅜	0.74¼	0.71½	0.69¾	0.68⅛	0.66½	0.64	0.58½	0.60½	0.58¾	0.59⅝	0.67

From the above table it will be seen that the average price of oil in 1891 was lower than any year from 1860, except 1887, when the average was $66\frac{3}{4}$ cents, and in 1861 when the average was 49 cents. The lowest monthly average for any of the months covered by the table, except during the years 1861 and 1862, was reached in June and July of 1882, when the price for June was $54\frac{3}{8}$ cents and for July $57\frac{3}{8}$ cents. The next lowest price was in September of 1891 when the price was $58\frac{1}{2}$ cents. The low price in 1882 was due to Cherry Grove; the low price of 1891 to McDonald.

Stocks of crude petroleum.—In the following table is given a statement showing the total stocks of crude petroleum in the Pennsylvania and New York oil fields from 1871 to 1891, inclusive, by months and years:

Total stocks of crude petroleum in the Pennsylvania and New York oil fields from 1871 to 1891, by months and years.

[Barrels.]

Years.	January.	February.	March.	April.	May.	June.	July.
1871	537,751	587,021	642,000	771,000	605,000	554,000	511,220
1872	532,971	579,793	662,497	877,832	950,803	1,010,302	990,229
1873	1,183,728	1,265,373	1,244,657	1,178,643	1,192,541	1,324,493	1,433,620
1874	1,948,919	2,283,032	2,648,210	2,623,534	2,594,286	2,701,625	2,279,479
1875	4,011,703	4,546,188	4,592,364	4,537,843	4,552,672	4,502,896	4,386,720
1876	3,585,143	3,734,835	3,829,250	3,900,703	3,989,904	3,791,642	3,326,726
1877	2,604,128	2,860,636	3,210,454	3,279,731	3,173,008	2,912,674	3,004,728
1878	3,555,342	3,875,964	4,342,832	4,692,090	4,996,058	5,078,189	5,031,600
1879	5,321,222	5,813,663	6,318,099	6,689,111	6,980,064	7,263,150	7,353,382
1880	8,724,194	9,004,062	9,606,683	10,780,153	11,916,577	13,099,934	14,116,753
1881	20,110,903	21,108,003	22,105,789	22,963,171	23,793,028	24,441,191	24,888,337
1882	26,716,188	27,059,611	27,822,825	28,547,481	29,206,697	29,859,952	30,715,144
1883	35,187,116	35,692,480	35,881,255	37,789,406	35,755,824	35,985,935	36,371,922
1884	35,884,509	36,041,898	36,220,270	36,642,794	38,631,203	38,665,838	38,985,767
1885	37,214,274	36,757,137	36,508,236	36,464,800	36,139,072	35,872,257	35,686,909
1886	34,186,238	34,082,775	33,954,493	33,823,385	33,969,486	34,187,377	34,428,490
1887	33,835,389	33,288,630	32,932,502	32,955,084	32,642,330	32,389,750	32,289,269
1888	26,927,634	26,084,574	25,404,276	24,893,223	24,653,043	24,219,496	23,586,951
1889	18,165,607	17,240,428	16,634,437	16,076,501	15,668,331	15,258,863	14,541,696
1890	11,060,220	10,990,417	11,170,997	11,178,990	11,062,100	10,866,587	10,663,497
1891	10,383,059	10,836,863	10,939,164	11,313,241	11,684,538	12,021,857	12,239,422

Years.	August.	September.	October.	November.	December.	Averages.
1871	530,146	541,330	495,102	502,960	532,[illegible]00	567,458
1872	997,166	951,410	914,423	886,909	1,084,423	869,897
1873	1,513,890	1,521,185	1,452,777	1,493,875	1,625,157	1,369,162
1874	2,932,444	2,758,504	3,134,902	3,449,845	3,705,639	2,755,035
1875	4,223,397	3,812,945	3,672,101	3,701,235	3,550,207	4,174,189
1876	3,304,405	2,930,456	3,040,108	2,955,092	2,551,199	3,411,622
1877	2,852,544	2,503,657	2,504,012	2,471,798	3,127,837	2,875,434
1878	4,717,877	4,599,362	4,221,769	4,289,309	4,615,299	4,501,308
1879	7,114,195	7,620,525	7,794,634	8,051,469	8,470,490	7,065,834
1880	15,063,651	16,157,316	16,877,019	18,025,409	18,928,430	13,525,015
1881	25,005,187	25,066,657	25,309,361	25,509,285	26,019,704	23,860,051
1882	31,772,094	32,400,303	32,608,533	33,728,555	34,596,612	30,419,500
1883	36,164,881	35,752,677	35,613,915	35,506,653	35,745,632	35,953,975
1884	39,084,561	38,740,734	38,192,317	37,925,756	37,366,126	37,698,481
1885	35,343,771	34,939,902	34,763,857	34,668,437	34,428,841	35,732,291
1886	34,800,397	35,061,614	35,027,877	34,525,871	34,156,605	34,350,384
1887	32,003,536	31,340,939	30,662,583	29,325,951	28,006,211	31,806,015
1888	22,825,298	21,876,681	20,722,024	19,734,132	18,995,814	23,326,929
1889	13,859,267	13,198,452	12,468,969	12,021,924	11,562,593	14,724,756
1890	10,526,613	10,346,878	10,263,258	10,080,538	9,993,600	10,682,807
1891	12,412,300	12,650,375	13,504,659	14,952,827	16,002,857	12,411,763

In the reports for the last two years, that is, 1890 and 1891, is included some oil produced in West Virginia, the runs from the wells of West Virginia and southwestern Pennsylvania being so united in the pipe lines that it is impossible to distinguish between stocks of West Virginia and stocks of southwestern Pennsylvania oils.

For the last three years the total stocks of petroleum are in excess of those held by pipe lines, the stocks for these years including, in addition to those held by pipe lines, the oil held in tanks at wells. In these tables, however, are not included any stocks of petroleum owned and held at refineries.

From the above table it will be noted that for the first time since 1884 there has been an increase in the average stocks of oil held at the close of each month. Beginning with 1884, when the average stock was 37,698,48 barrels, there was a gradual reduction in the average stocks until 1890, when the average stocks were 10,682,807 barrels. The average stocks for 1891, however, increased to 12,411,763 barrels. The stock at the close of December, 1890, was lower than at any corresponding period since 1879, it being 9,993,600 barrels December 31, 1890, and 8,470,490 barrels December, 1879. The stock at the close of the December. 1891, had risen to 16,002,856 barrels, an increase of a little over 6,000,000 barrels as compared with stocks at the close of December 31, 1890, though the increase in the average of stocks at the close of each month in 1891 was not quite 2,000,000 barrels in excess of the average stocks for 1890.

Well records in the Pennsylvania and New York oil fields.—In the following tables are given what are known as the well records; that is, the statistics of the number of derricks erected each month, the number of wells drilling, the completion of new wells and their initial daily production, as well as the number of dry holes or those wells that produced no petroleum. These statistics include the well records of New York, Pennsylvania, and northern West Virginia, the latter being included with southwestern Pennsylvania for reasons elsewhere stated. The statistics for New York have for many years been included with those of Pennsylvania.

In the following two tables are given statements of the number of wells completed in each district in the Pennsylvania, New York, and northern West Virginia oil fields during each month of 1891, by months and districts, together with the initial daily production of new wells:

Total number of wells completed in the Pennsylvania, New York, and northern West Virginia oil fields in 1891.

Months.	Bradford.	Allegany.	Middle field.	Venango and Clarion.	Butler and Armstrong.	Southwest field.	Total.
January	40	8	26	68	57	111	310
February	18	5	23	55	61	81	243
March	22	7	35	48	52	111	275
April	24	6	35	64	57	102	288
May	31	13	42	54	44	130	314
June	20	4	34	64	48	134	304
July	36	8	36	81	61	112	334
August	27	9	34	76	44	143	333
September	27	6	18	51	54	125	281
October	15	11	15	38	41	117	237
November	9	9	17	29	46	135	245
December	9	5	16	22	32	113	197
Total	278	91	331	650	597	1,414	3,361

Initial daily production of new wells in the Pennsylvania, New York, and northern West Virginia oil fields in 1891.

Months.	Bradford.	Allegany.	Middle field.	Venango and Clarion.	Butler and Armstrong.	Southwest field.	Total.
January	233	55	164	447	2, 323	10, 142	13, 364
February	100	30	178	257	1, 303	4, 750	6, 618
March	120	40	394	155	1, 613	5, 429	7, 751
April	102	35	335	224	1, 000	6, 014	7, 710
May	163	60	252	241	1, 396	5, 763	7, 875
June	111	21	358	343	911	3, 519	5, 263
July	205	34	295	471	1, 568	3, 970	6, 543
August	173	53	182	535	1, 593	11, 000	13, 536
September	176	26	105	445	1, 164	16, 202	18, 118
October	108	68	75	332	1, 308	44, 821	46, 712
November	48	38	94	150	1, 401	31, 664	33, 395
December	57	21	77	136	2, 598	12, 579	15, 468
Total	1, 596	481	2, 509	3, 736	18, 178	155, 853	182, 353

These tables do not include any wells drilling in the Franklin lubricating oil district nor the initial production of wells drilled in this district.

The districts in the above tables have been described in other parts of the report. Here it may be said briefly that the Bradford district includes a portion of Cattaraugus county, New York, and forms with Allegany, New York, district the northern field. The middle field is chiefly in Warren and Forest counties, though the lower field includes a small portion of Warren county. The Venango and Clarion and the Butler and Armstrong are the chief districts of what is known as the lower field. The southwest field includes the wells in Allegheny and Washington counties, as well as the wells in northern West Virginia.

The above tables show in the most graphic manner the influence of McDonald upon the production and drilling of wells in other fields. By reference to the first table it will be seen that the number of wells completed in all of the districts, except Bradford and Allegany and the southwest district, fell off under the influence of the large increase in production in the McDonald district, which is in the southwest field. In the Bradford district 40 wells were completed in January and but 9 in December. In the middle field 42 were completed in May and but 15 in October, 17 in November, and 16 in December. In Venango and Clarion 81 wells were completed in July and 22 in December. Of course, the total number of wells completed in each month shows a similar falling off. There were 310 wells completed in January, 334 in July, and 333 in August, yet the initial production in July was but 6,543 barrels and 13,536 barrels in August. On the other hand, though there were but 237 new wells completed in October, the initial production was 46,712 barrels.

The table of initial production given above also shows, in the column headed "Southwest field," the effect on initial production of the remarkable output of oil in the McDonald district.

The average daily production of the new wells completed in the Pennsylvania and New York oil fields from 1882 to 1891 is as follows:

Average daily product of the new wells in the Pennsylvania and New York oil fields from 1882 to 1891, by months and years.

[Barrels.]

Months.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
January	19.50	22.40	13.70	40.00	13.50	25.50	15.43	13.08	13.00	50.62
February ...	19.40	14.90	15.00	41.30	13.40	44.75	12.48	10.50	22.00	36.30
March	22.25	22.50	17.00	23.30	22.90	29.75	66.00	19.70	14.60	34.76
April	22.00	21.00	12.00	40.00	32.00	43.50	9.40	15.17	14.60	33.70
May	21.30	17.50	18.00	23.00	38.60	22.00	68.71	12.00	15.90	29.60
June	36.80	15.00	17.50	10.60	25.00	38.51	40.55	13.50	19.40	22.70
July	108.80	15.00	59.30	10.30	31.10	18.14	14.38	13.20	19.00	24.50
August.....	84.20	13.80	22.60	10.60	51.90	49.30	19.00	15.50	16.37	50.70
September..	25.75	14.40	41.70	13.20	62.40	57.70	19.00	14.14	28.40	77.40
October.....	15.90	14.20	165.50	14.00	28.00	25.98	13.72	11.50	22.72	243.29
November ..	12.90	13.80	87.40	10.90	28.00	19.69	12.80	15.20	28.87	174.84
December ..	20.40	11.80	92.60	10.90	23.00	11.40	13.30	14.25	29.56	97.90

In arriving at the above average the total initial daily production for each month is divided only by the number of producing wells; that is, from the total of completed wells given above is subtracted the number of dry holes given elsewhere in this report, the result being the number of producing wells completed during each month. The total daily production divided by the number of producing wells will give the average daily production. Never in the history of petroleum production in Pennsylvania were such remarkable wells struck as in October and November of 1891. In the above table are included the average initial daily production of wells from 1882 as this shows the effect of Cherry Grove on the average production of that year.

The following table gives the number of drilling wells completed in each month from January, 1872, to the close of 1891:

Number of drilling wells completed in the Pennsylvania and New York oil fields each month from 1872 to 1891, by months and years.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1872	37	120	89	121	135	84	128	118	82	100	64	105	1,183
1873	93	94	100	105	102	130	114	120	106	101	100	98	1,263
1874	102	104	110	113	109	101	121	107	104	120	106	120	1,317
1875	190	187	195	186	172	190	200	210	201	220	217	230	2,398
1876	240	231	242	200	202	261	248	270	209	273	272	272	2,920
1877	281	241	291	269	320	403	317	255	322	467	391	382	3,939
1878	274	226	211	409	470	269	203	186	174	229	248	165	3,064
1879	136	132	238	270	402	330	327	283	210	232	227	261	3,048
1880	320	230	367	500	426	310	338	368	356	364	336	302	4,217
1881	222	220	271	316	406	374	336	332	312	322	363	406	3,880
1882	347	340	385	432	469	340	185	253	164	117	150	122	3,304
1883	125	126	142	209	231	228	261	309	321	321	302	272	2,847
1884	229	227	256	298	311	244	268	145	89	59	73	66	2,265
1885	64	62	82	116	213	242	217	283	356	397	384	345	2,761
1886	270	280	291	328	343	365	357	313	253	272	221	185	3,478
1887	158	162	138	160	148	162	159	142	134	100	101	96	1 660
1888	57	52	56	49	56	97	82	96	132	229	307	302	1,515
1889	284	288	353	401	431	537	549	508	478	559	540	471	(a)5,435
1890	553	482	522	556	534	571	555	579	571	567	520	348	6,358
1891	310	243	275	288	314	304	334	333	281	237	245	197	3,361

(*a*) Including 36 wells drilled in Franklin district, data for which by months were not obtainable.

In the following table will be found a statement of the number of dry holes drilled in each district of Pennsylvania, New York, and northern West Virginia in 1891:

Total number of dry holes drilled in Pennsylvania, New York, and northern West Virginia in 1891.

Months.	Bradford.	Alle-gany.	Middle field.	Venango and Clarion.	Butler and Arm-strong.	South-west field.	Total.
January	1	1	0	15	10	19	46
February	1	1	2	8	8	41	61
March	1	0	4	9	7	31	52
April	3	0	4	12	15	25	59
May	2	1	0	4	6	35	48
June	1	0	2	11	11	47	72
July	1	2	3	9	12	40	67
August	3	0	3	17	8	35	66
September	2	0	1	2	13	23	41
October	0	2	2	7	7	27	45
November	1	1	5	10	12	25	54
December	2	0	8	6	8	15	39
Total	18	8	34	110	117	363	650

This table should be compared with the table given above showing the total number of completed wells. The number of producing wells for each district in each month for the year will be ascertained by subtracting the number of dry holes given in the above table from the number of completed wells. A study of these two tables, that is the table showing number of completed wells and the table showing number of dry holes is interesting as indicating a much larger proportion of producing wells to the total number of wells drilled in certain districts than in others. For example, in the Bradford district 278 wells were completed in 1891. Of these but 18, or a little over 6 per cent. were dry holes. In the Allegany district some 9 per cent. were dry holes; in the middle field 10 per cent. in Venango and Clarion district some 16 per cent.; in Butler and Armstrong some 20 per cent., while in the Southwest district of 1,414 wells completed in 1891, 363, or 25 per cent., were dry holes. This indicates that wells put down to the shallower strata of the extreme northwestern part of the Pennsylvania oil fields are more likely to be producers than those drilled to the deeper strata of the lower fields.

The earnestness with which new work is being prosecuted in the various fields and districts of Pennsylvania at the close of each month is shown in the record of rigs or derricks building and wells drilling.

In the following table will be found a statement of the number of rigs in course of construction at the close of each month in 1891 in each of the fields of Pennsylvania:

Rigs building in the Pennsylvania, New York, and northern West Virginia fields in 1891.

Months.	Bradford.	Allegany.	Middle field.	Venango and Clarion.	Butler and Armstrong.	Southwest field.	Total.
January	23	2	7	41	49	111	233
February	19	1	7	36	48	84	195
March	23	5	10	37	52	91	218
April	20	2	11	36	35	82	186
May	25	1	13	30	43	96	208
June	23	1	16	53	43	98	234
July	22	0	15	49	29	67	182
August	16	2	6	40	35	89	188
September	13	1	7	25	37	48	131
October	14	1	10	22	22	67	136
November	14	4	4	17	23	60	122
December	2	1	6	9	39	51	108
Average	18	2	9	33	38	79	179

Here again, as in the case of other portions of this well record, the influence of the wonderful production of oil in the McDonald field is shown. The number of rigs building in the Bradford region, for example, at the close of December was 2, the average for the year being 18. Indeed, all through this table the number of rigs building at the close of the year is very much less in each district than the average for the year. Even in the Southwest district this is true, as the enormous results obtained by drilling in the McDonald field led to reduction of price and discouraged the production of oil in other regions.

In the two following tables will be found statements regarding the number of wells drilling but not completed at the close of each month in 1891, and also from 1871 to 1891.

Wells in process of drilling in Pennsylvania in 1891.

Month.	Bradford.	Alle-gany.	Middle field.	Venango and Clarion.	Butler and Arm-strong.	South-west field.	Total.
January	23	7	34	40	82	221	407
February	24	9	22	40	93	222	410
March	26	10	27	50	80	208	401
April	26	14	22	42	72	211	387
May	29	7	31	42	63	208	380
June	29	12	21	53	87	205	407
July	28	6	24	43	71	248	420
August	24	6	15	36	77	248	406
September	19	8	11	26	66	267	397
October	14	7	13	21	61	255	371
November	11	3	22	13	58	230	337
December	7	2	14	5	43	205	276
Average	22	8	21	34	71	227	383

Number of wells drilling in the Pennsylvania and New York oil fields at the close of each month from 1871 to 1891, by months and years.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Aver-ages.
1871	140	173	240	279	356	303	329	330	439	486	477	394	329
1872	363	369	313	302	386	391	359	392	301	311	354	318	347
1873	361	349	227	177	228	395	340	267	197	163	137	60	242
1874	37	55	99	213	225	210	180	128	107	82	57	54	121
1875	40	40	45	64	127	162	118	96	132	170	179	168	112
1876	142	151	230	267	307	340	353	374	511	565	618	493	363
1877	457	463	395	448	512	395	365	417	535	573	565	426	463
1878	334	326	379	409	376	266	188	185	240	282	297	218	292
1879	265	323	406	468	460	384	329	258	270	313	372	440	357
1880	540	535	577	580	460	440	452	515	491	469	475	408	495
1881	383	420	437	446	470	408	379	352	388	445	475	468	423
1882	422	438	408	405	381	226	240	194	177	184	154	138	281
1883	126	151	205	199	216	228	262	315	314	341	301	263	243
1884	270	273	260	284	244	123	123	91	79	100	86	78	168
1885	97	109	139	190	228	209	242	308	382	355	359	277	241
1886	320	337	356	318	358	403	349	290	322	272	285	238	321
1887	201	177	155	155	157	142	135	137	107	104	114	88	139
1888	64	72	65	59	82	106	124	106	166	187	327	273	136
1889	341	350	453	487	574	612	598	598	600	698	659	610	548
1890	597	608	645	603	585	617	643	683	632	644	542	445	604
1891	407	410	401	387	380	407	420	406	397	371	337	276	383

In the first table is given the number of wells drilling at the close of each month in 1891, by districts. Similar remarks as to the effect of the McDonald production, as are given above in connection with rigs building, can be made with regard to the number of wells drilling at the close of each month. The only district in which the number of drilling wells approach the average for the year was in the Southwest district, the average for this district for the year being 227, and the number of drilling wells at the close of December, 205.

OHIO.

To the three oil producing districts in which this State has heretofore been divided, namely, Lima, Macksburg, and Mecca-Belden, is added a fourth, eastern Ohio, in which are included the wells near the

Ohio River north from Macksburg, the character of the oil produced being the same as that produced at Macksburg. This new district is found on both sides of the Ohio River, some of the wells being in West Virginia and others in Ohio. This makes it extremely difficult to distribute the production properly between the two States. The character of the oil is also so allied to that at Macksburg that in the table given the production is included with that of Macksburg.

There were produced in the State of Ohio in 1891, 17,740,301 barrels of petroleum, worth $5,576,705, an average of 31.4 cents a barrel. Of this production 17,315,978 barrels, valued at $5,281,373, or 30½ cents a barrel, were produced in the Lima district; 400,024 barrels in the Macksburg and 22,859 barrels in the eastern Ohio district, the total value of the oil from these two districts being $283,332, or 67 cents a barrel; and 1,440 barrels, valued at $12,000, or $8.33⅓ a barrel, from the Mecca-Belden district.

The production of 1890 was 16,124,656 barrels, and in 1889, 12,471,466 barrels. The total production and value of the petroleum produced in Ohio in the years 1889, 1890, and 1891 is shown in the following table:

Total production and value of petroleum produced in Ohio in 1889, 1890, and 1891.

Districts.	1889.		1890.		1891.	
	Total production.	Total value.	Total production.	Total value.	Total production.	Total value.
	Barrels.		*Barrels.*		*Barrels.*	
Lima	12, 153, 189	$1, 822, 978	15, 014, 882	$4, 504, 465	17, 315, 978	$5, 281, 373
Macksburg	317, 037	340, 683	1, 108, 334	1, 127, 730	(*a*)422, 883	283, 332
Mecca-Belden	1, 240	10, 334	1, 440	12, 000	1, 440	12, 000
Total	12, 471, 466	2, 173, 995	16, 124, 656	5, 644, 195	17, 740, 301	5, 576, 705

(*a*) Includes 22,859 barrels of oil produced in Eastern Ohio which is of the same character as the Macksburg oil.

As has been stated elsewhere all of the Macksburg and eastern Ohio districts can be classified as illuminating oil. A large proportion of the production of the Lima district is used as fuel oil, while the production of the Mecca-Belden district is lubricating oil.

The following table gives the production of petroleum in Ohio from the beginning of operations in that State to the close of 1891:

Production of petroleum in Ohio.

	Barrels.		Barrels.
Previous to 1876	200, 000	1885	650, 000
1876	31, 763	1886	1, 782, 970
1877	29, 888	1887	5, 018, 015
1878	38, 179	1888	10, 010, 868
1879	29, 112	1889	12, 471, 466
1880	38, 940	1890	16, 124, 656
1881	33, 867	1891	17, 740, 301
1882	39, 761		
1883	47, 632	Total	64, 377, 499
1884	90, 181		

Notwithstanding the enormous increase in production in this State, beginning with 1885, which marks the commencement of developments in the Lima field, the total production of this State, namely, 64,377,499 barrels, is not double the production of Pennsylvania and New York in 1891.

Lima district.—Possibly the most remarkable oil district ever developed in this country is that known as the Lima, or northwestern Ohio district. Not only has its development been most rapid since it began to assume prominence in 1885, but it as been found that the oil produced in this district, which, because of its peculiar character, it containing a portion of sulphur, it was believed could not be used for illuminating purposes, now furnishes most of the illuminating oil used in the United States, though the yield of the oil in illuminants is less than from Pennsylvania oil.

This region has been so thoroughly described in Mineral Resources that little need be said here. The reservoir of the oil is the Trenton limestone which lies as near a level terrace as an area of this sort ever becomes. The oil is found at Lima at a depth of 1,300 feet. The oil is dark or black and rather heavy, and contains sulphur compounds, in these respects resembling the oils of Canada and Tennessee.

The production of petroleum in the Lima, Ohio, oil fields from 1886 to 1891 is as follows:

Production of petroleum in the Lima, Ohio, district from 1886 to 1891.

	Barrels.
1886	1,064,025
1887	4,650,375
1888	9,682,683
1889	12,153,189
1890	15,014,882
1891	17,315,978

In the following table is found the production of petroleum in the Lima, Ohio, field from 1887 to 1891, by months, so far as the same was obtainable:

Product of petroleum in the Lima, Ohio, field from 1887 to 1891.

[Barrels.]

Months.	1887.	1888.	1889.	1890.	1891.
January	131,011	422,125		683,750	1,471,858
February	206,026	479,824		622,799	1,355,734
March	303,084	586,781		676,175	1,455,628
April	352,798	629,932		842,237	1,470,661
May	449,062	745,896		887,590	1,446,284
June	474,535	862,106		916,289	1,491,228
July	389,997	905,218		1,105,885	1,514,607
August	490,862	995,938		1,149,877	1,509,262
September	465,743	979,943		1,289,577	1,492,115
October	444,941	1,036,712		1,342,158	1,499,834
November	458,612	988,997		1,215,960	1,271,189
December	483,704	1,049,211		1,186,434	1,337,578
Total	4,650,375	9,682,683	12,153,189	11,918,731	17,315,978

The number of completed wells in the Lima district in 1891, as shown in the following table, is 1,574; the total daily production of these wells being, as shown in second table, 74,738 barrels.

Total number of wells completed in the Lima, Ohio, district in 1891.

Months.	Allen.	Auglaize.	Hancock.	Sandusky.	Wood.	Miscellaneous.	Total.
January	9	24	11	19	71	8	142
February	8	25	6	25	46	13	123
March	9	36	10	23	44	7	129
April	11	40	13	24	62	6	156
May	6	35	12	22	30	11	116
June	6	51	19	14	44	9	143
July	14	32	14	28	48	8	144
August	8	33	11	19	59	8	138
September	10	39	11	19	70	8	157
October	5	29	15	17	59	9	134
November	6	16	9	12	50	11	104
December	4	16	9	11	39	9	88
Total	96	376	140	233	622	107	1,574

Initial daily production of wells completed in the Lima, Ohio, district in 1891.

Months.	Allen.	Auglaize.	Hancock.	Sandusky.	Wood.	Miscellaneous.	Total.
January	305	880	655	341	3,577	100	5,858
February	320	1,855	275	555	2,374	95	5,474
March	285	1,555	188	710	1,605	85	4,428
April	365	3,048	156	510	2,370	100	6,543
May	180	2,491	163	617	815	145	4,411
June	133	3,172	523	300	2,457	82	6,667
July	520	2,894	1,085	1,309	2,353	300	8,461
August	197	2,120	650	710	4,305	445	8,427
September	181	2,223	865	535	3,921	130	7,855
October	160	2,220	955	555	3,988	155	8,033
November	123	812	627	425	2,895	710	5,592
December	145	693	168	345	1,298	340	2,989
Total	2,914	23,963	6,304	6,912	31,958	2,687	74,738

These tables show a great fluctuation both in the number of completed wells and in the initial daily production, the number of wells completed varying from 156 in April to 88 in December, and the initial daily production from 8,461 barrels in July to 2,989 barrels in December.

As will be seen in the following table, of the 1,574 wells drilled in the Lima region in 1891, 250, or about one-sixth, were dry holes:

Total number of dry holes drilled in the Lima, Ohio, district in 1891.

Months.	Allen.	Auglaize.	Hancock.	Sandusky.	Wood.	Miscellaneous.	Total.
January	....	3	3	7	11	4	28
February	....	6	....	3	11	7	27
March	1	5	2	2	9	4	23
April	1	4	6	7	7	3	28
May	....	4	3	1	1	5	14
June	....	3	3	2	6	4	18
July	1	1	2	5	11	2	22
August	1	3	3	1	4	2	14
September	4	8	....	3	9	2	26
October	1	1	1	2	11	4	20
November	1	4	....	1	8	3	17
December	1	2	2	1	4	3	13
Total	11	44	25	35	92	43	250

The number of rigs building and the number of wells drilling in the Lima, Ohio, field at the close of each month in 1891 is shown in the two following tables. Similar remarks as to the significance of these tables as were made in connection with the well records of Pennsylvania can be made regarding the well records of the Ohio field as well.

Total number of rigs building in the Lima, Ohio, field in 1891.

Months.	Allen.	Auglaize.	Hancock.	Sandusky.	Wood.	Miscellaneous.	Total.
January	4	20	11	23	55	7	120
February	13	25	14	24	60	1	137
March	13	31	13	30	60	8	155
April	10	22	16	21	45	3	117
May	14	22	10	12	52	5	115
June	15	23	14	17	48	6	123
July	16	27	18	19	51	6	137
August	5	17	13	12	68	5	120
September	5	21	16	15	54	6	117
October	5	19	16	8	52	6	106
November	4	15	9	8	50	5	91
December	4	17	9	11	50	8	99
Average	9	22	13	17	54	6	120

Total number of wells drilling in the Lima, Ohio, field in 1891.

Months.	Allen.	Auglaize.	Hancock.	Sandusky.	Wood.	Miscellaneous.	Total.
January	1	14	6	18	43	8	90
February	9	19	7	21	39	10	105
March	7	18	8	11	43	7	94
April	5	22	13	12	20	10	82
May	2	21	9	7	30	10	79
June	8	25	5	17	30	5	90
July	4	28	5	8	39	6	90
August	7	17	7	10	40	12	93
September	4	16	6	10	41	8	85
October	7	16	9	10	39	7	88
November	4	16	6	7	29	5	67
December	....	14	4	3	28	4	53
Average	5	19	7	11	35	8	85

Macksburg district.—The second largest oil-producing district in Ohio, and the district which, with the eastern Ohio, produces oil of a character similar to the illuminating oil of Pennsylvania, is that known as the Macksburg. The development of this field was almost coincident with that of the western Pennsylvania oil fields, the first well having been bored in 1860. The wells in this region are not as deep as those in Pennsylvania, and the oil is from another horizon than that in which the great deposit of Pennsylvania oil is found.

The production of the Macksburg district for the last seven years is given in the following table:

Production of petroleum in the Macksburg, Ohio, district from 1885 to 1891.

	Barrels.
1885	661,580
1886	703,945
1887	372,257
1888	291,585
1889	317,037
1890	1,108,334
1891	(a)422,883

a This includes 22,859 barrels of petroleum produced in eastern Ohio.

The production of 1891, it will be noted, even when the production of eastern Ohio is included, is very much below that of 1890 and also of the years 1885 and 1886.

Mecca-Belden district.—The wells in this district are located in Lorain and Trumbull counties, and include the Grafton and Mecca-Belden districts. The lubricating oil is produced from a few shallow wells, the total production for 1891 being 1,440 barrels. This is somewhat of an estimate, as the records of production are not accurately kept.

WEST VIRGINIA.

The oil fields of West Virginia, with the exception of Volcano and Burning Springs districts, are closely allied; indeed, are extensions of fields of southwestern Pennsylvania on one hand and eastern Ohio on the other. The character of the oils is identical with the oils of Pennsylvania, except that in the Volcano and Burning Springs districts, in which a quantity of lubricating oil is produced.

It is exceedingly difficult to separate the production of West Virginia from that of Pennsylvania and eastern Ohio. The best division possible for the last three years shows that there were 544,133 barrels of oil produced in this State in 1889, 492,578 barrels in 1890, and 2,406,218 barrels in 1891.

Total production and value of petroleum produced in West Virginia in 1889, 1890, and 1891.

Districts.	1889.			1890.			1891.		
	Total production.	Total value.	Price per barrel.	Total production.	Total value.	Price per barrel.	Total production.	Total value.	Price per barrel
	Barrels.			*Barrels.*			*Barrels.*		
Turkey Foot	199,460	$243,192	$1.21⅞	....	....	....	}		
Mount Morris	174,758	194,949	1.11½	....	....	....	} 2,404,218	1,610,826	$0.67
Volcano and Eureka	165,735	211,526	1.27⅝	....	....	....	}		
Burning Springs	4,160	4,160	1.00	....	....	....	2,000	2,000	1.00
Total	544,113	653,827	1.20⅛	492,578	$501,198	$1.01¾	2,406,218	1,612,826	.67

In the following table is given the production of oil in West Virginia from the beginning of operations, so far as we have been able to ascertain the figures:

Production of petroleum in West Virginia.

Years.	Barrels.	Years.	Barrels.
Previous to 1876	3,000,000	1885	91,000
1876	120,000	1886	102,000
1877	172,000	1887	145.000
1878	180,000	1888	119,448
1879	180,000	1889	544,113
1880	179,000	1890	492,578
1881	151,000	1891	2,406,218
1882	128,000		
1883	126,000	Total	8,226,357
1884	90,000		

COLORADO.

A full statement as to the occurrence of oil in Colorado, the character and amount of the production, as well as the history of the discovery of the oil fields and their development, is given in the volume of Mineral Resources for 1889 and 1890, pages 332 to 335, and need not be repeated here. It can be stated briefly that the Colorado fields are unlike those of any other section of the United States, if not of the world. The oil is struck in shale, though it is questionable if the reservoir is in the shale. When in drilling the shale seems to be solid and unbroken, no oil is found; but when crevices are struck and the strata appear broken, oil is almost sure to be discovered. Another remarkable feature regarding these wells is that in many cases the production increases rather than decreases, and the wells are not injured by being shut down.

Though oil has been known to exist for many years in Colorado, production really began in 1887. The total production by years since that date to the close of 1891 is given in the following table:

Product of crude oil in Colorado from 1887 to 1891.

Years.	Barrels.
1887	76,295
1888	297,612
1889	316,476
1890	368,842
1891	665,482

CALIFORNIA.

The statement regarding the petroleum fields of California and the character of its production given in the last volume of "Mineral Resources" is so complete that it need not be reproduced here.

The production of petroleum in this State from the beginning of operations is given in the following table:

Production of petroleum in California.

Years.	Barrels.	Years.	Barrels.
Previous to 1876	175,000	1884	262,000
1876	12,000	1885	325,000
1877	13,000	1886	377,145
1878	15,227	1887	678,572
1879	19,858	1888	690,333
1880	40,552	1889	303,220
1881	99,862	1890	307,360
1882	128,636	1891	323,600
1883	142,857		

INDIANA.

Indiana assumed considerable importance in 1891 as a producer of petroleum, though even yet the production in comparison with that of New York, Pennsylvania, West Virginia, and Ohio, or even Colorado and California, is exceedingly small.

The recent development of oil in Indiana may be said to have begun on May 6, 1889, when oil was struck in the Diall well at Terre Haute. The oil near this city is found in the upper part of the Hamilton limestone at a depth of 1,600 feet. The other locality in which oil was found in 1889 was in Montpelier, Blackford county. The production of petroleum in this section in 1889 was very small. Since 1889 the two sections, of which Terre Haute and Montpelier may be regarded as the pioneers, have produced some oil, as will be seen from the following table, which gives a statement of production of petroleum in Indiana from 1889 to 1891, inclusive:

Product of petroleum in Indiana in 1889, 1890, and 1891.

	1889.	1890.	1891.
Total production (barrels of 42 gallons)	33,375	63,496	136,634
Total value at wells of all oil produced, excluding pipage	$10,881	$32,462	$54,787
Value per barrel	0.32\frac{5}{8}$	0.51\frac{1}{8}$	$0.40

In the following tables are given statistics of the total number of producing wells, total number of new wells completed, total number of dry holes drilled, total number of wells drilling and total number of rigs building at the close of each month from July to December of 1891. These are the only figures that could be secured for this year.

Total number of wells producing in Indiana in 1891, from July to December, by counties.

Months.	Wells.	Blackford.	Jay.	Adams.	Allen.	Total.
July	133	120	....	....	....	253
August	135	0	0	....	....	135
September	180	640	55	....	....	875
October	120	160	20	20	10	330
November	295	45	50	0	0	390
December	110	25	40	0	0	175
Total	973	990	165	20	10	2,158

Total number of wells completed in Indiana in 1891, from July to December, by counties.

Months.	Wells.	Blackford.	Jay.	Adams.	Allen.	Total.
July	4	2	0	....	....	6
August	4	1	1	....	....	6
September	6	7	2	0	0	15
October	6	5	2	1	1	15
November	7	4	2	1	1	15
December	4	2	2	0	....	8
Total	31	21	9	2	2	65

Total number of dry holes drilled in Indiana in 1891, from July to December, by counties.

Months.	Wells.	Blackford.	Jay.	Adams.	Allen.	Total.
July	....	....	....	....	....	....
August	....	1	1	....	....	2
September	3	2	....	....	....	5
October	2	1	1	....	....	4
November	....	2	....	1	....	3
December	....	1	....	....	....	1
Total	5	7	2	1	....	15

Total number of wells drilling in Indiana in 1891, from July to December by counties.

Months.	Wells.	Blackford.	Jay.	Allen.	Adams.	Total.
July	3	0	2	0	....	5
August	5	3	4	0	1	13
September	3	4	3	0	2	12
October	6	0	1	0	1	8
November	1	2	1	0	0	4
December	5	1	5	0	1	12
Average	4	1½	2½	0	1	9

Total number of rigs building in Indiana in 1891, from July to December, by counties.

Months.	Wells.	Blackford.	Jay.	Adams.	Allen.	Total.
July	5	1	....	1	....	7
August	....	2	....	....	....	2
September	3	4	3	2	....	12
October	6	....	1	1	....	8
November	5	....	1	....	....	6
December	2	....	4	....	....	6
Average	3½	1	1½	1	....	7

KENTUCKY.

But little can be added to the statements given in previous volumes of "Mineral Resources" regarding the production of petroleum in Kentucky. The production for 1891 is reported a little in excess of that of any previous year for which exact figures are given, it being 9,000 barrels.

The total production of petroleum in Kentucky since the beginning of 1883 is shown in the following table. There are no details of the production by months for the last three years:

Product of petroleum in Kentucky from 1883 to 1891.

[Gallons,]

Months.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
January	11, 136	7, 806	20, 100	12, 332	19, 802	12, 501	....	....	....
February	15, 626	15, 863	12, 083	16, 547	20, 042	17, 101	....	....	....
March	13, 977	7, 806	15, 992	20, 029	16, 082	21, 032	....	....	....
April	19, 403	19, 666	20, 124	16, 432	12, 146	17, 166	....	....	....
May	23, 283	20, 943	12, 484	20, 138	20, 730	12, 871	....	....	....
June	19, 038	12, 157	16, 137	16, 137	16, 131	12, 620	....	....	....
July	16, 112	15, 746	24, 487	12, 076	16, 119	16, 620	....	....	....
August	15, 223	15, 840	16, 057	16, 021	16, 137	25, 166	....	....	....
September	18, 722	14, 310	20, 191	20, 141	16, 111	24, 562	....	....	....
October	19, 209	20, 174	22, 945	16, 120	16, 007	16, 711	....	....	....
November	11, 793	8, 013	16, 162	16, 113	15, 755	16, 860	....	....	....
December	16, 172	15, 872	20, 117	16, 379	16, 160	20, 815	....	....	....
Total	199, 694	174, 196	216, 879	198, 465	201, 222	214, 025	226, 800	252, 000	378, 000
Total ..... barrels	4, 755	4, 148	5, 164	4, 726	4, 791	5, 096	5, 400	6, 000	9, 000

OTHER STATES.

For statements regarding the production of petroleum in States other than those described in this report those interested are referred to previous volumes of "Mineral Resources" and the report of the Eleventh Census on the Mineral Industries of the United States. The statements regarding production in these States in 1891, and for other years, will be found in table on page 405 of this report giving production of crude petroleum in the United States for 1891.

NATURAL GAS.

By Joseph D. Weeks.

During 1891 the conditions as to the supply and the limitations as to the use of natural gas, which have always been recognized as existing, but which were first seriously felt in 1889, and to a greater extent in 1890, became more pronounced and operative. Sections of the country that believed, even as late as 1890, that their supply of gas was inexhaustible saw the pressure and production rapidly declining, and learned that there was a supply remaining sufficient only for those uses which demanded comparatively small amounts of gas, and which could afford, either because of its convenience or for other reasons, to pay much higher rates than those ruling in 1890. This reduced supply and increased price has led to the adoption of more economical appliances and methods for using the gas. Burners, stoves, and grates especially designed to burn gas were introduced in place of the old wasteful and inefficient coal stove or grate. As a result, though the price of gas has been advanced, doubled in many cases, the fuel cost was increased but little, if any, and the reduced supply was in many sections equal to the work to be done.

Notwithstanding these economies, the knowledge that the amount of gas remaining stored in the old fields was comparatively small and the manifest wisdom of retaining it for domestic and other small consumers led the gas companies to refuse in many cases to supply large manufacturers, or, when the supply was continued, to ask such prices as to make its use too expensive. At Pittsburg natural gas is no longer the fuel at many iron mills, producer gas or coal taking its place, and while many glassmakers still continue its use, even they are seeking for a substitute.

No important new district has been developed in 1891, while there has been a constant decline in the pressure and production of old fields. New fields have been found in old districts, which, though closely related to the old pools are evidently distinct. In western Pennsylvania, in the Pittsburg district, several important pools were developed in 1891. In this year, the Philadelphia Company, which supplies a large part of the gas consumed in Pittsburg, entered seven new fields. One of these, the Plum or Pin Hook, has since become one of the chief sources of supply of gas.

The chief sources of gas supply in the United States remain the same as heretofore; that is, western Pennsylvania, Findlay, Ohio, and the Indiana fields. To these may be added the smaller field of Meade county, Kentucky, from which Louisville obtains its supplies, and the

Haldimand-Welland field of eastern Ontario, near Niagara Falls, from which Buffalo draws a large proportion of the natural gas it uses. There are other small fields from which small amounts of gas are derived. Most of these have been described either in previous volumes of "Mineral Resources" or in the volume of Mineral Industries of the Eleventh Census. In some cases a brief description of new fields or of extension of old ones will be given below.

Production of natural gas in 1891.—No attempt was made to secure a statement of the production of natural gas in 1891 in cubic feet. In the census report of 1889 it is estimated that the consumption for that year was 552,150,000,000 cubic feet. For 1891 it was very much less, possibly not one-half, though the value of the gas consumed in 1891 is given as about three-fourths of the value of 1889.

Value of natural gas consumed in 1891.—In previous reports the measure of the value of the natural gas consumed in any one year has not been the amount of money received for it, but the value of the wood or coal required to do the same work. This method was necessary because so much of the gas used was from wells owned by the consumers or was either furnished free or at a very low cost. For these reasons the amount reported as received from the sale of gas was very much below the total value of the gas consumed when measured by the work done or by the cost of other fuel that would be required to do it, and it was therefore assumed that the cost or value of the wood or coal that would be consumed in doing the same work as was done by the gas would be a more accurate measure of the value of the gas than the money received.

In 1891, however, there were notable changes in the methods of selling the gas and marked increases in the price charged, changes which had begun in previous years, but which became more manifest in this year. The sale of gas, which at first was a fixed sum per stove or heater, or for heating a given building or doing a certain work, was, in most cases, except in very new territory or in large establishments, changed to sales per 1,000 cubic feet. These rates were quite low at first, but were soon advanced. In some instances, at works consuming large amounts of gas, the old method of charging a fixed price per ton of iron or per glass pot was continued, but at many others meters were used and the gas sold by measure. The gas companies in insisting upon the use of meters were seeking not only to make remunerative their large investments, but to compel economy in the use of gas so that the day of its exhaustion might be postponed.

These facts have necessitated a change in the methods of getting at the value of the gas. While it is still necessary in some cases to estimate the value of the coal or wood displaced, in many instances the sum actually received for the gas is a better measure of its value. In not a few cases it is believed that the cost of coal or wood to do the same work would be less than the amount actually paid for gas. In this report, therefore, in arriving at the value of gas consumed in 1891, both methods, that of the value of fuel displaced and of amount actually received for the sale of gas, have been used.

On this basis the value of the natural gas consumed in the United States in 1891 was, as given in the following table, $15,250,084. To this should be added the value of gas used in drilling, pumping, and operating wells, etc., not reported, making it, as estimated, a total of $15,500,084. Of this, gas to the value of $7,834,016 was produced in Pennsylvania, or fully one-half when its share of that used in drilling wells, operating pipe lines, etc., is considered. Indiana produced in value about one-fourth and Ohio less than one-fifth. As heretofore the value is for gas consumed, no account being taken of that produced and wasted.

Value of natural gas consumed in the United States in 1891.

States.	Value.	States.	Value.
Pennsylvania	$7,834,016	Illinois	$6,000
Indiana	3,942,500	Kansas	5,500
Ohio	3,076,325	Missouri	1,500
New York	280,000	Arkansas	250
Kentucky	38,993		
West Virginia	35,000	Total	15,250,084
California	30,000		

To this should be added the value of a considerable amount of gas produced at oil wells and used in drilling wells, pumping oil, etc., of which no definite statement could be secured. This will bring the total value of gas consumed in 1891 up to at least $15,500,000.

Value of natural gas consumed from 1885 to 1891.—In the following table is given the total value of natural gas consumed in the United States from 1885 to 1891, giving its value by localities as far as it could be ascertained.

Value of natural gas consumed in the United States, 1885 to 1891.

Localities.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
Pennsylvania	$4,500,000	$9,000,000	$13,749,500	$19,282,375	$11,593,989	$9,551,025	$7,834,016
New York	196,000	210,000	333,000	332,500	530,026	552,000	280,000
Ohio	100,000	400,000	1,000,000	1,500,000	5,215,669	4,684,300	3,076,325
West Virginia	40,000	60,000	120,000	120,000	12,000	5,400	35,000
Indiana	....	300,000	600,000	1,320,000	2,075,702	2,302,500	3,942,500
Illinois	1,200	4,000	....	....	10,615	6,000	6,000
Kentucky	....	....	....	....	2,580	30,000	38,993
Kansas	....	6,000	....	....	15,873	12,000	5,500
Michigan	....	12,000	....	....	....	....	....
Missouri	....	....	....	....	35,687	10,500	1,500
Arkansas	....	....	....	....	375	}	250
Texas	....	....	....	....	1,728	} 6,000	....
Utah	....	....	....	....	150	}	....
South Dakota	....	....	....	....	25	}	....
California	....	....	....	....	12,680	33,000	30,000
Elsewhere	20,000	20,000	15,000	75,000	1,600,000	1,600,000	250,000
Total	4,857,200	10,012,000	15,817,500	22,629,875	21,107,099	18,792,725	15,500,084

It will be noticed that the smallest total value of natural gas consumed in any one year was in 1885, which practically marked the beginning of importance of natural-gas production in western Pennsylvania. The total value of the natural gas consumed in 1885 was $4,857,200, of which gas to the value of $4,500,000 worth was consumed in Pennsylvania, $357,000 worth being consumed in all the other States. From 1885 to 1888 there was a gradual increase in the value of gas consumed, the total value in the latter year being $22,629,875, nearly five times the value of gas consumed in 1885. In this year the value of gas consumed in Pennsylvania reached its highest point, being $19,282,375, a little less than four and one-half times the value of the gas consumed in 1885. The largest value of gas consumed in Ohio in any one year was in 1889, when the value of gas consumed was $5,215,669. The largest total value of gas consumed in Indiana was in 1891, when the value reported was very nearly $4,000,000. The total value of gas consumed in the United States gradually declined from 1888, when, as stated before, it was $22,629,875, until the close of 1891, when the total value was $15,500,084.

It will be noted that in 1889, 1890, and 1891 the value of gas "produced elsewhere" is very large, being $1,600,000 in each of the years 1889 and 1890, and $250,000 in 1891. This is the value of gas estimated as consumed in the drilling of gas and oil wells and the pumping of oil wells, and operating oil and gas-pipe lines, for which no accurate figures could be ascertained.

Production of natural gas by 190 persons, firms, or corporations in 1889, 1890, and 1891.—For the purpose of more fully indicating the great differences in production, values, etc., of natural gas in the three years, 1889, 1890, and 1891, the three following tables are given, in which are consolidated the returns from 190 companies or persons, showing the total amount actually received for the sale of gas in these three years, as well as the number of producing wells and the total number of feet of pipe in use on December 31 of each year. The same companies report in each year. It is not to be understood, however, that these figures give the total production of gas, but only the production of these 190 companies.

Production of natural gas by 190 persons, firms, and corporations in 1889.

States.	Number of companies or persons reporting.	Amount received for sale of gas.	Number of producing wells December 31.	Total number feet of pipe December 31.
Pennsylvania	37	$4,285,609	373	6,659,187
Indiana	93	396,026	217	2,858,744
Kentucky	5	3,664	14	254,000
New York	8	83,716	80	738,128
Ohio	36	62,750	83	320,765
Illinois	2	2,205	2	21,120
Kansas	2	250	2	5,200
Arkansas	1	250	2	....
Missouri	2	75	1	30
California	2	20	1	200
Texas	1	0	1	100
West Virginia	1	0	0	0
Total	190	4,834,565	776	10,857,474

Production of natural gas by 190 persons, firms, and corporations in 1890.

States.	Number of companies or persons reporting.	Amount received for sale of gas.	Number of producing wells December 31.	Total number feet of pipe December 31.
Pennsylvania	37	$3, 964, 997	435	7, 720, 891
Indiana	93	709, 760	267	3, 468, 690
Kentucky	5	24, 866	22	257, 000
New York	8	104, 202	96	769, 288
Ohio	36	71, 957	99	392, 318
Illinois	2	5, 527	3	21, 120
Kansas	2	500	4	6, 200
Arkansas	1	250	2	....
Missouri	2	375	3	930
California	2	20	1	200
Texas	1	0	1	100
West Virginia	1	612	1	2, 000
Total	190	4, 883, 066	934	12, 638, 737

Production of natural gas by 190 persons, firms, or corporations in 1891.

States.	Number of companies or persons reporting.	Amount received for sale of gas.	Number of producing wells December 31.	Total number feet of pipe December 31.
Pennsylvania	37	$3, 311, 209	556	8, 051, 655
Indiana	93	1, 482, 795	305	3, 874, 071
Kentucky	5	28, 993	38	263, 500
New York	8	108, 161	106	783, 556
Ohio	36	86, 238	110	518, 720
Illinois	2	3, 434	4	21, 120
Kansas	2	700	5	8, 200
Arkansas	1	250	2	....
Missouri	2	1, 275	3	2, 030
California	2	1, 649	2	100, 200
Texas	1	0	1	100
West Virginia	1	1, 443	1	2, 000
Total	190	5, 026, 147	1, 133	13, 625, 1[illegible]2

Consolidating these three tables we have the following:

Production of natural gas by 190 persons, firms, or corporations in 1889, 1890, and 1891.

Years.	Number of companies or persons reporting.	Amount received for sale of gas.	Number of producing wells December 31.	Total number feet of pipe December 31.
1889	190	$4, 834, 565	776	10, 857, 474
1890	190	4, 883, 066	934	12, 638, 737
1891	190	5, 026, 147	1, 133	13, 625, 152

From the above table it appears that these 190 firms, with about 20 per cent. more pipe and 158 more wells, received but some $50,000 more for their gas in 1890 than in 1889, or about 1 per cent. more. In 1891, with about 10 per cent. more pipeage and some 200 additional wells, the amount received for gas was but $143,081 more. Comparing 1889 with 1891 it will be seen that these 190 companies, having 357 more producing wells in 1891 than in 1889, received but $191,582 more for gas in 1891 than in 1889—that is, with nearly 50 per cent. additional wells, the increase in earnings was not quite 4 per cent.

A notable feature in the first three tables given above is the great increase in the amount received for their gas by the 93 companies or persons in Indiana. In 1889 these 93 companies received but $396,026 for their gas. The amount received in 1890 is nearly double and the amount received in 1891 nearly double again. On the other hand, the amount received for gas by the 37 companies in Pennsylvania decreased each year, though there was a notable increase in the number of producing wells.

It is to be understood that in the above table are only included those concerns that were paid for their gas during all of these three years. It does not include reports from many concerns that furnished any considerable quantity of gas free.

Storage of natural gas and localities in which natural gas is found.—Broadly speaking there are two conditions under which natural gas is stored. In the first of these the reservoir is a porous, granular, or crystallized rock with small interstices, the reservoir being capped with a slate or shale impervious to the passage of the gas. This is the condition under which the great volumes of gas that have been discovered in western Pennsylvania, Ohio, eastern and central Indiana, and the other great gas regions, have been stored. These deposits are usually found at considerable depth and either in sandstone or limestone with capping of slate or shale.

The second condition under which natural gas is stored is in gravel or sand in the drift. This reservoir, when any amounts of gas are found, is usually capped with impervious clay. These gas deposits are often quite shallow. The volume of gas, however, is sometimes very large, though with high pressure, but is rapidly exhausted owing to the ease with which the gas finds its way through the gravel or sand to the bottom of the well which has capped the deposit.

The permanent gas deposits are usually those of the first class; the temporary, those of the second class. The shallow wells or gas deposits struck in sinking water-wells or in driving the shallow artesian wells are always of the second class, unless through the cracking or disturbance of the capping of a deposit of the first class of much greater depth gas has escaped from this large deposit and has been accumulated in the gravel or sand of the shallow deposit and kept in place by the clay. In such cases the life of a shallow well sunk only to sand, gravel, or hard-pan, may be very long. In most cases, however, these deposits are short-lived. Bearing in mind this distinction between deep and reasonably permanent and shallow and short-lived deposits it may be said that natural gas has been found in varying quantities all through the territory of the United States from the Hudson river on the east, to California on the west. In some of the States and Territories, however, it has not been found in commercial quantities, the gas coming to the surface either through springs or through comparatively shallow water wells. In the year 1891 gas was reported as found in commercial quantities in Arkansas, California, Illinois, Indiana, Kansas, Kentucky, Missouri, New York, Ohio, Pennsylvania, Texas, and Utah. The important gas fields, however, are still, as they have been for so many years, those of western Pennsylvania, western New York, northwestern Ohio, and eastern central Indiana. Considerable gas is also reported as being produced in West Virginia, which may be regarded as an extension of the western Pennsylvania field; in Kentucky, chiefly from Meade county, from which Louisville is supplied, and in California, the chief deposits in which are in the petroleum region of southern California and at Stockton.

The deposits in the various States have been so thoroughly described in previous volumes of "Mineral Resources," and especially in the report on the Mineral Industries in the United States at the Eleventh Census, 1889, that they need not be described in detail at this time.

Pumping natural gas.—With the reduction in the rock pressure of gas, difficulty was found in securing a supply at the point of consumption if it were located at any great distance from the wells. This led to the abandonment of many wells and pipe lines where the initial pressure was low and the line a long one.

Where the plant was an extensive one and the volume of gas large, though at a low pressure, the pumping of the gas was suggested and successfully carried out in several cases. The air-compressor particularly adapted to this work is used. The first company to try this method was the People's Company, operating in the Murrysville field. This company had two complete pumping plants constructed and put in operation in the winter of 1890–'91, and thoroughly demonstrated the practicability of pumping gas. Other companies have adopted this method. The Kentucky Heating and Lighting Gas Company operates wells in Meade county, Kentucky, furnishing gas for the city of Louisville. The line is an 8-inch pipe, and is 30 miles long. At West Point, 10 miles from the gas fields and 20 miles from Louisville, is located the pumping plant, which contains three boilers and two Clayton duplex compressors with 22-inch steam cylinder, 18-inch gas cylinder, and 30-inch stroke. It was originally intended to use gas under the boilers, but as the compressors were never needed except when gas was scarce, it was decided to use coal instead. The plant has been in operation for over two years, the pump being used only in cold weather. It has been the experience of this company that the amount of gas needed by the consumers varies with certain known conditions, primarily with the temperature, and also with the day of the week and the time of day. The variation due to temperature generally lags about a day behind the change. A record is kept of the pressure each hour at the field, at the low and high side of the compressor at West Point and at Louisville. When the thermometer is no lower than 38 degrees, 14 pounds at the discharge end of the compressor at West Point gives good service at Louisville, but as the temperature falls the pressure must be increased, according to a table in the hands of the engineer. When the thermometer falls to 25 degrees, 17 pounds are needed to maintain the supply. During the last two years the pressure on the low side at West Point has varied from 17 pounds down to a vacuum of 3 pounds. The line pressure at the wells has averaged about 15 pounds; but, although the number of customers of the company has very nearly doubled recently, this has increased to from 36 to 45 pounds, according to the temperature. The improvement has been due mainly to taking care of the field and stopping leaks as far as possible. It has not been found necessary to use more than one of the compressors at a time, but it is expected, in view of the rapidly increasing consumption of gas in Louisville, that soon it will be necessary to run both compressors in order to supply the demand, and at much higher pressures. As a general conclusion, it may be said that in cases where the rock pressure is too low to carry the gas through a long main the use of a good compression or natural-gas pump to supply the needed pressure will be found advantageous, but in cases where the effort is made to obtain by a pump a greater volume of gas than would flow if the well were blowing off into the air, suction is introduced, reducing the rock pressure at the wells, it may be, to less than zero, and difficulty may be experienced from water or oil being drawn up. If the water come from strata above the gas seam, casing may be employed, but if it be below there is no remedy. As such a state of affairs does not occur very often, it is not of much importance. It has been found by those using pumps in the Pittsburg region that a pump operating a well in a locality where the rock pressure is very low may exhaust all wells within a radius of, say, a mile; for in some cases the suction at a well several hundred feet away has been sufficient to draw a bat into it, thus showing clearly the economic value of a pump to the one operating it.

NATURAL GAS IN ONTARIO.

In Ontario two natural-gas fields, both on the north shore of Lake Erie and some 150 miles apart, are recognized. The extent of these fields is known in part only, as the borings have not been over sufficient territory to clearly define their limits. These fields are called, though the names are not accurately descriptive, the Essex and the Haldimand-Welland fields, from the counties in each field where the most gas is found. Essex county, from which one field takes its name, is the extreme western county in Ontario, at the western end of Lake Erie, and has as its southern boundary Lake Erie, its western the Detroit river, and its northern Lake Saint Clair. The Haldimand-Welland field includes the two counties at the extreme eastern end of Lake Erie, having as their southern boundary Lake Erie, their eastern the Niagara river, and their northern Lincoln county, which borders on Lake Ontario.

The Essex field.—The natural-gas discoveries in the Findlay field, Ohio, led to the exploration of the Essex county field. It was demonstrated that the Cincinnati arch, the great storehouse of the limestone gas, extended under Lake Erie and the western counties of Ontario and Manitoulin islands to Lake Huron, and perhaps beyond. Dr. Robert Bell, in a paper on the petroleum fields of Ontario, read before the Royal Society of Canada, stated that as the result of careful study he had come to the conclusion that this great arch maintains its northward course and runs into the southern extremity of Lake Huron. As the result of this belief in the northward extension of the Cincinnati anticlinal and of the results obtained at Findlay, Ohio, explorations for gas were undertaken in the Essex county field. The first well was put down in Gosfield by the Ontario Gas Company, in January, 1888. While negotiations were in progress for supplying Kingsville with gas, disputes arose between the members of the company and the enterprise came to naught. In May, 1889, a well was bored on the lake shore at Kingsville, but no oil or gas was obtained. In the meantime the Ontario company had leased all the farms in what was considered the gas field, and demanded such terms for a supply of gas as the people of Kingsville declined to make, and in the spring of 1890 application was made to the town council for leave to bore on the public road, which was granted. The Ontario company sued out an injunction, which was dissolved after some two months' delay, the justice holding that gas was a mineral and that therefore the council was authorized to lease the highway for the purpose of mining it. This judgment was approved by the full court. Boring was resumed, and gas was struck in August, 1890, at a depth of 1,025 feet, in what is believed to be the Clinton limestone. Gas was also found in small quantities and light pressure at a depth of 800 feet. The gas at the lower depth is found, so it is claimed, at a pressure of 500 pounds. It is piped to the village of Kingsville through a 3-inch service pipe. The production is stated to be 9,000,000 cubic feet a day. This same well also furnishes a supply to the village of Ruthven. About nine-tenths of the dwellings, factories, and places of business in both villages are supplied.

No. 3 well was drilled in January, 1891. It is three-quarters of a mile from No. 2. A small vein of gas was found at 700 feet. At 1,114 feet a strong vein of salt water was struck. In No. 4 well gas was found at a depth of 1,030 feet. It was drilled 33 feet deeper in hopes more gas would be secured, but the flow was not increased. The measured production of this well is 2,231,000 cubic feet. These small wells supply some 350 cook stoves, 175 heating stoves, 25 house furnaces, besides open grates, lights, etc., a woolen mill, grist mill, sash and door factories, turning factory, churches, halls, etc. The rates for cook stoves are $1.50 a month each month of the year; heating stoves, $1.50 a month for seven months; furnaces, $2.40 per month for seven months; open grates when furnaces are used, 75 cents per month, and if furnaces are not used, $1.50 per month, for seven months in both cases. Several other wells have been bored in the vicinity of Kingsville, but gas has not been found in any of them.

Natural gas has been found in small quantities for some thirty years in the deep Glacial Drift in Kent county, the next county east of Essex on the lake shore. Several wells which were sunk for petroleum have given surprising yields of gas from the sand beds of the drift. These supplies of gas have been found particularly along the base and on both sides of a high ridge which extends in a southeasterly direction through the townships of Orford, Howard, and Harwich, and reaches to the lake shore 3 miles west of Blenheim. As the result of the gas strike at Kingsville, deep borings were undertaken at several points along the course of the ridge. In no one of the deep wells was gas found, though shallower gas was struck in a number of wells repeating the experience of years ago in this district. Indeed, the record of shallow gas wells along this ridge is interesting. As early as 1867 gas was found at the depth of 100 feet near Middle Road. In other wells since this date and at a number recently it has been found at the depth of from 60 to 180 feet. From these wells supplies in small quantities for domestic use can usually be depended upon, but no considerable amounts can be found.

The Haldimand-Welland field.—While the Essex field has given one small area in which some good, deep gas wells have been struck, the largest gas producing area is at the eastern end of Lake Erie in the counties of Haldimand and Welland. This field extends from the Grand river at Cayuga, in Haldimand county, to the village of Bertie, near the Niagara, in Welland county, a distance of some 42 miles. The producing belt varies from 1 to 2 miles in breadth and lies nearly parallel with Lake Erie. The gas is found at a depth of some 750 to 800 feet, 200 feet higher than in the Essex field, and chiefly in the Medina sandstone. The supply is abundant. It is piped to Buffalo, New York, as the chief point of consumption.

Gas has been known to exist in the neighborhood of Port Colborne for a quarter of a century. In 1866 it was struck at a depth of 420 feet in a well at Humberstone bored for oil. The flow has kept up until the present, though intermittently. It was at Port Colborne and in 1885 that the first well seeking natural gas was drilled in Ontario. It was bored to 1,500 feet and abandoned. Sulphur gas was struck at 432 feet and a good flow at 763 feet. Though water interfered with the supply, some 7,000 feet a day are secured and used. Other wells have been drilled in Port Colborne, but only small amounts of gas have been obtained.

A number of wells have been bored at the village of Humberstone, on the Welland canal, a mile north of Port Colborne, and where gas has been found the flow has been greater and the pressure stronger than at Port Colborne. In Near's well the greatest flow of gas was obtained at a depth of 683 feet. The yield was 500,000 feet a day at a pressure of 375 pounds. In October, 1891, there were 105 houses supplied by this well. The Morning Star well found gas at 666 feet and

798 feet. The Port Colborne Natural Gas Company has three wells at Humberstone. In one of these gas (100,000 cubic feet a day) was found at 685 feet. Another yields 500,000 feet, while the largest well is stated to have a pressure of 365 pounds, and to yield 1,500,000 to 2,000,000 feet a day. Gas was struck in this well at 690 feet. This company has some 7 miles of service pipe, and supplies some 200 consumers.

At Wainfleet, in 1889, a gas well was bored at the lime kiln of Mr. John Reeb. Sulphur gas sufficient to run one kiln was struck at a depth of 456 feet, and pockets of gas all the way down to the Medina, which was encountered at 823 feet. The greatest flow was in the Clinton, at 685 feet. The well pressure is stated to be 230 pounds. It furnishes gas sufficient to run two kilns, with a producing capacity of 720 bushels a day, for three boilers, besides light and fuel for six dwelling houses.

The largest operations in the Haldimand-Welland field are those of the Provincial Natural Gas and Fuel Company of Ontario. This company, whose first trial was at Bertie, 7 miles east of Port Colborne, has explored by borings an area 28 square miles. The largest supplies of gas are from wells near Humberstone. In the first well gas was struck at 846 feet. Drilling began by the company in 1889. In that year 5 wells were finished, and by the close of 1891 18 wells had been drilled, and 6 others were in progress. Of these, 3 had been abandoned, though some gas was found in them all. In some of these wells gas has been found in the Clinton, but in all the greatest flow has been from the Medina sandstone. Small quantities of the gas produced by this company are supplied to consumers near the wells, but the great bulk of it is supplied to the Buffalo Natural Gas Fuel Company. The supply of gas which this fuel company obtained in Pennsylvania failing in whole or in part, connection was made in January, 1891, with the wells of the Provincial Company. The Buffalo Company charges 25 cents per 1,000 feet delivered to consumers, of which the Provincial Company receives 50 per cent. An 8-inch main has been laid to the Niagara river. The lines from the wells to this main are 2 to 6 inches. The rock pressure is stated to be 500 to 550 pounds, and the yield per well 300,000 to 12,500,000 cubic feet. The average of 15 wells is stated to be 2,500,000 feet per day.

Other wells have been struck at Humberstone. Carroll Brothers struck a well in March, 1890, which yielded 2,000,000 feet a day. A little later a second well, equally strong, was drilled. In addition to these, 4 other wells were drilled, and in August, 1891, the firm united with the Erie County Gas Company for further development of the territory and the piping of the gas to Buffalo. Three additional wells have been put down, 2 productive, and a line laid to Buffalo. The Bertie Natural Gas Company, organized February, 1891, struck gas June 8 in the Clinton at a depth of 725 feet and at 785 feet in the Medina. The best flow was at 840 to 850 in the Medina. The gas from the Clinton and Medina is delivered through separate pipes. The Niagara Falls Natural Gas, Fuel and Light Company, which was organized in the spring of 1889, recorded a failure at its first and second wells drilled in Drummondville. It renewed operations, however, in the spring of 1891 in Humberstone. Its first well here was drilled just west of that of Carroll Brothers, gas being found in a bed of sandstone 21 feet thick at a depth of 860 feet. The yield of gas was estimated at 1,000,000 cubic feet a day, with a rock pressure of 590 pounds. Its second well was finished the 3d of October, gas being found here also in sandstone. It is claimed that the capacity of this well is 5 times that of the first well.

In 1891 two companies were formed for prospecting for gas in the town of Welland. Each of these companies bored a well during the summer with but little results. Gas was found in the Clinton in both cases, but the supply was small and the wells were abandoned. In April of 1891 a company was organized at Dunnville. Gas was found in the well drilled here in the Clinton at a depth of some 612 feet. The larger amount, however, was found in the Medina sandstone at a depth of from 740 to 752 feet, the strongest flow being at a depth of 747 feet. This well was finished on the 22d of August, the yield being estimated at 150,000 to 200,000 cubic feet. Second and third wells were drilled with about the same result. In the fall of 1891 arrangements were made to put down test wells near Cayuga. The wells were completed on the 16th of January, 1892. Gas was found at three levels—in the Clinton limestone, and in the red Medina and the white Medina sandstones. The daily yield was estimated at 210,000 cubic feet.

New Toronto field.—Natural gas has been discovered in New Toronto, one of the suburbs of Toronto, near the old village of Mimico. The remarkable fact about this discovery is that gas was found here at all. Toronto is nearly due north from Port Colborne and Humberstone, the important natural-gas districts in the Haldimand-Welland field just described. In putting down artesian wells for a supply of water for the Mimico Asylum for the Insane, some flows of gas were met with at various depths. Dr. Bell, of the Geological Survey, to whom the log of the well bored in 1889 was submitted, gives his opinion that the Utica was struck at 575 feet and the Trenton at 725 feet. The supply was small, and though the well was shot, there was no apparent increase of flow.

The syndicate of real-estate operators who founded the town of New Toronto took steps late in 1891 to put down a deep well. The well was drilled to the depth of 1,312 feet, when it was concluded that the quest for deep gas was hopeless. Moderate flows of gas were found, according to the report, at 780, 885, and 1,089 feet. This well was also shot at three different levels, with the result that the flow of gas was somewhat increased. The amount of gas, however, is exceedingly small, the pressure being not over 45 pounds.

From the above statement it will be seen that the chief sources of gas of a commercial charactor in Ontario are the wells in the neighborhood of Humberstone and Port Colborne, from which a large amount of gas is produced, which is piped to Buffalo, and from Essex county, in the neighborhood of Kingsville, from which gas is piped to both Kingsville and Ruthven. The latter district, so far as explorations had been conducted up to the close of 1891, showed a moderate supply of gas, sufficient to furnish domestic consumers and small manufacturing establishments in these two villages. In the neighborhood of Humberstone, however, a very large production has been secured, as is evidenced by the fact that the gas from this section has been piped to Buffalo, taking the place of the supply which Buffalo had heretofore secured from the upper Pennsylvania gas fields, especially from the neighborhood of Bethlehem. The value of these natural-gas deposits, especially that near Humberstone, is in this fact, that they supply such large amounts of gas to consumers at Buffalo.

CHINA.

Annales des Mines, vol. XIX, 1891, describes in detail the brine and gas wells of the province of Sze Chuen, in western China. This produces annually, as nearly as can be estimated, there being no regular statistics, about 812,000 tons of salt, which is entirely derived from borings, the salt being accompanied in places by petroleum and natural gas, the latter being utilized for boiling down the brine. The most important centers of production are in a district about 80 square miles in extent, about 25 miles northwest of the town of Fou Chouen. The geological structure of the district appears to be somewhat complicated, but, according to the author, a complete succession from Cambrian up to Tertiary and post-Tertiary strata, which is recognizable in the following order:

Stratigraphy of the Sze Chuen gas fields, China.

	Meters.
Yellow sandstone Tertiary	38 to 100
Red sandstone Gray limestone Ferruginous oolite, often with bituminous springs at	200
Blue and yellow sandstone, Lias	270
At this level gas is found sometimes in small quantities.	
Blueish gray marl White limestone, Permian	330 to 600
These strata yield brine of a yellowish color and medium saturation (10 to 15 per cent of salt).	
Sandstone and limestone with coal	Carboniferous.
Brown shining shale	Silurian.
Black schist	Roofing slates.
Green schist	Cambrian.

Dark-colored brine, of the higher strength of 15 to 28 per cent. of salt, is found below the last-mentioned strata at depths varying from

930 meters to 1,100 meters, as well as the most important gas springs. As a rule, the upper yellow brine-bearing beds are not found in these deep borings.

The system of boring is percussive, the cutting tool and sliding piece, weighing from 200 pounds to 300 pounds, being suspended by a rope, and lifted about 2 feet at a stroke, by a lever worked by groups of coolies acting as dead weight. According to the depth, from two to ten men are required to lift the tool from twelve to fifteen times a minute, the gangs being relieved at intervals of ten minutes. The cutting tool has eight steel-faced teeth, but without grooves, so that the detritus accumulates at the bottom of the hole. This is removed by a sludger, consisting of a cylinder of wood covered with deep notches arranged ladderwise, which is lowered into the hole and moved about by a jerking motion on the rope until the grooves are filled with the sludge. Usually a pit is sunk by hand to a depth of about 100 feet from the surface, and lined with blocks of stone before the actual boring is commenced. The diameter adopted is from 9 to 12 inches, which may be contracted to 6 or 7 inches when it is necessary to line the hole through loose ground. The lining tubes are either large bamboos bored out or are built up of half trunks of cypress trees fitted together by swallow-tailed joints, which are covered by hempen cloth, water-proofed with a paste of lime and oil. This first covering is protected by a close serving of cord, with a thicker layer of the cement over all, the total thickness of the structure being but little less than the diameter of the hole. According to the nature of the ground, the length of these casing tubes may vary from 10 to 300 feet; but when more than 20 feet are required in one length, the high derrick must be provided. This is made up of two legs of timber 40 feet to 50 feet high, with two diagonal struts, and a multiplicity of guy ropes, the use of iron being restricted to a minimum. As may be imagined, the progress of the work is very slow, varying from a few feet per day in loose ground to an inch or less on very hard rock. Some of the deeper wells have taken from twenty to forty years in sinking, and have ruined several sets of adventurers in succession. The deepest actual boring, 1,160 meters, has never yielded anything. Some three or four holes are above 1,000 meters deep, but the greater number are between 530 and 930 meters, in the Tsze-liu-tsing group. In the Kong-tsin group they vary from 330 to 660 meters as the most general depth, the shallowest being about 200 meters. The accidents to which the borings are liable and the method of remedying them are treated at length by the author, with illustrations of the tools employed from Chinese drawings. These are generally similar to those adopted in Europe; but the construction is very different in principle, bamboo and string entering very largely into their composition instead of metal. As a last resource, the method of pulverizing a lost tool is adopted and carried out with incredible patience. The removal of a tool weighing 300 pounds, in this manner, required about five years' continuous work, night and day, of thirty-two men, at a cost of about £3,000.

The brine is brought to the surface by tubular buckets of bamboo, with a foot valve varying from 2 to 6 inches inside diameter, and from 16 to 140 feet in length. For the latter size, used in the deepest wells, derricks for 90 to 120 feet are required, the highest in use being 164 feet. These are built up of beams of timber lashed together with bamboo ropes, and cost from £800 to £1,000. The bucket is lowered and lifted by a flat rope 20 millimeters broad and 5 millimeters thick, formed of slips of bamboo united by hempen cords, winding upon a gin which is usually drawn by buffaloes, two, four, or six of these being required, according to the depth of the well; but in the shallower ones the lifting is sometimes done by a windlass worked by from two to six men tread-mill fashion. The load upon the rope in the deeper wells in some cases exceeds 30 hundredweight, corresponding to a stress of 9½ tons per square inch. The quantity of brine raised at each lift varies from 116 liters (25½ gallons), with the smallest bamboos, to between 620 and 950 liters (136 to 200 gallons) with the larger ones, and under the most favorable conditions from two to four lifts may be made per hour, according to the depth. When the bamboo is raised to the surface, a cover is pushed over the top of the bore hole, the valve is lifted by the lander with an iron hook, and the brine runs into a reservoir. The product of the deep wells is very dark-colored, and often emits sulphuretted hydrogen in sufficient quantity to be dangerous to the workmen about the top of the pits if it is incautiously inhaled. In addition to salt, some of the wells yield petroleum and gas in variable quantity, the former is skimmed off from the surface of the water after it has been allowed to settle in the reservoirs. The product varies in quality from a pure white-burning oil to yellow, greenish, and black kinds of low illuminating power, and giving much smoke. All are, however, burned; as the Chinese have no knowledge of petroleum-refining.

The wells being generally away from the salt works, the brine is carried to the latter either by hand, when the journey is short, or by conduits made of bamboos, with chain and bucket-lifting wheels for overcoming intermediate differences of level, when a greater distance has to be traversed. The boiling down is done in shallow cast-iron pans about 4 feet in diameter, and 1.7 inch deep in the center. The thickness varies from 1½ inch in the center to 1 inch at the edges, and the weight is about 1,000 pounds. The heating may be done by straw, wood, coal, or natural gas. The operation lasts from twelve to twenty-four hours, according to the intensity of the fire, and yields about 100 pounds of salt.

In the district of Fou Chouen, where natural gas wells are principally found, from 600 to 1,200 pans may be heated by a single well. The principal supply is obtained from depths of not less than 670 meters. It is mainly marsh gas, being less carburized than that obtained at shallower levels, which burns with a tolerably white flame, but is only got in small quantities. The top of the well is inclosed to a depth of 10 feet by a wooden casing, as nearly tight as possible, and the gas is led by bamboo pipes into cemented reservoirs with domed roofs formed by inverted salt pans. From these reservoirs the distribution of the gas is effected by means of bamboos leading to the pans, a short length of iron pipe being attached to the end of each line. The actual burner is a perforated block of stone of a conical form about 1 foot high; the gas is introduced by a lateral pipe at the bottom, and mixing with air is burned at the top of the block over which the pan is placed.

The whole arrangement is very primitive and imperfect, nothing of the nature of a stop valve being used anywhere on the line of pipes. When the workman wishes to extinguish the flame, he places a brick on the top of the burner; but the gas continues to flow without interruption, and disperses in the atmosphere. As, however, the work is done under open sheds, there is not much danger of explosions; but the smell of the gas is very prejudicial to the health of the workmen.

The salt pans are usually built by the proprietors of the gas wells, who leases them to salt makers at a rental of about £32 per annum. The yield to the proprietors is therefore large, but the duration of the gas is very uncertain.

ASPHALTUM.

By E. W. PARKER.

The total output of bituminous rock in California in 1891 was 39,962 short tons, worth at the point of production, exclusive of cost of transportation, $154,164. Kentucky produced 3,360 tons of bituminous rock, worth $2 per ton at the mines. The amount of gilsonite and bituminous limestone from Utah was 1,732 short tons, worth $82,100. It has been customary to give the value of gilsonite at St. Louis, to which city the product is shipped for sale and manufacture. This custom has been adhered to in this report. The bituminous limestone was sold in Salt Lake City, and the value of this portion of the product has been taken at its selling price in that city. We have then, as the total value of the asphaltum products in 1891, $242,264, an increase of $51,848 over the value of the product in 1890.

The bituminous rocks of California and Kentucky do not materially differ. It is in each case a sandstone impregnated with bitumen, the value being determined by the amount of pure bitumen contained. This product is used principally for street paving, for which comparatively little preparation is necessary.

Considerable attention is being paid to the bituminous sandstones of California. Several of the mining companies have pooled their interests, looking to the development of the best of the many properties, to the further introduction of the material in the arts and manufactures, and maintaining the industry upon a profitable and satisfactory basis.

The consumption of California bituminous rock must, however, remain restricted to a practically local community until such arrangements can be made with transportation companies as will admit of its being brought into competition with Trinidad and other foreign asphaltum in the Eastern market. The condition of the Kentucky product is as yet undetermined, the product for 1891 having been experimentally used for street paving. If proved satisfactory it will probably find a good market in Louisville, Cincinnati, and adjacent cities. The California rock is used largely in San Francisco, Oakland, Los Angeles, etc., but owing to difficulty and expense of transportation reaches no market distant from the coast.

The form of asphaltum which has been styled "lithocarbon," and said to be found in great quantities on the line of the Southern Pacific Railroad in Texas, is still a matter of technical interest, as press notices from time to time indicate. It has not been shown, however, that any active steps are being taken to develop the property and place the mineral on the market. If all that is claimed for it be true there should be small delay in getting it before the country.

The following table shows the annual product of asphaltum and bituminous rock since 1882:

Production of asphaltum and bituminous rock since 1882.

Years.	Short tons.	Value.
1882	3,000	$10,500
1883	3,000	10,500
1884	3,000	10,500
1885	3,000	10,500
1886	3,500	14,000
1887	4,000	16,000
1888	50,450	187,500
1889	51,735	171,537
1890	40,841	190,416
1891	45,054	242,264

Imports.—The amount of asphaltum imported continues to be largely in excess of the domestic production. The island of Trinidad furnishes the greater portion of the supply, 71,112 tons of the 102,433 tons imported during 1891 being from that source. The remainder of the imports are made up of bituminous limestone from Sicily, Germany, Switzerland, and France, and a small amount of asphaltum from Cuba.

Asphaltum imported into the United States from 1867 to 1890.

Years ended—	Quantity.	Value.	Years ended—	Quantity.	Value.
	Short tons.			*Short tons.*	
June 30, 1867	....	$6,268	June 30, 1880	11,830	$87,889
1868	185	5,632	1881	12,883	95,410
1869	203	10,559	1882	15,015	102,698
1870	488	13,072	1883	33,116	149,999
1871	1,301	14,760	1884	36,078	145,571
1872	1,474	35,533	Dec. 31, 1885	18,407	88,087
1873	2,314	38,298	1886	32,565	108,528
1874	1,183	17,710	1887	30,808	95,735
1875	1,171	26,006	1888	36,494	84,045
1876	807	23,818	1889	61,952	138,163
1877	4,532	36,550	1890	73,861	223,368
1878	5,476	35,932	1891	102,433	299,350
1879	8,084	39,635			

As stated above, 71,112 tons of the asphaltum imported in 1891 were from Trinidad. The most of this was used for street paving, the number of square yards of Trinidad asphaltum laid during the year by all companies being 2,141,049, an increase of nearly 300,000 square yards over 1890, when the amount of paving laid was 1,857,000 square yards. To further illustrate the growth of this industry the following tables, showing the total amount of Trinidad asphaltum imported and the number of square yards of paving laid annually since 1880, are given:

Imports of Trinidad asphaltum by all companies from 1880 to 1891, inclusive.

Years.	Long tons.	Years.	Long tons.
1880	3,913	1887	26,593
1881	6,707	1888	35,137
1882	14,263	1889	52,881
1883	23,309	1890	54,692
1884	19,630	1891	71,112
1885	15,289		
1886	27,757	Total	351,283

Pavements of Trinidad asphaltum.—The number of square yards of Trinidad asphaltum laid in the United States in the past eleven years is as follows:

Number of square yards of Trinidad asphalt paving laid in the United States from 1880 to 1891, inclusive.

Years.	Square yards.	Years.	Square yards.
1880	106,838	1887	799,335
1881	116,629	1888	757,101
1882	196,184	1889	1,130,863
1883	387,510	1890	1,857,000
1884	424,524	1891	2,141,049
1885	403,882		
1886	623,188	Total	a8,944,103

a Equivalent to 586 miles of roadway 26 feet wide.

Trinidad asphaltum is being used for street paving in the fifty-nine cities in the United States and Canada named in the following list:

Cities where Trinidad asphalt pavements are used.

Washington and Georgetown, District of Columbia.
Denver, Colorado.
Savannah, Georgia.
Chicago, Cicero, and Peoria, Illinois.
Fort Wayne and Indianapolis, Indiana.
Topeka, Wichita, and Wyandotte, Kansas.
Covington, Louisville, and Newport, Kentucky.
New Orleans, Louisiana.
Baltimore, Maryland.
Boston, Massachusetts.
Detroit and Grand Rapids, Michigan.
Minneapolis and St. Paul, Minnesota.
Kansas City, St. Joseph, and St. Louis, Missouri.
Omaha, Nebraska.
Long Branch and Newark, New Jersey.
Albany, Amsterdam, Binghamton, Brooklyn, Buffalo, Dunkirk, Lockport, Long Island City, New York, Rochester, Schenectady, Syracuse, Troy, and Utica, New York.
Cincinnati, Cleveland, Columbus, Toledo, and Youngstown, Ohio.
Allegheny, Altoona, Erie, Harrisburg, Philadelphia, Pittsburg, Scranton, and Wilkesbarre, Pennsylvania.
Newport, Rhode Island.
Chattanooga, Tennessee.
Montreal and Toronto, Canada.

In eleven of the above cities the Trinidad asphalt paving was laid for the first time in 1891. These cities were: Denver, Colorado; Cicero and Peoria, Illinois; Covington and Newport, Kentucky; Grand Rapids, Michigan; Minneapolis, Minnesota; Long Branch, New Jersey; Amsterdam and Dunkirk, New York; and Newport, Rhode Island.

Sicilian asphaltum.—Mr. C. S. Chamberlin, secretary of the Sicilian Asphalt Paving Company, of New York, reports that his company imported into the United States during 1891 5,000 tons of crude bituminous limestone from Sicily and 1,500 tons from Germany, and estimates that the amount of bituminous limestone imported by other parties was about 500 tons.

The following pavements made from a mixture of Sicilian and German bituminous rock have been laid up to the close of 1891:

	Square yards.
1886 to 1891, at Rochester, New York	58,390
1886 to 1889, at St. Augustine, Florida	30,000
1889 to 1891, at New York, New York	84,599
1890, at Allegheny, Pennsylvania	6,011
1891, at Philadelphia, Pennsylvania	1,576

Of these there were laid in 1891 at Rochester, New York, 10,000 square yards; in New York city, 49,335 square yards, and in Philadelphia, 1,576 square yards, a total of 60,911 square yards.

STONE.

By William C. Day.

The year 1891 has been a comparatively dull one for the stone industry. There appears to have been less building done than usual, particulary in New York, as well as in other large cities. Labor troubles have been the cause of diminished output in particular places, but they have not interfered with production to an extent at all comparable with their effects in the early part of the present year (1892).

General depression in finances seems to have been felt in every productive State, and while in some States an increase (in some cases quite remarkable) is to be noted, it is fair to assume that the advance would have been much greater but for the obstacle named above. Small producers have been driven out of business by the score, and as a consequence it has been a good year for concerns with large capital to acquire new quarry property at reasonable figures.

Prospects for a large output in 1892 are, in general, referred to as good, or at least much better than in 1891.

While considerable quarry property has changed hands, by either sale or lease, actual new developments have not been numerous, and the state of business did not call for much prospecting for new discoveries.

The effects of overproduction in certain branches of the stone industry have been severely felt by producers. This is particularly true of granite in the form of paving blocks and of lime at a number of important centers.

The following tabular statement shows the total value of the different kinds of stone produced in the United States in 1891:

Production, by kinds, of stone for the year 1891.

Granite	$13,867,000
Sandstone	8,700,000
Limestone	15,792,000
Marble	3,610,000
Slate	3,825,746
Bluestone	1,500,000
Total	47,294,746

GRANITE AND ALLIED ROCKS.

Production.—The value of the granite product of the United States in 1891 was $13,867,000. This figure falls somewhat below that for the census year 1889, although it represents an increase as compared with

1890. The latter part of the season of 1891 has been referred to by producers generally as dull; demand for stone fell off and prices declined while wages remained unchanged in most cases.

The paving-block industry particularly shows a falling off; this was in part due to over production in 1890. The larger cities are becoming more critical as to the sizes and quality of the blocks, so that it seems to be quite generally conceded that there was very little money, comparatively speaking, in the manufacture of blocks. Inasmuch as the production of paving blocks requires no refined skill comparable to that involved in the production of fine building and ornamental stock, the depression in this branch of the industry has been felt keenly by many of the smaller concerns having no great amount of capital invested. Many of them have suspended operations and others have sold out and quit the business. There has been, moreover, not a little trouble with labor, although this was not serious by comparison with that which broke out in the early part of the present year, 1892.

In the production of building and ornamental stock the industry seems to have progressed almost normally in spite of the fact that in New York city, and probably also in others, the amount of building done in the last two years is somewhat below the average.

In a number of States in which granite quarrying is a comparatively new thing large percentage gains in production have been revealed, but most of these have been due to greatly extended operations on the part of a few wealthy and enterprising corporations rather than to an increase in the number of individual concerns. The present year opened with encouraging prospects, but the labor troubles, which began early in the season, will undoubtedly curtail production to a very serious extent.

The following table shows the distribution of the year's output among the productive States:

Production of granite in 1891, by states.

Arkansas	$65,000	New York	$225,000
California	1,300,000	Oregon	3,000
Colorado	300,000	Pennsylvania	575,000
Connecticut	1,167,000	Rhode Island	750,000
Delaware	210,000	South Carolina	50,000
Georgia	790,000	South Dakota	100,000
Maine	2,200,000	Texas	75,000
Maryland	450,000	Vermont	700,000
Massachusetts	2,600,000	Virginia	300,000
Missouri	400,000	Wisconsin	406,000
Montana	51,000	Total	13,867,000
New Hampshire	750,000		
New Jersey	400,000		

The following is a consideration of the industry in the various productive states:

Arkansas.—Quite a large percentage gain has been made in this State, although the total output is small. Future prospects are encouraging. The productive quarries are in the vicinity of Little Rock.

California.—The granite output of 1891, valued at $1,300,000, failed to reach the figure of the census year and was also lower than that for 1890. Less demand and lower prices are reported by the majority of the producers. The figure above given includes the estimated value of the granite produced by the State prison and the Folsom Water Power Company at Folsom City. This product is estimated at a value of about $500,000 and was used entirely in the construction of a dam and a canal for the purposes of power and irrigation. The Folsom Granite Company has been incorporated, with the intention of working the quarries of the Folsom Water Power Company as soon as the latter shall have finished the canal on which they are engaged.

The production of basalt paving blocks in Sonoma county showed the effects of overproduction in the two years previous.

Colorado.—Although the subject of the development of stone quarries is thoroughly and persistently agitated in the daily and technical papers of the State the limited transportation facilities afforded will doubtless prevent for some time to come anything like a vigorous development of the valuable granite which occurs in abundance.

Connecticut.—The value, $1,167,000, represents a small gain in production over the census year. The product is largely used for general building purposes.

Delaware.—While the granite output of the State is not large, being valued at only $210,000, it is nevertheless true that some of the quarries, notably those nearest Wilmington on the Brandywine, are exceptionally well equipped. The latest improvements for handling stone are in use, as well as machines for splitting large blocks. In this respect these quarries are ahead of many more productive quarries in the New England States.

Georgia.—Owing to increased production on the part of a few of the larger concerns in this State the output of granite has been larger than in any previous year. On account of the cheapness of unskilled labor and the ease of quarrying at Stone Mountain and Lithonia the granite business in these localities appears to have been profitable and to justify expectations of continued prosperity in the future.

Maine.—In this State the output did not quite equal that of the census year. The product in 1889 was about equally divided between general building purposes and street works. In fine stocks, such as cut stone and polished products, business seems to have increased over that of 1890, but the paving-block production seems to have suffered from depression in prices, while at the same time wages have been for the most part unchanged. Furthermore, the larger cities are beginning to be more critical as to the uniformity of size and the quality of the blocks. As a result of this condition, probably brought about by over-production in 1889 and 1890, not a few of the producers report that there is no money to be made in paving blocks at the present time. Labor troubles have also made themselves felt in a number of places, although difficulties in this direction bear no comparison with those which manifested themselves early in the present year.

Maryland.—Production in 1891 was somewhat ahead of that in 1890 and also in 1889. The output is about equally divided between Baltimore and Cecil counties.

The finest stone is that taken from quarries at Port Deposit, which has a high reputation as a building stone and is somewhat remarkable for the comparative ease with which large blocks may be quarried.

Massachusetts.—In general, business was better than in 1890, but in the last few months of 1891 it appeared to be quite dull.

Demand for ordinary building stone seemed to be somewhat better than for finished products. The production of paving blocks in this State is on a much smaller scale than in Maine, so that the depression in the paving-block trade was much less felt.

Minnesota.—Considerably extended operations on the part of 1 of the 23 active quarries in the State resulted in quite an increase in the output for the year.

Missouri.—The paving-block industry suffered a noticeable depression, but the demands for building granite exceeded that of 1890. The most extensive quarries are at Graniteville, in Iron county; they are quite well equipped, as are also those at Granite Bend, in Wayne county.

New Hampshire.—The product in 1891 was valued at $750,000; this figure represents an increase over 1890, although the gain is a small one.

New Jersey.—A considerable proportion of the output of this State is trap rock, which is largely used for street and road work. Comparatively little of the stone goes for general building, but is largely consumed as stated above and for bridge and railroad construction.

New York.—The value of the output in 1891 is very slightly above that for 1890. Most of the stone goes for general building purposes. The paving-block trade suffered in the same way as in other States which contribute to the supply of New York city.

North Carolina.—Granite-quarrying in this State has a promising outlook and particularly in the vicinity of Salisbury, Rowan county, do the prospects appear to be encouraging. The stone appears to be of fine quality, adapted to polished and ornamental work. The following firms have more or less recently commenced operations at Salisbury: The Granite Millstone Manufacturing Company, the Pink Granite Company, the Pearce Granite Company, the J. D. H. Fisher Granite Company, the Salisbury Granite Company, and the Stone Mountain

Granite Company. There are also good prospects at Mooresville, Iredell county, where the stone appears to be attractive in quality for ornamental products and is easily worked. Increased capital appears to be the thing needful.

Pennsylvania.—While the output in this State amounts in value to $600,000 it can not be said to exert much more than a comparatively local influence. While good building granite is quarried in a number of localities, the great bulk of the State's product goes for street and road purposes, while slightly more than one-fifth is devoted to general building. The amount quarried fell below that of the census year.

Rhode Island.—Granite quarrying in this State was hampered in 1891 by more or less trouble among the granite-workers.

At Westerly a large amount of finished monumental work is done, and the strikes which occurred in the spring of the present year will make a sad inroad upon the activity of 1892.

Vermont.—Substantial progress has been made in this State during the past two years. The most important advances have been made at Barre, and a marked increase in production has characterized both 1890 and 1891. The quality of the Barre granite is such that most of it is used for monumental purposes, and, judging by the increasing demand for it, its popularity seems to be well established, although the operations at Barre have all been built up in the last twelve years. Labor troubles in 1891 interfered to some extent with production, although they were hardly a serious drawback.

Virginia.—The output for 1891 was valued at $300,000; this figure falls below the total reached in 1889.

The Southern Granite and Marble Company was organized in the fall of 1891 to operate granite and marble quarries in a property of 300 acres about 6 miles from Roanoke.

SANDSTONE.

Production.—The total value of the sandstone output in the United States for the year 1891 is $8,700,000, while the corresponding figures for the census year 1889 were $10,816,057.

Depression in demand and prices is reported from the great majority of producers in every productive State. The increase in production in Ohio, the leading State, is almost entirely due to the extended operations of the Cleveland Stone Company, while the notable increase in Wisconsin is due to comparatively new enterprises in that State. The decline in business has been keenly felt by the smaller producers, many of whom have suspended operations or sold out permanently.

The following table shows the distribution of the output:

Production of sandstone in 1891, by States.

Alabama	$30,000	New Jersey	$400,000
Arizona	1,000	New Mexico	50,000
Arkansas	20,000	New York	500,000
California	100,000	North Carolina	15,000
Colorado	750,000	Ohio	3,200,000
Connecticut	750,000	Pennsylvania	750,000
Illinois	10,000	South Dakota	25,000
Indiana	90,000	Texas	6,000
Iowa	50,000	Utah	36,000
Kansas	80,000	Virginia	40,000
Kentucky	80,000	Washington	75,000
Maryland	10,000	West Virginia	90,000
Massachusetts	400,000	Wisconsin	417,000
Michigan	275,000	Wyoming	25,000
Minnesota	290,000		
Missouri	100,000	Total	8,700,000
Montana	35,000		

The following is a brief consideration of the individual productive States:

Alabama.—The value of the product is less than in the census year 1889. The general depression in the business which has shown itself during the past year in nearly every State accounts for the diminished output.

Arizona.—Sandstone is quarried at Tempe and Prescott. The product of the latter locality is shipped chiefly to Denver and Los Angeles. A branch of the Atlantic and Pacific railroad runs to the quarries. The work is so recent an undertaking that as yet no large output has been secured.

Arkansas.—The output of 1891 did not amount to so much as in 1890. It was used chiefly for curbing and flagging, and to a less extent for building.

California.—Sandstone quarrying was for much of the year at a low ebb. The product for 1891 was valued at only $100,000, while that of the census year amounted in value to $175,598.

Colorado.—In 1889 the sandstone output was valued at the remarkably high figure $1,224,098. The two years following have been exceedingly dull by comparison, the value for 1891 amounting to only $750,000. Demand for stone was so poor that quite a large number of quarries shut down altogether for both years. Nearly all the producers, however, report the early part of 1892 as very encouraging in outlook.

Connecticut.—Sandstone quarrying in this State is so old and well established a business and the product is so well and favorably known that such a thing as financial disaster, such as has visited many producers in other regions of the country, is here almost out of the question. The product of 1891 did not, however, reach the figure attained in the census year, being $750,000 for 1891 or more than $100,000 short of the value for 1889.

Labor troubles and distrust in the money market are referred to by producers as causes for the decline in production. Practically all the sandstone of the State comes from Portland, Middletown, and Cromwell on the Connecticut river, in Middlesex county.

Illinois.—The sandstone output has never amounted to very much in this state; the value of the product in 1891 was $10,000, which is less than the corresponding figures for either 1889 or 1890.

Indiana.—There has been quite a marked increase in this State during the past two years, the product for 1891 being valued at $90,000.

The product of special interest in this State is that which comes from Orange county, inasmuch as it is well adapted to abrasive purposes and the demand for it is rapidly increasing. About one-half of the value of the output represents the value of whetstones.

Iowa.—The output was valued at $50,000 for the year 1891; this is $30,000 below the figure for 1889.

Kansas.—Production fell off very remarkably in 1891, amounting in value to only $80,000 or about $70,000 behind the figures of 1889. The product is used mainly for street work.

Kentucky.—In 1889 the output amounted in value to $117,000, but fell off to $80,000 in 1891.

Maryland.—Very little sandstone is produced in this state; the output for 1891 being valued at $10,000.

Massachusetts.—The product in 1891 was valued at $400,000, or about $250,000 behind the figures for the census year; business was universally reported as dull throughout the year.

Michigan.—The product in 1891 was valued at $275,000; this figure represents a gain of $30,000 as compared with 1889. The entire product is the result of quite extensive operations on the part of a few producing concerns. Much larger developments may be looked for in the course of a few years.

Minnesota.—The product of 1889 was valued at $131,979; that of 1891 at $290,000. This notable increase was due to the extensive operations of a single firm, and even greater results may be expected in a few years. The product was about equally divided between curbing and building.

Missouri.—Although the prospects for a satisfactory output in 1892 are good, the operations of 1891 failed to come up to those of 1889. The product of 1891 was valued at $100,000.

Montana.—While the value of the output in 1891 reached only the moderate figure $35,000, there are reasons for expecting quite an increase in a few years.

Nevada.—A small amount of stone was produced in the neighborhood of Carson City during 1891.

New Jersey.—The value of the output in 1891 was $400,000; this means a falling off of nearly $200,000 since 1889. The product is devoted mainly to building purposes.

New York.—The sandstone considered here does not include bluestone, as was the case at the tenth census. The value of the sandstone, exclusive of bluestone in 1889, was $702,419, but in the past year 1891 this figure fell to $500,000; the decrease is due simply to the general depression in the quarry business.

North Carolina.—The sandstone output has never amounted to much, although the outlook is better at present than ever before; the product of 1891 was valued at $15,000, a gain of $3,000 over 1889.

Ohio.—A gain of $153,000 in the value of the sandstone output in 1891, as compared with 1889, marks the progress which has been made in the last two years; the value of the output in 1891 was $3,200,000. A large advance in the product of the Cleveland Stone Company accounts for the State's increase. Quite a number of the smaller concerns failed to find the year a prosperous one, and many of them either suspended operations or sold out. The Cleveland Stone Company has added considerably to its property during the year and will probably show a much larger advance in 1882.

Pennsylvania.—Strikes in various localities, notably Pittsburg, interfered with the stone industry, and the product of 1891 was reduced from a value of $1,609,159 in 1889 to $750,000 in 1891. The demand for stone was slight all through the year.

South Dakota.—The product was valued at $25,000 for 1891. The prospects of an increased output in 1892 were good early in the year.

Texas.—The sandstone business in this state has never yet amounted to a great deal. The product in 1891 was valued at $6,000.

Utah.—A decrease in the amount of building done in Salt Lake City caused a falling off in the amount of sandstone produced. The product for 1891 was valued at $36,000.

Virginia.—Quite a gain in production has been made in this State since 1889. For the latter year the product was valued at $11,500, while for 1891 it amounted to $40,000. This gain was due to the operations of a few new firms who have commenced business since 1889.

Washington.—The sandstone product was valued at $75,000. The prospects for 1892 are very good. A fine grade of stone is quarried in Whatcom county.

West Virginia.—The value of the output in 1889 was greater by $60,000 than that of 1891; the value for the latter year was $90,000.

Wisconsin.—Owing to very largely increased operations on the part of a few new firms, the output has grown from a value of $183,958 in 1889 to $417,000 in 1891. Prospects for 1892 are very good.

Wyoming.—The output was valued at $25,000 in 1891. This means a gain of about $9,000 over 1887.

LIMESTONE.

The limestone industry showed very decidedly the effects of general depression in 1891. The prices for lime were almost invariably lower, and the demand as compared with previous years was very light.

A reduction in the amount of building done in many of the large cities affected the limestone industry, both as to the stone used for building as well as the lime produced from it. There seems to have been overproduction of lime in 1889 and in 1890, but more in the former year than in the latter.

Depression in the iron industry caused a very marked falling off in the consumption of stone for blast-furnace flux. This was particularly noticeable in Ohio and Pennsylvania.

The total value of the limestone product in 1889, the census year, was $19,095,179, while in 1891 it was $15,792,000, thus showing a falling off of over $3,000,000.

New undertakings were not numerous, while on the other hand a large number of small producers went out of business temporarily. A large amount of limestone is quarried in the United States by individuals, who work their quarries only in a small way, and perhaps for no other reason than that the stone is at hand on their property, and they therefore utilize time not required for farming or such other work as may regularly employ most of their time. This state of affairs exists in a number of the Western states, and particularly in Ohio and Pennsylvania.

One of the most notable changes that has occurred in the limestone industry within a few years is the formation of the Western Stone Company, with headquarters at Chicago, and operating quarries at Joliet, Lockport, and Lemont. This is referred to more in detail in connection with the consideration of Illinois limestone, page 465.

The following table shows the distribution of the limestone output among the various productive States:

Limestone production in the United States in 1891.

Alabama	$300,000	New Jersey	$100,000
Arkansas	20,000	New Mexico	2,000
California	400,000	New York	1,200,000
Colorado	90,000	Ohio	1,250,000
Connecticut	100,000	Pennsylvania	2,100,000
Illinois	2,030,000	Rhode Island	25,000
Indiana	2,100,000	South Carolina	50,000
Iowa	400,000	Tennessee	70,000
Kansas	300,000	Texas	175,000
Kentucky	250,000	Vermont	175,000
Maine	1,200,000	Virginia	170,000
Maryland	150,000	Washington	25,000
Massachusetts	100,000	West Virginia	85,000
Michigan	75,000	Wisconsin	675,000
Minnesota	600,000		
Missouri	1,400,000	Total	15,792,000
Nebraska	175,000		

The following is a series of more detailed statements in regard to the individual states:

Alabama.—The total value of the product in 1891 was $300,000. Of this, $150,000 is the value of lime made. The remainder of the product was devoted to blast-furnace flux, building, and road making. The value of the product in 1889 was $324,814.

Arkansas.—Most of the limestone is burned into lime. The total value of the output, including the value of lime, was $20,000.

California.—Almost all the limestone product of the State is burned into lime. Owing to a reduction in the amount of building done, the product did not come up to that of 1889. The total value of the output was $400,000. Prospects for 1892 are reported as better than for the past two years.

Colorado.—Most of the product is used for burning into lime. Business was exceedingly dull, much less building being done than usual. The total value of the product was $90,000.

Connecticut.—Nearly all of the product was burned into lime. The total value of the output was $100,000. Both demand and prices inferior as compared with 1889.

Illinois.—Although the limestone industry was far more prosperous in this State than in many others, business was not, on the whole, so good as it bids fair to be in 1892. The total value of the output in 1891 was $2,030,000. Something more than half of the product, estimated by value, goes for general building purposes, Illinois devoting more limestone to building purposes than any other State in the Union.

The Western Stone Company, with headquarters at Chicago and a capital of $2,250,000, has recently been formed. This company embraces the following firms, previously existing as separate and distinct concerns: Singer and Talcott Stone Company, Excelsior Stone Company, Chicago and Lemont Stone Company, Joliet Stone Company, Corneau Stone Company, Bodenschatz and Earnshaw Stone Company, Lockport Stone Company, and Crescent Stone Company. The quarries operated by this combination are located at Lemont, Lockport, and Joliet. The officers are B. J. Moore, president; E. A. Hamill, treasurer; H. L. Draper. secretary; M. B. Madden, vice-president; G. W. Campbell, manager of the Joliet department, and D. C. Norton, superintendent of the Lemont and Lockport quarries. The product sold consists of building stock in the form of rough, sawed, and machine-dressed stone.

Indiana.—The total value of the limestone output in 1891 was $2,100-000. Of this amount something more than half was devoted to building purposes. Production was about the same in activity as in 1890, although the difference, if any, was in favor of 1890. General financial depression resulted in less demands for the stone than usual. The prospects for 1892 are very good.

The oolitic stone of this State has been very completely described in the report for 1889–'90, and nothing further need be said here.

Iowa.—The product for 1891 was valued at $400,000. Somewhat more than one-half was used for building purposes, while the remainder was burned into lime. There are but few large concerns producing limestone in this State, but a large number of small producers, many of whom suspended operations in 1891, and some of them for 1890 also.

Kansas.—The output for 1891 was valued at $300,000. There are no large producing concerns in the State, and the large number of small producers report business as exceedingly dull, although improved in the early part of 1892.

Kentucky.—The total value of the product was $250,000. Business was greatly inferior in amount to that of 1890.

Maine.—The limestone of this State is almost entirely burned into lime. Business in 1891 was far less remunerative than usual. Overproduction brought about a lowering in price. The total value of the output was $1,200,000.

The consideration of the limestone industry in this State has been completely given in former reports.

Maryland.—The total value of the output, which was mainly converted into lime, was $150,000. As is evident from the figures given, comparatively little quarrying is done in this State.

Massachusetts.—Most of the limestone quarried in this State comes from Berkshire county, and is almost entirely burned into lime. The total value was $100,000.

Michigan.—The total value of the output was $75,000. Most of the product was used for building.

Minnesota.—The value of the limestone product was $600,000. This figure represents very little, if any, increase over 1890. About two thirds of the output was used for building purposes.

Missouri.—The limestone industry in this State is a large and important one, but business was very much less in amount in 1891 than in 1890, while the product of the census year 1889 amounted in value to $1,859,960, in 1891 it fell to $1,400,000. The universal report was decrease in demand and prices. The product is distributed between general building, lime burning, and street and road works.

Nebraska.—Production for the year was light, the amount falling below that of the census year. The value of the product for 1891 was $175,000.

New Jersey.—The value of the product in 1891 was $100,000. Most of this represents the value of lime, into which the stone was, for the greater part converted. As in most other States, a falling off in the amount is reported. Reports for 1892 were much better.

New Mexico.—The limestone product amounted to only a few thousand dollars, and was converted almost entirely into lime.

New York.—The value of the limestone output in 1891 was $1,200,000; one-half of this represents the value of lime, while the remainder was divided between building and road works.

The lime burners universally complain of lower prices than in 1890, and a reduced demand for the lime. The same depression as is noticeable in other states prevailed in New York during the year.

Ohio.—In the census year 1889 the limestone product of Ohio was valued at $1,514,934. The corresponding figure for 1891 is $1,250,000. Somewhat more than one-third of this amount represents the value of lime produced, while for building a little less than one-third of the total was used. The remainder was devoted to road making, bridge, dam, and railroad construction, and blast-furnace flux. In the lime business lower prices, in general, prevailed, although there are a few exceptions to this. The shutting down of a number of blast furnaces for a part of the year decreased very noticeably the consumption of stone for flux. The amount of stone used for road making was less than usual for the year.

Quite a large number of small producers who had suspended operations for either or both of the years 1890 and 1891 resumed business again in 1892, and the prospects for the latter year are very good.

Pennsylvania.—The limestone industry of this State is on the whole a very important one, although not for building purposes. The census of 1889 showed a total value for the limestone and lime output of $2,655,477; this was distributed among the various uses as follows: For building, $238,431; the value of the lime output was $1,195,955; quite a large proportion of this was devoted to fertilizing purposes; the output for blast-furnace flux was valued at $949,083; this figure was, however, somewhat below the true total, as quite a number of furnaces quarry their own flux and keep no careful account of the amount.

The total value of the limestone output for 1891 was $2,100,000. There was quite a noticeable falling off in the consumption of stone for blast-furnace flux and also for stone for manufacture into lime.

Rhode Island.—The limestone output of this State amounted to $25,000. The industry in this state amounts to but little.

South Carolina.—The value of the output for 1891 was $50,000. This figure represents a decided increase for theState as compared with the census year, when the product was valued at only $14,520. Most of the stone was burned into lime.

South Dakota.—Very little indeed was produced in 1891.

Tennessee.—The limestone industry was very dull during 1891. The total output including lime was valued at $70,000. Most of it was burned into lime.

Texas.—The output for 1891 was valued at $175,000. Most of the product was used for building.

Vermont.—The total value of the limestone output was $175,000. Most of this figure represents the value of lime produced.

Virginia.—The total value of the output was $170,000. While this figure is higher than the corresponding one for 1889, it represents no increase over 1890. More than half the total value is that of lime produced, while the remainder was used largely for blast-furnace flux.

Washington.—Practically the entire output was burned into lime, which was valued at $25,000.

West Virginia.—The output was valued at $85,000. Most of the stone was burned into lime.

Wisconsin.—The census year 1889 resulted in an output of limestone and lime valued at $813,963. In 1891 the value had fallen to $675,000. The stone is used principally for burning into lime and, to a less extent, for building.

MARBLE.

Production.—The value of the marble output of the United States in 1891 is $3,610,000. This figure represents the value of the output as sold by the producers at the place of production. Most of the product was sold in finished condition ready for the consumer. The remainder, comparatively small in amount, was sold in the rough, the work of finishing being done by marble dealers and stonecutters who make a business of finishing but not of quarrying marble.

The following table shows the distribution of the output among the various productive states:

Marble product in 1891 by States.

California	$100,000	Tennessee	$400,000
Georgia	275,000	Vermont	2,200,000
Maryland	100,000	Scattering	100,000
Pennsylvania	45,000		
New York	390,000	Total	3,610,000

Included in the designation "scattering" in the above table are the outputs of quarries in various states which have hardly gotten beyond the experimental stages and whose existence can hardly be regarded yet as likely to be permanent.

In the marble-quarrying industry there seems to have been in the last two years an unusually marked tendency toward the absorption of smaller concerns by the more powerful and prominent ones.

Cases illustrative of this tendency have occurred in Vermont, Tennessee, and Georgia.

Powerful resources seem to be absolutely essential to unqualified success in the difficult and frequently highly uncertain industry of marble quarrying. Although the output of marble in 1891 is greater than in either of the two preceding years, the number of producing concerns is less on account of the failure or absorption of a number of the minor operators.

The following statements relative to the industry in individual states will serve to show the changes and progress made in each during the past year.

Alabama.—Mention has been made in the Census Report of 1889 of marble near Florence. Actual developments, however, have not yet been made, although investigations may be continued in 1892.

Arkansas.—The development of marble property near Yellville is progressing slowly, although the quarry is not yet yielding a marketable stone. The chief hindrance is lack of transportation facilities.

California.—The output in this State amounts to $100,000, as compared with $87,030 in 1889. The operations of the Inyo Marble Company have increased and the outlook is more favorable than heretofore. Amador county marble is increasing in popularity and the output of 1892 will probably largely exceed that of former years. Most of the marble output of the State comes from quarries in San Bernardino county and the industry appears to be established on a permanent footing.

Colorado.—The production of marble in this State is still prospective. Considerable agitation of the subject of marble resources has been going on in the past few years, but it has not yet resulted in any actual developments, although the stone seems to be of desirable quality and abundant. Transportation facilities are greatly needed before much can be done.

Georgia.—Operations in this State have notably increased in the last two years, the output having advanced from $196,250 in 1889 to $275,000 in 1891. This increase is largely due to progress that has been made at the quarries at Tate. The American Marble Company, operating a green marble quarry near Marietta, has discontinued operations and their plant is now the property of the Kennesaw Marble Company, which will be devoted to the work of finishing. The Georgia product is used for all the purposes for which marble is adapted. More of it is used for cemetery work than for any other one purpose; but large quantities are also used for ornamental work and interior decoration.

Idaho.—Marble is now produced in limited quantity at Shoshone. It is used for cemetery work and building.

Maryland.—The quarries at Cockeysville produce most of the marble of this state. The value of the product in 1891 was $100,000. The Serpentine Company, of Wilmington, Delaware, operating quarries of green serpentine in Harford county, Maryland, did nothing in 1891, owing to litigation.

The Lake Chrome and Mineral Company is still engaged in the preliminary work of opening their quarries, and made only small sales of rough stone during the year.

Pennsylvania.—The marble of this State comes from quarries near Conshohocken and King of Prussia, in Montgomery county. The value of the output in 1891 is $45,000. The product is used chiefly for building purposes in Philadelphia and other cities and towns in the State.

New York.—The product comes from St. Lawrence, Westchester, Columbia, and Warren counties. The total output in 1891 was valued at $390,000. The product of the Glens Falls, Warren county, quarries is a black marble quite unique in color and general properties. The demand for it is always good. It is quite largely used for ornamental purposes and interior decoration.

Messrs. Norcross Bros. have recently reopened what is known as the old Stewart quarry at Tuckahoe, Westchester county.

Tennessee.—The marble industry of Tennessee has not increased during the past two years. This period has been quite disastrous to a number of the smaller producing concerns, which have either failed or suspended operations. The largest operators show increasing production and fair business. The use of marble for furniture has very greatly declined, but the consumption of stock for interior decoration is gradually increasing from year to year. The stone is too valuable as an ornamental article to be used for rough building, so that its use is now limited practically to cemetery work and interior decorations—particularly the latter. The Tennessee Producers Marble Company includes a number of firms who, up to a few years ago, did business under their individual names. This consolidation has doubtless benefited the industry by sustaining prices and facilitating the transaction of business by bringing a large variety of stock under one control. Messrs. W. H. Evans & Son, of Knoxville, are opening up three new quarries in Blount county in addition to the ones now operated by them. The great obstacle to satisfactory development in the Tennessee quarries is the lack of railroad facilities, which necessitates a long and expensive haul by wagon to the shipping points.

Vermont.—The marble output for 1891 was valued at $2,200,000. The industry is progressing steadily, particularly among the leading producers, although nearly all report good business and increasing demand. Most of the output is used for cemetery purposes. The Vermont Marble Company has extended its operations by leasing a number of additional quarries. The True Blue Marble Company of West Rutland, has increased its output quite markedly within the past two years, and the product is now almost exclusively sold as monumental stock, for which the demand is good. The quarry operated by this company was opened only a few years since, and it has turned out in a manner gratifying to the operators. The Rutland County Marble Company has recently commenced operations at West Rutland.

Virginia.—The operations of the Virginia Marble Company at Mountsville, Loudoun county, were suspended during 1891, owing to lack of transportation facilities. This firm has sold very little stone up to the present for the reason given above. Improvement in transportation will doubtless result in active production.

North Carolina.—Although no marble is as yet produced in this state, much of a favorable nature has been said of marble found on the property of the Nantahala Marble and Talc Company, in Swain county, western North Carolina. This property comprises 8,000 acres, and contains large quantities of marble, talc, and slate. Experts have been employed to examine the various mineral deposits, and favorable opinions have been expressed by them in regard to the extent and character of the minerals found. The marble includes a variety of colors, of which the black and gray have been especially commended, although blue and green shades are described as choice. The American Marble Company, of Marietta, Georgia, worked up and finished a car-load of the marble, and as a result expressed a very favorable opinion of the stone as regards texture, quality, and color. Through the property runs a stream known as the Nantahala river, which represents a water power of 12,000 horse power. The enterprise gives expectations of actual productive results within a year or two.

Marble imported and entered for consumption in the United States, 1867 to 1883, inclusive.

Fiscal years ending June 30—	Sawed, dressed, etc., not over 2 inches in thickness.	Sawed, dressed, etc., over 2 and not over 3 inches in thickness.	Sawed, dressed, etc., over 3 and not over 4 inches in thickness.	Sawed, dressed, etc., over 4 and not over 5 inches in thickness.	Sawed, dressed, etc., over 5 and not over 6 inches in thickness.	Veined and all other, in blocks, etc.	White, statuary, Brocatella, etc.	Not otherwise specified.	Total.
1867	....	....	....	....	....	$192,514	$2,540	$51,978	$247,032
1868	....	....	....	....	....	309,750	4,403	85,783	399,936
1869	....	....	....	....	....	359,881	3,898	101,309	465,088
1870	....	....	....	....	....	332,839	3,713	142,785	479,337
1871	$5,973	$168	$77	$44	$28	400,158	1,134	118,016	525,598
1872	3,499	1,081	452	....	318	475,718	4,017	54,539	539,624
1873	3,124	21	....	....	....	396,671	4,148	69,991	473,955
1874	1,837	....	....	....	....	474,680	2,863	51,699	531,079
1875	1,456	427	96	....	....	527,628	1,623	72,389	603,619
1876	595	126	203	87	....	529,126	1,151	60,596	591,884
1877	2,124	....	....	....	....	349,590	1,404	77,293	430,411
1878	198	11	8	....	....	376,936	592	43,915	421,660
1879	184	....	....	....	....	329,155	427	54,857	384,623
1880	....	....	....	....	....	531,908	7,239	62,715	601,862
1881	339	....	....	....	....	470,047	1,468	82,046	553,900
1882	655	....	....	....	....	486,331	3,582	84,577	575,145
1883	619	....	....	....	....	533,096	2,011	71,905	607,631

Marble imported and entered for consumption in the United States from 1884 to 1891.

Classification.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
In block, rough or squared, of all kinds...	$511,287	$429,186	$408,895	$355,648	$357,220	$498,275	$510,354	$492,894
Veined marble, sawed, dressed or otherwise, including marble slabs and marble paving tiles.	12,941	43,923	96,625	142,405	107,957	115,909	142,653	83,416
All manufactures of, not specially enumerated..	67,829	54,772	44,053	31,880	69,086	61,231	132,376	119,787
Total	592,057	527,881	549,573	529,933	534,263	675,415	785,383	696,097

SLATE.

Production.—The total value of all slate produced in the United States in 1891 was $3,825,746. Of this amount $3,125,410 represents the value of 893,312 squares of roofing slate, and the remainder, $700,336, is the value of slate used for all other purposes besides roofing.

The following table shows the distribution of the product by states:

Production of slate in the United States in 1891.

States.	Roofing slate.	Value.	Other purposes than roofing (value).	Total value.
	Squares.			
Arkansas	120	$480	None	$480
California	4,000	24,000	...do	24,000
Georgia	3,000	13,500	...do	13,500
Maine	50,000	250,000	...do	250,000
Maryland	25,166	123,425	$2,000	125,425
Michigan	None		None	
New Jersey	2,500	10,000	...do	10,000
New York	17,000	136,000	40,000	176,000
Pennsylvania	507,824	1,741,836	401,069	2,142,905
Utah	None		None	
Vermont	247,643	698,350	257,267	955,617
Virginia	36,059	127,819	None	127,819
Total	893,312	3,125,410	700,336	3,825,746

The years 1890 and 1891 do not show large gains in production, and the industry for this interval may be regarded as nothing more than fairly prosperous, although the latter year shows an advance on 1890 both in amount and prices. The West is becoming to a greater and greater extent the market for roofing slate, while mill stock is more uniformly distributed. The increasing use of metal on the roofs of buildings in the large cities in the East interferes quite largely with the consumption of slate.

Arkansas.—The production of slate in Arkansas is in its initial stages, but there is reason to look for an increase within the next few years.

California.—The amount produced in 1891 is well in advance of that reported by the census of 1889. The product comes from El Dorado county. The Chili Bar quarry, one of the newest, has made very satisfactory advances in the past two years. The demand for slate in this State appears to be sufficient to stimulate development.

Georgia.—There is an evident need of capital in the slate region of Georgia to cause an increasing production. The natural advantages of Rock Mart would appear to justify largely increased operations.

Some steps have recently been taken looking to the development of the Rock Mart quarries on a large scale, but nothing has as yet actually been done. From present appearances, however, it seems not improbable that sufficient capital will be invested to bring the slate more prominently into public notice. The methods of quarrying hitherto employed have been very crude and consequently expensive.

Maine.—The value of the product in 1891 represents some increase over that of the census. The slate is of superior quality.

Maryland.—The productive region is known as the Peach Bottom, in Harford county, bordering on York county, Pennsylvania.

The Henrietta Slate Company has begun to operate a quarry at Ijamsville, Frederick county; only 100 squares were produced in 1891, but a larger product will be the result of operations in 1892.

New York.—The most interesting feature of the slate produced in New York is the red slate taken from quarries in Washington county. This is the only locality in the country yielding red slate, and it brings a higher price than any other on account of its unique color and durable quality. Much of it commands a price of $10 per square at the quarries. Eight thousand squares were produced, valued at $72,000, or an average of $9 per square.

Pennsylvania.—A complete account of the general features of the slate industry in Pennsylvania was given in the report for 1890, and there is little to be said in the way of new developments. Many changes in the personnel of the quarry operators have taken place, but they are in the majority of cases of no interest to the general public. Progress is steady and substantial from year to year.

Utah.—Although no product is reported from the Provo Slate Company, Provo, Utah, the firm has begun to advertise for sale roofing slate as well as the various varieties of mill stock, thus indicating their readiness for active business in 1892. The slate is described as unfading purple and green, and unchangeable in color under the action of sulphuric acid.

Vermont.—Progress in slate quarrying has been steady but comparatively slow during the past two years. The uses to which milled slate is put are increasing and the outlook in that direction is favorable. The total value of the product for 1891 reaches the highest point yet attained, namely, $955,617, but the increase since the census year is not surprisingly great.

Virginia.—From $113,079 in 1889 the value of the output has increased to $127,819 in 1891.

Operations have also begun at Snowden, although nothing but preliminary work has thus far been accomplished. Actual production will probably be realized at this point in 1892.

North Carolina.—Large quantities of slate have been found at Nantahala, and it seems probable that development will follow shortly. For particulars in regard to the property in question see the report on marble in this volume.

CLAY MATERIALS OF THE UNITED STATES.

By Robert T. Hill.

PRODUCTION.

During 1891 the use of clays for pottery showed an increase beyond either 1889 or 1890, both in quantity and quality of the product and in the state of the trade. Regarding the importance in kinds of pottery it may be said that, besides the growth of art pottery in this country, much greater attention is being paid to fine decoration on utility pottery, such as tableware, etc. The demands in the direction of sanitary pottery showed even more than the normal increase of this rapidly developing industry. The quantity of the product is perhaps best indicated by the increased consumption of the raw materials, as shown below.

Amount and value of potters' materials from 1887 to 1891.

	1887.		1888.		1889. (*a*)		1890.		1891.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*		*Tons.*		*Tons.*	
Kaolin and china clay	22,000	$231,000	18,000	$189,000	294,344	$635,578	350,000	$756,000	400,000	$900,000
Ball clay	6,000	36,000	5,250	31,500						
Fire clay	15,000	45,000	13,500	40,500						
Ground flint	19,800	168,000	16,250	138,125	11,113	49,137	13,000	57,400	15,000	60,000
Ground feldspar	10,200	112,200	8,700	95,700	6,970	39,370	8,000	45,200	10,000	50,000

a From 1889 all clays burned in kilns are considered.

IMPORTS.

Earthenware and china imported and entered for consumption in the United States, 1867 to 1891, inclusive.

Years ending—	Brown earthen and common stone ware.	China and porcelain not decorated.	China and decorated porcelain.	Other earthen, stone, or crockery, glazed, etc.	Total.
June 30, 1867	$48,618	$418,493	$439,824	$4,280,924	$5,187,859
1868	47,208	309,960	403,555	3,244,958	4,005,712
1869	34,260	400,894	555,425	3,468,970	4,459,549
1870	47,457	420,442	530,805	3,461,524	4,460,228
1871	96,695	391,374	571,032	3,573,254	4,632,355
1872	127,346	470,749	814,134	3,896,664	5,308,893
1873	115,253	479,617	867,206	4,289,868	5,751,944
1874	70,544	397,730	676,656	3,686,794	4,831,724
1875	68,501	436,883	654,965	3,280,867	4,441,216
1876	36,744	409,539	718,156	2,948,517	4,112,956
1877	30,403	326,956	668,514	2,746,186	3,772,059
1878	18,714	289,133	657,485	3,031,393	3,996,725
1879	19,868	296,591	813,850	2,914,567	4,044,876
1880	31,504	334,371	1,188,847	3,945,666	5,500,388
1881	27,586	321,259	1,621,112	4,413,369	6,383,326
1882	36,023	316,811	2,075,708	4,438,237	6,866,779
1883	43,864	368,943	2,587,545	5,685,709	8,686,061
1884	50,172	982,499	2,664,231	666,595	4,363,497
1885	44,701	823,334	2,834,718	963,422	4,666,175
Dec. 31, 1886	37,820	865,446	3,350,145	951,293	5,204,704
1887	43.079	967,694	3,888,509	1,008,360	5,907,642
1888	55,558	1,054,854	4,207,598	886,314	6,204,324
1889	48,824	1,148,026	4,580,321	788,391	6,565,562
1880	56,730	974,627	3,562,851	563,568	5,157,776
1891	99,983	1,921,643	6,288,088	353,736	8,663,450

Clay imported and entered for consumption in the United States, 1867 to 1883, inclusive.

Fiscal years ending June 30—	Fuller's earth.		Kaolin.		Unwrought pipeclay and fireclay.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		*Long tons.*		
1867	280.25	$3,113	....	....	6,383.75	$72,204	$75,317
1868	211.00	2,522	....	....	8,383.75	66,958	69,480
1869	324.10	3,587	....	....	12,963.75	84,645	88,232
1870	239.40	2,619	....	....	8,014.15	76,057	78,676
1871	290.20	3,383	....	....	10,900.48	103,144	106,527
1872	274.00	3,358	....	....	13,081.20	128,130	131,488
1873	251.18	2,978	1,378.30	$13,091	12,883.82	141,927	157,996
1874	277.20	3,440	89.21	1,378	12,909.14	147,782	152,600
1875	300.06	3,694	130.47	1,977	10,374.65	116,307	121,978
1876	246.73	3,097	142.00	2 152	11,799.12	126,738	131,987
1877	400.00	4,460	204.26	3,009	11,680.14	129,016	136,485
1878	335.07	4,095	3,499.30	38,899	9,406.74	95,877	138,871
1879	361.21	4,269	4,774.60	45,272	8,477.80	87,948	137,489
1880	578.00	6,925	7,823.66	67,740	11,899.80	117,350	192,015
1881	267.55	3,207	6,887.37	66,654	12,444.28	123,545	193,406
1882	908.27	11,444	13,954.85	135,448	12,181.39	119,620	266,512
1883	1,241.27	14,309	12,870.60	115,492	7,841.32	74,673	204,474

Classified imports of clay during the calendar years ending December 31 from 1885 to 1891.

Kinds.	1885.		1886.		1887.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
China clay or kaolin	10,626	$83,722	16,590	$123,093	23,486	$141,360
All others:						
Unwrought	9,736	76,899	13,740	113,875	17,645	139,405
Wrought	3,554	29,839	1,654	20,730	2,187	22,287
Total	23,916	190,460	31,984	257,698	43,318	303,052

Kinds.	1888.		1889.		1890.		1891.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
China clay or kaolin	18,150	$102,050	19,843	$113,538	29,923	$270,141	39,901	$294,458
All others:								
Unwrought	20,604	152,694	19,237	145,983	21,049	155,486	16,094	118,689
Wrought	6,832	53,245	8,142	64,971	2,978	29,143	6,297	56,482
Total	45,586	307,989	47,222	324,492	53,950	454,770	62,292	469,629

It is unnecessary here to give an encomium upon the value of clay material. No substance is so widely distributed and available, or so universally used in every phase of human economy. Neither is there any material in nature, except the precious metals, which is capable of being so easily converted into value by human skill. It is doubtful if the ultimate product of any of our mineral resources, excepting iron, exceeds it in value, while its benefits are far more widely distributed among mankind than even the latter. Among the uses of clay-making materials in this country are the following:

1. *Domestic.*—Utensils, porcelain ware; china ware; granite or ironstone ware; yellow ware; earthen ware.

2. *Structural.*—Brick, common, front or pressed, ornamental, hollow, glazed; adobe; terra cotta; roofing tile; drain tile; flooring tile; fire-place tile; chimney flues; chimney pots; door knobs; puddling.

3. *Agricultural.*—Drain tile; soil tile; irrigating tile; soil tempering; barn flooring.

4. *Hydraulic structures.*—Water conduits; reservoir lining; sewer pipe.

5. *Sanitary engineering.*—Granite ware; urinals and water-closet bowls; earthen ware; sewer pipe; absorbent brick; drain tiles; ventilating flues.

6. *Industrial arts.*—China clay, chemists' crucibles, and other apparatus; wall and writing paper filling; refractory clay, lime, cement, and pottery kilns; puddling hearths; reverbatory and other smelting furnaces; assaying furnaces; gas retorts; stove and furnace linings; saggars; plugs; models, etc.

7. *Ornamental and æsthetic uses.*—Tiling, ornamental pottery; terra cotta decoration; artists' molding clay; base for retaining pigments.

8. *Imitative uses.*—Food adulterants; paint adulterant.

THE COMMERCIAL CLASSIFICATION OF CLAYS.

The word clay has a diverse and elastic meaning. To the popular mind it is the familiar, gritless, plastic earth which is readily molded when wet. To the manufacturer it is the material he molds and bakes which may be the natural plastic material above mentioned, or a mixture of many ingredients either natural or artificial, according to the refinement of the ultimate product; this product varies in simplicity of processes from the ordinary brick clays, which are natural mixtures of the essential sand and clay, with iron and other accessories, to the washed, ground, screened, and compressed artificial mixture of kaolin, feldspar, flint, and plastic clay from which the potter shapes china and porcelain into works of art.

Clay material in nature is not always plastic, and many of the most valuable products are made from consolidated rock, as the Cornwall stone or rock kaolin, which is a crumbling granite; many common brick clays are more like impure sand than clay, and some of these, from earliest times, have been molded with straw to give them sufficient tenacity for the handling necessary before burning. Much of the aboriginal pottery of America is composed of various earths, with just enough clay to hold the particles together.

The chief function of clay in the fictile arts is its partial fusion upon firing, and upon this and the skill of the artisan who fires the kiln depends the product, which is wonderfully varied by the mixtures of fluxes and tempering material.

Plasticity is desirable for the handling of the unfired material. Nearly all unconsolidated or powdered rock material may be made to adhere by water and other ingredients than clay, so that it can be shaped for burning, but plastic clay is the cheapest natural material used for this purpose in all clay-burning. The material for the coarse products occurs naturally and is mixed with the nonplastic kaolins by the porcelain-maker to give the "clay" the necessary tenacity for handling and shaping.

The table on page 480 gives a general classification of the natural clays, but it should be remembered that it is the scientific handling, mixing, and firing of these that produce the more refined results in every kind of product.

In discussing clays it must be remembered that while chemical analysis is an important guide to the study of clays the physical characteristics are often of greatest importance in determining their value; many clays almost identical in chemical analysis (*a*) result in the most diverse products upon firing.

With these preliminary remarks the classification of the clay-making materials of commerce can be better explained.

Pure clay, which seldom occurs in nature, is a chemical compound of silica and aluminum oxide (*i. e.*, silicate of aluminum), and is primarily the product of the dealkalization of feldspar by decomposition.

China clays.—The china clays (rock kaolin, sedimentary kaolin, Indiana kaolin, etc.) are in general distinguished by their nonplasticity, and all of them do not come under the popular use of the word "clay," although they often show a composition identical with that of the plastic clays. They are seldom used as they occur in nature, but after refining are used pure for paper filling and adulterants. They are essential ingredients, but are largely mixed with feldspar and silica (ground flint or quartz), in the manufacture of china clay and porcelain and granite or queensware clay. The occurrence of this material is fully treated in the geological portion of this paper. In general the china clays should be free from iron and alkaline impurities, especially lime.

Plastic, ball, or pottery clays.—Plastic clay is used as the essential material in the manufacture of earthenware, pottery, terra cotta, drain tile, brick, and stoneware. It is also used as an accessory ingredient in the manufacture of fire clay, porcelain, china, and granite ware. In its greatest purity it is indistinguishable in analysis from kaolin, but it generally contains accessory ingredients of iron and alkalies. Its functions in the clay industry are twofold: (1) It fuses in the kiln into the desired hard product, or "pottery;" (2) it is used in the china-making and other industries under the name of "ball" clay to give plasticity and tenacity to the green clays, that they may be handled before firing. While the pure clay may present the same chemical analysis as kaolin, it can in no manner be substituted for the latter in the chinaware industries, owing to the fact that its physical properties cause it to burn into a different product. The cause of plasticity of clay is a scientific question which has not been clearly deter-

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a For the chemical analyses of the principal clays of commerce, the reader is referred to the valuable little brochure by Mr. Alfred Crossley, entitled "Tables of Analyses of Clays, etc.," published by T. A. Randall & Co., Indianapolis, Indiana, 1888.

mined, but, inasmuch as it is a quality of only the sedimentary clays, it is supposed to have been produced by the repeated grinding and washing of nature, wherein the particles have been rendered exceedingly fine and more susceptible to the retention of water.

The plastic clays stand next to the brick clays in relative popular value and are secondary to them only in extent of distribution. Like the brick clays (which may be considered as impure plastic clays), they occur in their greatest purity in fresh-water deposits, and in the greatest quantity in those formations laid down at marine base level, becoming rapidly more impure as they encroach upon the sea water.

They have a wide distribution in nature and are of various colors, red, blue, green, yellow, and white, before burning and often the reverse upon firing. In the older (Paleozoic) formations the plastic clays have been altered into shales, slates, and schists, which have lost their original plasticity, but some of them are again rendered plastic upon grinding. "Fat clay" is a term denoting the presence of too much lime in plastic clays. The opposite term, "lean clay," is used to denote excessive plasticity.

Brick clays.—This division includes clays for building brick, also used for agricultural drain tile, cruder stone ware, and other coarser articles. The best building brick is firm, porous grained, of uniform texture, and either a rich red color or no color, *i. e.* white. Glazed brick are made for certain uses, and the matter of color is secondary for good stock or interior brick.

The essential materials of brick clay are sand and clay and, if color is desired, iron. The accessory materials in most brick clays are iron, lime, magnesia, soda, potash, combined with water. The best brick clays are composed of silica three-fifths and alumina one-fifth, the remaining fifth being the accessory ingredients above mentioned. The ideal brick clay consists of a mixture of fine sand and pure plastic clay. Good brick has been produced when the sand constituted as high as 85 per cent. of the whole. If there is too little sand in the clay the bricks are liable to crack in firing and to be too slightly porous. An excess of sand, on the other hand, renders the product friable and incapable of endurance. In the preparation of clays for the finer qualities of brick, sand is generally added artificially in due proportions.

Iron is more or less present in all brick clays and is the basis of color, which may be modified by different degrees of firing. The remaining ingredients of brick clays may be classed as impurities and the quality of the product deteriorates with their increasing presence in the composition. Of these lime is the most common and when in large quantities the most objectionable; over 3 per cent. renders the product very undesirable, although the London malms, or stock brick, often contain 46 per cent. of lime. Clays taken from the seashore or ancient sea deposits do not make good brick. Before they receive heat sufficient to burn them into hard bricks they warp and twist in the kiln and melt into unshapely clinkers, although a small proportion of fair brick may sometimes result in the lower interior of the kiln. In addition, the bricks will effloresce, or "saltpeter," when exposed to dampness. The clays best adapted to brickmaking and those most universally used are fresh-water deposits, such as the alluvium of rivers, fresh-water lake sediments, and glacial deposits, and, as will be seen in the following pages, these have a wide distribution over the land and belong to the latest of the geological periods.

Refractory or fire clays.—No branch of the fictile industries is so difficult to satisfactorily define as the manufacture of clay mixtures for refractory material; and it may be stated that fire clay does not occur in nature in a condition to be converted into refractory material, but the substance which is fired by the maker is an artificial mixture or preparation of various earths. Some refractory material, like the famous dinas brick of Europe, is manufactured from a quartzose rock, which is finely ground and given tenacity by a bond of lime. Other fire clays are manufactured from the so-called "kaolin" of New Jersey, which is mostly sand; on the other hand, much refractory clay is made by the calcination of plastic clays, so that their plasticity is destroyed, or from old crockery, pottery débris, etc. In localities such as the central Carboniferous area of the United States, and along the front of the Rocky mountain region, there are clays called natural fire clays which are best suited for this preparation. The essential quality desired in refractory products is power to withstand highest temperatures without melting or combining with the alkaline slags of the metals which are reduced in furnaces constructed with it. Hence the presence of alkaline material in any quantity more than to form the merest trace of binding on fusion is undesirable.

Next to infusibility porosity is most desired, and for this purpose the particles must be of proper coarseness, neither too fine nor too large.

Sand, plastic clay, old crockery, and fire material are the principal materials used in making fire clay, although talc, serpentine, and other nonalkaline silicates are sometimes used. For fine crucibles, old crucibles are ground and form the chief supply. When plastic clays are used they are generally submitted to long weathering, and then calcined into the material known as chamatte, after which they are reground, mixed, and burned. Owing to these conditions, it is hardly proper to classify any natural clay as a fire clay by occurrence. Kaolin is also used in place of calcined plastic clay in some localities.

Origin and distribution of the clay deposits of the United States.

Kinds.	Origin.	Geographic distribution.	Utilization.
Rock kaolin, Cornwall stone, etc.	Residual decomposition of feldspars of igneous rocks (granites), etc.	Appalachian, Superian, Arkansan, Texan.	Porcelain, china, and granite ware. Refractory material.
"Indianaite" or Indiana kaolin.	Residuum of decaying limestones.	Central Carboniferous area. Appalachian central states.	Pottery, tile, and plastic-clay products.
Florida, or sedimentary kaolins.	Sedimentary deposits of transported rock kaolins.	Southern and Gulf portions of Atlantic Coastal plain.	Porcelain, china, and refractory. Paper filling.
Plastic clays:			
White burning ...	Mostly sediments of Carboniferous and later age.	Principally Atlantic and Gulf Coastal plain and central states, Pacific coast. and Rocky mountain region.	Plastic clay for china and kindred wares. All earthenware products, pipe ware, tile ware, granite ware, etc.
Color burning	......do	....	All grades of colored ware.
Mixed clays:	All of sedimentary origin.		
Brick clays (siliceous).	Principally later alluvial and glacial deposits.	General................	Use indicated in name.
Marly clays (calcareous).	Principally of Cretaceous age.	......do	......do ....
Paint clays (ferruginous).	Principally of early Mesozoic.	Gulf plain, Rocky mountain and great southwest states and territories.	......do ....
Cement clays (siliceo-calcareous).	Principally of Cretaceous and Paleozoic formations.	Appalachian, central Texan, Gulf, Rocky mountain.	......do ....
Alum clays	....	General................	......do ....
Altered clays (shale and slate).	Earlier formations; Mesozoic formations.	Appalachian and central Cordilleran.	......do ....

THE ORIGIN AND NATURAL CLASSIFICATION OF CLAYS.

Clay is the immediate or ultimate product of the decomposition of feldspar. Feldspar is a constituent mineral of all the igneous rocks of the earth, and is especially abundant in the older granites and gneisses, which are the foundation upon which the sedimentary rocks are deposited. By its decomposition, which is produced principally by the action of water, the soda, lime, potash, and other alkaline components of the feldspar are removed in solution, leaving the aluminum silicate and quartz as a residuum, commercially known as rock kaolin, a non-plastic material which when free from iron, is also known as porcelain clay.

Water in nature, as in pottery, is the chief agent in clay working, and besides its original work in decomposing the feldspar, it transports and grinds the original kaolin, and deposits it in various degrees of purity or mixture in secondary localities as a sediment. Clay material thus produced is known as sedimentary or transported clay, and, with the exception of some of the kaolins which have not been far removed from their place of origin, are more or less plastic. The washing and grinding of clays by clay-workers is a repetition of fundamental geologic processes of erosion, corrosion, and deposition constantly going on in nature, and the geologist can see in the flumes and settling tanks of the potter a laboratory demonstration of the principal agencies which he studies.

The clay material resulting from the decay of feldspar may be broadly classified under the two general heads of residual and sedimentary.

The residual material is that which is found in the original place of occurrence of the decomposing feldspar, and may possess many physical aspects, sometimes occurring as a firm or crumbling rock, resembling decomposed granite, or again as a fine white nonplastic clay or kaolin. It is usually accompanied by quartz, a material not essentially injurious, and which can be removed, when desirable, by washing. The former residual clay materials are sometimes called rock kaolins, a name which is generally appropriate to the whole class.

The sedimentary clays are those which have been removed from their place of origin and redeposited in water. They embrace all degrees of mixture and purity, and may be either kaolinitic or plastic.

Kaolin or kaolinite.—The use of this term has a wide and vague meaning in Mineralogy, but to the practical potter it has a very definite application to a particular material, which he has no difficulty in distinguishing, even though it is difficult to define technically. In the older editions of Dana's Mineralogy its meaning is expanded to include all varieties of clays derived from feldspar, but in the potter's trade it is usually confined to the white clays, which are nonplastic when washed, and which, upon microscopic examination, would show that the particles retain traces of the rhombic or hexagonal crystallization of the original feldspar.

The processes in nature by which the original feldspar rocks decompose into clays can nowhere be better observed than in the eastern portion of the United States, along the region of granitic and other feldspathic rocks outcropping along the eastern margin of the Appalachian system from New England to Georgia, and the following description of these processes by Mr. I. C. Russell, in Bulletin No. 56, of the United States Geological Survey, Washington, 1889, will give a sufficient idea of the geological origin of clay material in general:

"*Decay of the crystalline rocks of the Piedmont region.*—In traveling south from the southern margin of the moraines left by the Pleistocene ice sheet of northeastern America, along the belt of crystalline rocks bordering the Appalachian mountains on the east, the surface exposures exhibit greater and greater evidences of decay as one proceeds. The observations on the decay of rocks presented in this paper refer principally to changes that are obvious to the eye, and not to the alterations frequently detected when thin sections of apparently sound rocks are examined with a microscope. In Pennsylvania and Maryland the mica schists and allied rocks are frequently disintegrated to a depth of many feet, so that they may be removed with a pick and shovel. The strata, however, are for the most part simply broken down, so far as is apparent to the eye, although chemical alteration, especially of the feldspars, has unquestionably occurred. With the exception of a few feet at the surface, however, it is principally disintegration, not decomposition, that has taken place. In a handful of fragments the eye immediately determines the character of the rock from which they were derived; if chemical change was far advanced this would not be the case. It is difficult to ascertain the depth of this alteration, but in general it may be taken at from fifteen to thirty feet; localities are not uncommon, however, where well-marked disintegration has reached a depth of fully 50 feet below the surface. Typical examples of residual clay—the extreme result of subaërial decay—are not common in this portion of the Appalachian belt, but may occasionally be seen in railroad cuts and similar excavations.

"As one travels south from the Potomac a great increase is seen in the extent and in the depth of the chemical changes that have affected the outcrops. Throughout nearly the entire area underlaid by crystalline rocks in Virginia and the Carolinas east of the Blue Ridge the soil is red clay, which is a residual deposit produced by the subaërial alteration of the rocks on which it rests. Over large areas this alteration reaches more than a hundred feet below the surface, but owing to lack of exposures its full extent is seldom seen.

"About Greenville, South Carolina, the character of the residual deposits resulting from the subaërial decay of highly micaceous gneiss may be observed. The deep red color of the plowed fields, merging at times into broad areas of yellow, to be seen in early spring, together with the exposures of decayed rock in railway cuts and along carriage roads, shows that this region has not escaped the decay and leveling effects of atmospheric erosion. The exposures of residual débris are not remarkable, however, as compared with typical localities in North Carolina and Virginia, for example, and seldom exceed 40 or 50 feet in depth. The rock in the stream beds is quite compact, although presenting indications of considerable chemical change. This portion of South Carolina, in common with other areas in the southern Appalachians, forms an apparent exception to the rule that the residual deposits of the Atlantic States increase toward the south. This exception is explained by the conditions of erosion which obtained in some portions of the southern states.

"In regard to the widespread decay of the crystalline rocks of South Carolina we have the testimony of M. Tuomey, whose conclusions in this connection of some forty years' standing can not be questioned, as is shown by the following quotation:

"'There is scarcely anything more striking in the face of the country in this (western) part of the state than the great extent and depth to which disintegration of the rocks has proceeded. Were it not for the occasional blocks of granite that lie scattered here and there, a person whose observations were confined to the surface would scarcely suppose himself traveling over the upturned edges of a series of rocks.'(*a*)

a From a report on the Geology of South Carolina, Columbia, S. C., 1848.

"When average samples of residual deposits left by the decomposition of crystalline rocks are agitated in water more or less angular fragments of quartz and feldspar, with scales of mica and fragments of other minerals, are usually obtained. This material differs with variations in the character of the parent rocks and with variations in its degree of decomposition. On examining these residual sands with the microscope, especially in cases where the decomposition is well advanced, it has been found that each grain is coated with a thin shell having a brownish or red color. Prolonged washing fails to remove this superficial coating, a fact which is well illustrated by the color of the sands deposited by the streams of Virginia and the Carolinas in the regions underlaid by crystalline rocks. Hot hydrochloric acid dissolves the coloring matter, however, and leaves the grains of quartz, feldspar, etc., with their normal tints. It has been determined from chemical analyses of a number of samples of partially decomposed crystalline rocks that the incrustation which gives the grains their characteristic color is rich in both ferric oxide and alumina, and may perhaps be best described as a ferruginous clay. It is therefore evident that the predominant red color of residual deposits is due to a coating consisting largely of ferric oxide deposited during the disintegration and decomposition of the parent rocks, around the individual grains into which the rock becomes divided in weathering.

"The decay of the rocks in the southern Atlantic states has been observed by many travelers and has been the subject of a number of essays. Among the many contributions to the subject, one of the most definite and instructive is by Prof. T. Sterry Hunt, who, in writing on the lithology of the southern Appalachian region, says:

"'The rocks are covered often to a depth of a hundred feet or more by the undisturbed products of their own decomposition, the protoxide bases having been removed by solution from the feldspars, the hornblende, and the whole rock, with the exception of the quartzose layers, reduced to a clayey mass, still, however, showing inclined planes of stratification.'

"Similar testimony is furnished by Prof. W. M. Fontaine, who states that 'the depth to which decay has penetrated here (in the granites and gneisses near Richmond, Virginia) is far less than in the southern and southwestern parts of the state. In the latter we find strata not specially prone to decay often decomposed and changed to a loose earth for fifty and even one hundred feet.'

"Descriptions of the surface decay of the rocks of the southern Appalachian region by other observers might be quoted, but enough has been presented for the purposes of this paper."

Only a small part of this decay produces rock kaolin of sufficient purity for industrial uses, for there are few localities of the original rock material where the feldspar is free from iron-bearing minerals which destroy their kaolinitic value, and only a fraction of this is preserved in nature from removal by erosion. In soil-covered depressions in granitic regions, void of deep-cut outlet drainage, residual clays are likely to be found, and in these search is made in Wales and other countries.

In the Appalachian region rock kaolins are preserved from erosion by the thin overlapping sheets of later sediments; hence along the parting between the interior margin of the sedimentary sheets of the coastal plain and the feldspathic rocks valuable deposits often occur.

RESIDUAL OR ROCK KAOLIN.

All the so-called kaolins are not residual rock kaolins. All rock kaolins are not suitable for porcelain ware, though some of them are used for coarse products, such as fire brick. The term kaolin should be confined to clays of sufficient purity for the manufacture of the body of porcelain, and rock kaolin or residual kaolin be used for those kaolins which remain in the place of origin. The original kaolin of China is an entirely different rock from the kaolin materials of Western countries; hence the terms employed in this paper, although historically improper, are sanctioned by usage and are the accepted nomenclature of clay workers. The Chinese kaolin, as shown by von Richtofen (Am. Jour. Sci., On the Porcelain Rocks of China) is a metamorphosed sedimentary rock occurring between layers of stratified slate, which after mining is repeatedly pulverized and sorted and the finest particles retained for use.

The kaolins of Europe upon which our commercial nomenclature is founded are residual or rock kaolins, derived from feldspathic igneous rock.

The famous Sevres porcelain clay of France, found near Limoges, is a residual mass, the result of the decomposition of a vein of feldspar (pegmatite) in a mass of gneiss, and is separated by washing out its impurities of quartz.

The porcelain clay of England is obtained by grinding and washing a weathered granite of orthoclase feldspar and quartz which occurs in Cornwall. The rock is also used under the name of Cornish stone, and is largely imported into this country.

The Dresden porcelains are made from decomposing granite and porphyry, which are separated into clay and impurities by artificial sedimentation. Other European porcelains are obtained from graphic granite and altered andesite.

In all these instances it is important to remember that the clay does not occur as a pure material, but as the disintegrated residual igneous rock, which must be artificially pulverized, washed, and settled in pools—processes imitative of those of nature by which sedimentary clays are deposited, and processes which constitute an industry distinct from pottery-making. Neither are clays pure white in color; they are sometimes quite dark, but must be free from foreign metallic substance.

It is important to state these facts, because, owing to the popular impression in this country that porcelain clays occur pure in nature, many valuable localities have been overlooked.

The occurrence of rock kaolin is necessarily confined to regions where feldspathic rocks abound and the disintegrating rainfall is abundant. The principal areas in the United States presenting these conditions are—

1. The eastern margin of the Appalachian mountains, composed of feldspathic granites, etc., extending from eastern Alabama to Maine, through Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, Pennsylvania, and New England.

2. The granitic area extending into the northern margin of our country from Canada, including northern New York and parts of Michigan, Wisconsin, and Minnesota.

3. Local granitic areas in Missouri, Arkansas, Indian Territory, and Texas.

4. Granitic and volcanic areas of the western Cordilleran region.

Residual kaolins of sedimentary rocks.—Sedimentary rocks sometimes produce kaolin by decay. Feldspar is ground, transported as a sediment, and redeposited without being dealkalinized until after redeposition and a fair kaolin is produced. This is especially possible when the feldspar is mixed with porous sand, which favors percolation of water. Deposits of this kind are rare, however, unless most of the sedimentary kaolins are so produced. "Feldspar and mica occur in the plastic clays of New Jersey, irregularly distributed through the beds. The feldspar is seen in some of the coarser clays, in some of the fire sands, and in the so-called 'feldspar beds,' but in small quantities. It appears much altered or kaolinized. This condition is very marked in the kaolin beds at Trenton, which is the decomposed gneissic rock." (*Clay Deposits of New Jersey*, p. 276.) The nearly kaolin clays of Richmond are also apparently of this origin.

Another peculiar origin of clay as a residual deposit is that produced by the decay of limestones. One would hardly suppose the firm limestones of the Paleozoic formations, many of which contain only little over a trace of aluminum in their analyses, would, upon dissolving under atmospheric influences, leave behind them such vast deposits of clay. Yet this has been proved, and the immense accumulations of red clay in the Appalachian limestone regions are attributed to this origin, and in general where limstones are being dissolved by the infiltration of water clays may be observed as an accompaniment.

In Indiana, as has been shown by Cox and others, the residuum of the limestone is a pure white clay, which is alleged to be kaolin, and to which the name indianaite has been given. The following descriptions of this material are taken from the reports of the Indiana state geological survey for 1885–'86:

Kaolin exists in Indiana, covering with its beds a large area and presenting various grades of fineness and color from a pure-white impalpable powder to a red or brown-red, gray, whitish, greenish, and bluish clay, unctuous to the touch, and perfectly plastic and ductile when softened and mixed with water.

The kaolins of Indiana are found occupying the space which at other points is filled by a stratum of limestone in the Coal Measures. In Lawrence county the bed is next below the Conglomerate and occupies the place of a limestone, which, not far away, is still seen in position.

The white kaolin of Lawrence county is probably identical with the clay of Golconda, Illinois, as its horizon is the same, and its similarity to that of New Jersey is very close, though the latter is found in the Cretaceous rocks. The ball clay of Missouri is much more siliceous, and, further, its silica, as well as that of the New Jersey clays, is in a larger ratio free and "grainy."

In Harrison county pockets of white kaolin were found in the "glass-sand" deposits. There is also in Harrison county an immense deposit of tinted kaolin admirably adapted to the purposes of the potter and terra-cotta worker. Owen county, too, has practically inexhaustible beds. But the kaolin of Lawrence county alone is sufficient to build up and maintain for many years a manufacturing center as great as any of the pottery and porcelain establishments of England, France, or Germany.

It is somewhat doubtful, however, if the claims that this material is a true kaolinite are not somewhat extravagant, and that after all it should not be classified as a plastic, or ball clay. The clay manufacturers of New Jersey, who are searching the country for good kaolins, do not recognize it as the source of future supply for the china and porcelain clay. It is beyond doubt of great value for all the uses to which plastic clays can be put, however.

It is difficult to present an accurate catalogue of the known localities of rock kaolin in the United States, or to differentiate workable from the worthless localities, owing to the fact that the subject has received little attention from previous writers.

SEDIMENTARY OR BEDDED CLAYS.

The residual clays are attacked by the rainfall and transported by the running streams which deposit them as sheets or strata whenever the current is checked. Since the first appearance of land and rainfall this process of disintegration and transportation has been going on, and, as a result, the earth's crust is coated in various places with numerous deposits of sediments of which at least one-third is clay in various degrees of purity or mixture. These clay deposits may be of vast extent or of limited local occurrence.

Occasionally a bed of these clays may be found composed almost entirely of rock kaolin free from injurious impurities, which has not acquired the plasticity of other bedded clays; such occurrences are rare. In general, however, the sedimentary clays are highly plastic from the constant regrinding they have undergone and more or less mixed with ingredients injurious to the production of the finest grade of ware. They form the chief basis of the world's clay industry, being the chief material except for the china ware and refractory industries, and they are a requisite accessory in these.

Each running stream grinds and washes the material preliminary to its deposition in the natural settling tanks, found wherever the current is checked by meeting a quiet body of water, a lake, lagoon, or even the great ocean. When the muddy streams of nature are checked by these settling reservoirs and can no longer carry their load of sediment, they are said to have reached base level, and it is at these ancient base levels of older ocean, lake, or river that the great clay deposits of the world are found, often since elevated by mountain movements into the highest land. As the clay washer puts in his tank nodules of flint to grind the clay, so in the streams there are bowlders and pebbles of harder material which grind the clay upon its journey to base level. These are usually deposited, owing to their heavier weight, at the first checking of the current, while the clays are laid down above them or beyond, at the final checking of the waters. The alkaline substances, especially lime, are carried still further in solution and finally precipitated by chemical and animal agencies as the deeper water limestones. Thus it is that throughout the geologic strata of the world there exists a three-fold succession in any sedimentary formation of sand, clay, and limestone, or alternations thereof.

These deposits are often elevated into land and again subjected to the processes of disintegration and redeposition or hardened into shales and slates. So often is this repeated that the original source of the clay deposit can no longer be traced, except through many repeated depositions and mixtures, during which they have gained increased plasticity and often injurious mixtures of iron, lime, and other ingredients. So comprehensive and varied are the clay-making processes of nature that every degree of variation in product is the result; yet we can trace in the various sedimentary sheets of our country some generalizations that will be of great value to the practical clay worker. With these facts in mind the clays of our country will be discussed according to their natural classification.

Nine-tenths of the total surface of the United States is composed of sedimentary formations, which were deposited at marine, lacustral, or fluvatile base level. These vary greatly in thickness. In some localities, as along the Atlantic coastal plain, only a few feet cover the underlying igneous floor. Again, as at Galveston, there may be 10,000 or 20,000 feet in thickness of these sediments, an artesian well at the last-named place having penetrated 3,000 feet of the sediments without reaching deposits of older age than the Tertiary. Of the total thickness of these deposits there is hardly a layer which can not be used by man in the industrial arts, either as building stone and sand in the natural state, or by fusion converted into cements, brick, lime, or pottery. In fact, if the value of our mineral resources were measured by their utility, it would be found that the humbler products of these sediments constitute the chief value of our nation.

We must omit further reference to the products of the lime and sand strata, which constitute two-thirds of the sedimentary formations, and in this article confine our remarks to the clay layers, or mixtures of clay and sand which are used in the clay industries.

The clay strata will now be described in sequence of their deposition.

It may be well argued that clay deposits are variable in character, and that only the practical clay worker is capable of determining their value; hence any attempt at a geological classification will be of little value. Upon the contrary, however, while the first of the foregoing propositions is true, much can be learned by properly defining the general distribution, occurrence, and geologic range of the formations, whereby, if no other good is accomplished, a waste of capital and energy may be prevented in searching for materials in negative regions. It is also true that rocks of similar geological age often present great variation in character in different areas of their outcrop, but notwithstanding these exceptions, there are certain almost world-wide resemblances, the product of simultaneous world-wide agencies, which have given to portions of the geological column a remarkable individuality wherever found. Thus it is that the oldest known rocks are generally Archean granites and schists, overlapped by the earlier sedimentaries or Paleozoic group, which are, in general, hardened and altered material, the lime usually occurring as massive limestones, the clays as shales and slates, and the sands as quartzites. Likewise, in the earlier half of middle geologic time the striking red and vermilion clays and sandstone have a world-wide occurrence, while in the latter half the Cretaceous sands and clays are usually unaltered, except when folded into mountainous strata, and the lime occurs in a more or less chalky condition. Likewise in the Tertiary deposits there is still less consolidation of materials, while in the more recent deposits of Quarternary time we have deposits greatly resembling those being made at present.

In no country are such great exceptions found to these generalizations as in America. The fundamental facts hold true in most cases, and to the seeker after clay materials they will be of great assistance. Good plastic clays have been deposited in formations of all geologic ages since sedimentation began, but, in general, it may be said that those of the older group, the Paleozoic, have been so altered into slates and shales as to have lost their original plastic condition. Exceptions are found to this rule, for in the later beds of the Paleozoic (the Carboniferous formation) are found some of the most useful sedimentary clays of our country. The deposits of the later half of the Mesozoic group and of the Tertiary are the most productive of valuable clay beds, because they have been little altered, and retain their original plasticity. Likewise the most recent group of deposits, the Quaternary and recent, may be said to be the most propitious for the production of brick clays, which, as has been explained in the definition of brick clays, should be fresh-water or land deposits. The constant erosion of time has removed all superficial deposits of earlier geological age, hence it is but natural and logical that the brick clays should be almost limited to those of the later ages in which they have been preserved. The distribution of sedimentary clay material throughout the geological ages and formations is approximately shown in the table on page 480.

Inasmuch as the original source of all the clays is in the feldspar of the igneous rocks, it is evident that the greatest clay deposits must occur in regions where those rocks are disintegrating, or on their border where their detritus has been redeposited by later sedimentation. It is likewise evident that the disintegrating and depositing processes have been longer in operation in the regions adjacent to the exposures of the older igneous rocks, and hence the finer clay deposits occur there, rather than in the regions of the newer igneous rocks, such as the eruptive areas of the West. Likewise clay deposits should theoretically be of greater abundance in the regions of greater humidity. A glance at the distribution of the older igneous rocks of our country and the areas of relative rainfall will show that the best conditions attain in the eastern United States, along the eastern and southern front of the Appalachian mountain system, and the least propitious in the arid regions. The outcrop of the nucleal granitic masses from which the sedimentaries have been derived has already been given in the discussion of the residual clays and rock kaolin. The clay-bearing formations are in general coastward of these, or at least in the direction of the off-flowing drainage.

Coastward of the Appalachian line is the great coal region of the Atlantic and Gulf States, in which most of the plastic clays of middle and later geologic time are deposited, extending in a belt from the islands of the Massachusetts coast, southward through New Jersey and other States into Mexico.

West of the Appalachian divide and south of the northern granitic region is the central drainage basin of the Ohio, Upper Mississippi, Missouri, and Tennessee, in which the plastic clay deposits of the Coal Measures of Carboniferous time are developed.

Throughout the western or Cordilleran region there is an absence of the Carboniferous clays, but the plastic formations of middle geologic time occur, either folded up into the Rocky mountains or developed beneath the great plains along their eastern front, while between the main chains of the great Sierras there are extensive lake deposits of recent age.

The shale and slate industries are mostly confined within the Appalachian or central areas.

Stretching nearly across the northern end of the United States is the great sheet of glacial débris, which gives to the country north of the Ohio, Missouri, and Potomac an individuality entirely different from the rest.

SEDIMENTARY CLAYS OF THE GEOLOGICAL FORMATIONS IN SEQUENCE.

CLAYS OF THE OLDER, OR PALEOZOIC, FORMATIONS.

The older sedimentary formations contain extensive beds of clay material, but with the exception of those of its latest formations, the Carboniferous and Permian groups, they generally occur in the condition of shales or slates. These are widely distributed throughout New York, the central States, western New England, Pennsylvania, and other States along the western part of the Appalachian range. The slates are used for roofing and other purposes without firing, and do not properly come under the head of clay materials for burning. The shales from the Cambrian formation in Pennsylvania and in Washington county, New York, are ground for the purpose of making plastic clays and paints. At Springfield, Illinois, the shales from the Carboniferous formations are ground and burned into a paving brick of excellent durability.

The Carboniferous clays are extensively mined for material used in the manufacture of fire clay. Plastic clays for drain tile, and pottery are also worked from the Carboniferous formation in Missouri, Illinois, and adjacent States.

West of the one hundredth meridian the Carboniferous formation is composed of more consolidated deposits than in the east, and is of no value in the clay industry.

The description of the Carboniferous clays found elsewhere under the head of Missouri may be applied to large areas of the same formation in Iowa, Illinois, Indiana, West Virginia, and western Pennsylvania, Kentucky, middle and western Tennessee, and northern Alabama and Georgia, where the same formations exist and where the products are applied to the same uses as those of Saint Louis. Western Arkansas and eastern Indian Territory are likewise largely composed of similar material, while in central Texas, in the counties of Parker, Palo Pinto, Eastland, Young, Stephens, Coleman, Brown, Comanche, San Saba, and Burnet, the formation is also present, though as yet little appreciated for the uses of commerce.

In all of these States the clays can be utilized, and, except in the three southwestern ones mentioned, it may be truthfully said that nearly one-half of the refractory and brownware products of the country are from this formation, and that in importance it is equalled only by that of the Cretaceous deposits of the Atlantic coast and the Rocky Mountain region.

THE PERMIAN CLAYS.

In eastern Kansas south through the Indian Territory into Texas along a line through Albany, Baird, and Ballinger, the Carboniferous formation continues upward into the Permian, which, together with the Trias, westward to the Sierras, constitutes a vast and little appreciated formation known as the Red beds. This formation from its bottom to top contains many beds of clay, which are of value for brick and terra cotta. These clays are of two characters. (1) Along the eastern margin and at the lower portion of the formation they consist of brown and pink or blue clays resembling those of the Carboniferous. (2) In the upper portion the clays are of striking chocolate and vermilion colors and mixed with very fine sand. Those of the first-mentioned category should be very valuable for refractory, tile, and pipe clays, but the latter would only be suitable for brick, owing to the excess of iron and silica. It may be mentioned here, however, that no finer mineral paint can be procured than that furnished by these Red bed clays, which can be procured by washing the clay from the sand.

CLAYS OF THE MESOZOIC AND CENOZOIC FORMATIONS.

As the older or Paleozoic formations of the country are generally distinguished by their hardness or induration, so the later half of the geologic column is principally composed of unconsolidated or earthy formations, the original sediments having been little indurated by the chemical and orographic movements. There are exceptions to this generalization, but, as a rule, it holds true. Owing to this lack of consolidation these clays and sands are easily mined, and we must look to them for the larger and more widely distributed clay deposits. In fact, with the exception of the Carboniferous-Permian clays before mentioned, all of the commercial clays of the United States are found in the Meso-Cenozoic deposit formations. As with the Paleozoic formations, however, the older beds of the Mesozoic are least propitious, and the basal Triassic formation of the Mesozoic is of little use in the clay industry except for the manufacture of paint. These are principally composed of red clays and sandstones both in the Atlantic and Cordilleran regions of the country.

Too little is known of its scant occurrence in the Cordilleran area to make it worthy of discussion at present from an economic standpoint.

It is in the Cretaceous period, however, that we find the greatest series of clay deposits, extending from that time to the present, and often overlapping each other in close proximity, as in New Jersey. These will now be briefly reviewed in sequence, beginning with the lowest.

THE LOWER CRETACEOUS OR POTOMAC CLAYS.

These include, provisionally, the Potomac clays of Maryland and Virginia; the Gay Head clays of Massachusetts; the plastic clays of New Jersey; the Tuscaloosa clays of Alabama and Mississippi; the Trinity clays of Arkansas and Texas.

The Potomac formation is the oldest unindurated formation of the Atlantic coastal plain and outcrops along its interior margin, near the fall line of the rivers, from Gay Head, the western point of Martha's Vineyard, through New Jersey via the cities of Trenton and Princeton, through Delaware, Maryland, and the District of Columbia. In east Virginia via Richmond, Alexandria, Fredericksburg. Its beds in the Carolinas and Georgia are either lacking or concealed by the newer formations. In Alabama it outcrops as the Tuscaloosa formation and occupies a narrow belt around the southern foot of the Appalachian mountains and extends into Mississippi.(*a*) For a long distance across the Mississippi valley the beds are again concealed by overlap, but appear again near Antoine, Pike county, Arkansas, whence they extend westward into Indian Territory west of Marietta; thence they strike southward through Texas to the Brazos, and finally disappear at the Colorado. The accompanying sands of the formation constitute the greater portion of the layers west of the Mississippi.

Throughout its extent the Potomac formation is distinguished by similarity of structure and composition. It consists of beds of fine white sand (pack sand) and white and mottled clays. The latter are distinguished by a peculiar tint of magenta red, which differs from the iron red, the yellow red, and brick-dust reds of the underlying formations. The proportion of clays to sand diminishes Texasward, but exists throughout its extent.

Although utilized extensively only in the North Atlantic States, they are the most valuable of the North American plastic clays, and are used in the clay industries of New Jersey, Maryland, and the District of Columbia. These clays are very compact, glossy, requiring vigorous blows of the pick to break them up when unweathered. In the Texas region the upper beds of the Lower Cretaceous formation contain many beds of marly calcareous and magnesian clays which would be serviceable in certain industries, especially in cement making. One of these, the Arietina clay, is valuable for coarser earthenware products if properly manipulated.

THE UPPER CRETACEOUS CLAYS OF THE UNITED STATES.

1. Basement division: The Amboy clays of the New Jersey region; the Eutaw clays of the Alabama-Mississippi region; the Dakota and Benton clays of the Arkansas, Texas, and Rocky Mountain region.

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a Bulletin United States Geological Survey No. 43. On the Tertiary and Cretaceous Strata of the Tuscaloosa, Tombigbee, and Alabama rivers.

2. The marly clays of the Middle division.

3. The clays of the Upper division: The Ripley clays of Alabama, Arkansas, and Texas; the clays of the Montana group of the Rocky mountains and Great Plains region; the clays of the Upper Cretaceous of the Pacific division.

From the above headings it will be evident that the Upper Cretaceous formations of this country contain a great number of useful clay deposits. These are of two general characters: (1) The true clays sufficiently pure for firing, such as those of the upper and lower divisions, and (2) impure clays, mixed with lime or sand, or both, which are of value for agricultural uses and the manufacture of Portland cement, and need not be further mentioned in this paper, except to say that they do not occur in the Atlantic div ision, but attain their maximum development in Texas and adjacent states.

The clays of the basement division.—The most valuable clays of the Upper Cretaceous formation are found in the basement beds, and are of the greatest value for refractory and earthenware uses.

In New Jersey this formation is said by some geologists to rest directly upon the Lower Cretaceous clays, and its beginning is placed at the so-called kaolin and feldspar beds. The formations are so intimately associated that other geologists do not agree upon their separation, and include them all in the Upper Cretaceous beds. The details of the beds and their products are well set forth in the admirable report before mentioned, which the State of New Jersey has prepared upon its clay deposits. The beds produce both refractory and stoneware clays and are the basis of a large and profitable industry in that state.

South of New Jersey to Alabama there is no recorded evidence of the occurrence or utilization of the clays of this age. In Alabama and Mississippi they have been described by the State Geologists, Smith and Hilgard, but little is said concerning their economic value, which, from their silence, it is inferred can not be great. Neither do we possess any data concerning them in Arkansas, the writer of this paper, who made a survey of the Cretaceous deposits of that State, having failed to find them there.

In Texas and southern Indian Territory there are many clay beds in the Dakota formation free from excess of lime and iron, which may be of value for earthern ware and drain tile, but that State possesses no report upon their value. Concerning the Benton clays, which inseparably succeed the Dakota in Texas, more will be said after the discussion of the Rocky Mountain region, with which beds are continuous.

Along the plains at the eastern base of the Rocky Mountain region, the Dakota formation affords clay which equals, if it does not excel, any found in this country. This is a firm black clay, almost a slate, and is extensively mined and manufactured near Golden and Denver, its products having supplanted the refractory utensils and brick used in smelting formerly imported into this country, and used in the refining and smelting processes of the mining regions. This clay no doubt has wide extent along the Rocky mountain front and should be found as far south as Texas. In fact, in the region of the latter State between the White Rock escarpment and the Lower Cross timbers, which extend southward from the vicinity of Denison to Waco, there is much clay which in the former beds I have described in other reports as the Eagle Ford shales, which have a strong resemblance to the Colorado clays.

Clays of the Upper or Montana division of the Upper Cretaceous.—In the Atlantic division the uppermost beds of the Upper Cretaceous are mostly composed of greensand marls and sands, and hence are of little or no use in the clay industries. In the states of Georgia, Alabama, Mississippi, Arkansas, and Texas north of the Colorado, the upper beds of the Upper Cretaceous (the Glauconitic division of the writer) are intercalated with beds of clay very much resembling those of the Eocene beds to be described later, and also with marly or calcareous clays. The purer beds of these upper clays are suitable for earthenware and cruder plastic clay products. In Mississippi and Alabama they are known as the Ripley clays. In the region of the Lower Rio Grande and thence northward along the Great Plains region and the Rocky mountain region extending as far west as into Washington, the uppermost Upper Cretaceous beds become more argillaceous and are said to pass by transition into the Eocene age, the combined formation being called the Laramie. These, with the immediate lower beds (the Montana group of White), contain many beds of useful clays, alternating with sands and lignites, and should prove of value. They are further discussed in the description by States.

The lignitic clays of the Eocene beds at the base of the Tertiary are of little commercial value in the North Atlantic States, but increase in relative importance southward, especially in Alabama, Mississippi, Tennessee, Arkansas, and Texas, where they consist of alternations of sand and white or blue white clays and have a total thickness of 1,000 feet or more. These clay strata vary in thickness from one inch to several feet, and are remarkably pure and tenaceous. Doubtless they are the source of much of the clay found in the overlying Lafayette formation. They are used for making pots and jugs in northern Tennessee, near La Grange and Grand Junction and at various points in Mississippi, Arkansas, and eastern Texas. They are valuable for all earthenware, drain tile, and similar purposes, but are not suitable for higher grades. Their quantity and distribution should encourage more general use.

CLAYS OF THE TERTIARY FORMATIONS.

The deposits of the Tertiary formation belong to several widely differing classes. (1) The Great Basin deposits of the West, the Great Plains deposits, the Atlantic and Gulf coast Miocene, the Laramie of the West. (2) The Eocene of the Atlantic and Gulf. Coastal plain Lacustral deposits.

Those of the earlier Tertiary, or Eocene, are closely allied in composition and origin to the beds of the Upper Cretaceous formation, and, like them, apparently were deposited at marine base level in the fresh or brackish estuarine and littoral waters. In fact, geologists consider the so-called Eocene of the Rocky Mountain region which extends down the Rio Grande as far as Laredo, Texas, where it meets the great Eo-Lignitic formation of the Atlantic coastal plain as a direct continuation of the uppermost Cretaceous beds. In other words, there was a formation which was deposited during the close of the Cretaceous and the beginning of the Tertiary. This formation begins as far north on the Atlantic coast as New Jersey, extending continuous with the Cretaceous deposits as far south as Mexico, and thence northwest over the Rocky Mountain region into Washington. In fact, the beds ought to be classed by affinity of origin and distribution with the Cretaceous clay-bearing group.

The later Tertiary deposits.—At the close of the Eocene it is generally conceded that a great elevation of the continent took place, whereby the whole of the Rocky Mountain region was elevated and the conditions destroyed whereby the long-continued deposition of clay and other littoral deposits had so long continued over the Great Plains and Atlantic and Gulf coastal regions, so that in later Tertiary time the whole physical aspect of the continent was more or less modified, and a different character of deposition resulted. Along the immediate Atlantic coastal plain, especially southward from Virginia to Texas, this deposition continued at marine base level, but it was much modified in arrangement and character of material. In these beds are found some of the purest plastic clays and sedimentary kaolins of our country. They are further described under the states lying within the regions of its occurrence. In the western half of the United States, however, entirely different conditions were initiated. The Gulf of Mexico was withdrawn from over the Great Plains region, and numerous lakes developed in the Great Basin region between the great mountain ranges; sedimentation continued in these and over the Great Plains region, but, inasmuch as great aridity prevailed, the material deposited was very calcareous and in many places alkaline and of entirely different arrangement and composition from that laid down at the marine base level of the Atlantic coast. It is true, however, that in some of these beds there are fair deposits of clay which have been used from time immemorial by the aborigines, but they are in general inferior for other than brick purposes. The Tertiary deposits of the Great Plains region are especially unpropitious for workable beds of clay, although good clays do occasionally occur in the breaks of the plains where these have been eroded through into the Cretaceous formations.

CLAYS OF THE PLEISTOCENE (QUATERNARY) AND RECENT FORMATIONS.

Recent alluvial deposits. Glacial deposits of the northern United States. Loess. Lacustral deposits of the western region. Clays of the Columbian and Terrace epochs.

The Quaternary (Pleistocene) and recent formations afford the best brick-clay material of the United States. This is principally owing to the fact that they are mostly fresh-water deposits, free from the injurious saline salts of marine formations, and that in general they possess the requisite impurity, in the nature of sand, an essential to all brick clays.

They are diverse in origin and material, the same formation revealing great differences throughout different portions of its extent, and varying with the general composition of the land drained by the streams which deposit them. In general, they may be classified according to the above divisions.

Recent alluvial deposits.—In many localities local deposits of clays may be seen forming in the beds of streams after an overflow, in ponds, and under other conditions. In the northern States the clays of the glacial deposits are being rewashed by the rainfall and are largely used, especially in northern New York, for brick clays. All outcrops or exposures of the older formations, of whatever age, are being worked over by the rain-falls, and in the daily decay and redeposition of the rocks we may see repeated all the great sedimentary processes of the past.

The Glacial clays.—The great sheet of glacial débris extends across the northern end of the United States, as far south as the Ohio, and from its material clays are in some localities procured for the making of brick. In general they are of inferior value to the river deposits, owing to the fact that the material is exceedingly irregular in size and composition.

The Loess.—The Loess is an exceedingly fine material or rock powder, which was deposited by the streams flowing south from the great ice sheets during the glacial epochs. It especially abounds in the valleys of the Missouri, Ohio, and Mississippi, and, with its accompaniment of yellow loam, it forms the bluffs of the latter stream as far south as Vicksburg and Natchez. The Loess and yellow loam constitute an excellent brick material which is the basis of large brick industries at Saint Louis, Omaha, Memphis, Vicksburg, and elsewhere. It ranks next to the Columbia clays in importance as the chief brick-producing formation of the country.

The alluvial and terrace clays of the stream valleys.—The lower ports on all of the streams draining into the Gulf and the Atlantic are in general marked by extensive "second bottom" deposits of older clays and alluvium, which usually extend up these streams far inland, the distance increasing as we go southward. Similar to these ancient stream deposits in the rivers, especially in the lower portion of the streams of the south and southwest which are subject to overflow, are recent alluvial deposits being made by every rise of the streams. These, the older and the recent, are the familiar clays and gravels of all the river valleys from Maine to Mexico. North of the San Marcos river, in Texas, these occur as bright iron colored, or red, mixtures of clay and sand and gravel. In the streams or the arid region the deposits are lacking in these red colors and are usually white or dirty gray. The Loess previously mentioned in the Mississippi Valley is also of this light color. Throughout their extent the character of these river deposits varies with the character of the formations drained by the respective streams. The older terrace or second bottom deposits are mostly of the Quaternary (Pleistocene) age and have been called the Columbian formation by McGee.

The Columbian and other alluvial brick clays of the Atlantic and Gulf coastal plain and the Mississippi drainage area may be classified as follows:

1. The Haverstraw type. Those of the Hudson and New England area are brick of good quality and fair color, but lacking the bright red luster of the bricks of the Philadelphia type. These are mostly made from clays of the terrace epoch, a late phase of the Columbian formation, according to McGee, and are derived from a differently composed surface from the river clays south of the Hudson.

2. The Philadelphia type. The river alluvium from the Hudson to the James, and perhaps beyond, produces the clays of the bright brick red colors, known as the "Philadelphia" type. This color is due to the excess of iron in the rocks from the Piedmont area and Appalachian plateau, from which the material is derived.

3. The Nashville type. The alluvial clays of the streams draining the hard limestone and red clay formations of the Appalachian area, such as those of the southern portion or the coastal plain in Alabama, Mississippi, and the Tennessee, Cumberland, and Ohio, are generally of a dark dull color, with a tendency to glaze on firing. These constitute most of the clays of the Mississippi Valley, except those made from the loess and yellow loam.

4. In the trans-Mississippi States, Arkansas, Texas, and Indian Territory, the character of the terrace clays of the principal streams is again modified in composition by the drainage of different formations, containing lime, gypsum, and other ingredients. Each stream in this region presents a different variety of detritus from the other, and a corresponding brick product, varying in color and hardness, but generally of light colors.

The deposition of any stream at marine base level is a continuous sheet with finer material, which is carried to the margin of the sea and there laid down as a littoral formation. Along the north Atlantic coastal plain the marine continuation of the river deposits of the Columbian formation has not yet been elevated above sea level, but as we go southward, especially in Louisiana and Texas, this marine phase of the Columbian is more and more developed, until in those regions immediately bordering the coast there is a formation of supposed Columbian age, known as the coast clays, underlying the coast prairies. This is rather different in arrangement and composition from the material of the river brick clays, which extend inland from it, and they should not be confused.

In the Gulf states the Columbian clays are of a somewhat different composition and very variable. In Georgia, Alabama, and Mississippi, except the Mississippi Valley, they are largely derived from the Appalachian terminus, but contain more lime and do not color so finely. West of the Mississippi they vary in composition in every stream from the Missouri to the Rio Grande, affording numerous brick materials of many qualities. The débris of each of the western rivers is derived from a different source. That of the Missouri is largely charged with washed clays and a little alkali of the Great Plains and Rocky Mountain region. Where the Arkansas enters the coastal plain at Little Rock it deposits the sediments derived from each of the conspicuous formations of the west, viz., the granite of the Rocky mountains, the red clays, and alkaline salts of the Red beds (introduced into the Arkansas from the Cimmaron and Canadian), the silt of the Great Plains, and much Appalachian like débris from Indian Territory and western Arkansas.

The Ouachita River deposits are mostly derived from the Paleozoic formations of the Ouachita mountains and produce good brick clays at Arkadelphia, although lacking in fine color.

Red River clays consist of a great diversity of formations, including lime and gypsum, which are not desirable. Fair brick is made at Texarkana, Denison, Shreveport, and elsewhere.

The Trinity River clays are better at Dallas, but contain too much lime and magnesia to produce good colors. The clays of the Brazos are of diverse origin and consist of many sediments. The large percentage of clays from the Carboniferous beds of its medial course add much to their quality, and good brick void of color are made at Waco and elsewhere along its course.

The Colorado presents an exceptional condition. The sediments are largely composed of decomposed feldspar from the the Llano-Burnet Granite district, from which a superior quality of cream-colored brick is manufactured of the Milwaukee type. The clays of the rivers south of the Colorado are over-supplied with lime and alkalies, but fair brick for local use is made at Laredo and Eagle Pass, on the Rio Grande.

The diversity of material in the river deposits may be appreciated better by considering the varying character of the geological formations of the regions drained by the rivers in which the clays are found.

The clays of the Quaternary and recent origin in the western or Cordilleran area do not differ in general from those of the Tertiary lake deposits. The rewash or sediments derived from these beds and the various formations of the mountains, as found in the few stream valleys, are the principal material used for brick and adobe. In Montana, Idaho, Utah, and California, the Quaternary formations are used for local brick consumption.

Clays of the Appomattox or Lafayette formation.—The Lafayette formation is a sheet of coarse gravel sands and clays of latest Tertiary or early Quaternary age, coinciding in extent with the preceding formations around the Atlantic coastal plain and Mississippi embayment into Arkansas and Texas. North of the Colorado river, in Texas, it is characterized by excessive ferrugination, and is distinguished from the Columbian or later clays by the fact that its remnants occupy the divides or uplands separating the stream valleys, while the latter is found in the valleys of the rivers. The Lafayette formation is known in its North Atlantic extent as the Appomattox formation; in Alabama and Mississippi as the Orange Sand; in west Tennessee as the Lafayette; in Arkansas as the Plateau gravel, and in Texas as the Fayette formation. The clays of this formation are abundant, useful, and the most valuable of any in the Gulf region. According to Hilgard the clays of this formation are meager pipe clays of great plasticity, requiring little seasoning before working; in this respect they differ materially from the fat intractable clays of some underlying formations. They are poor in lime and magnesia. It is a singular fact that although the inclosing deposits are intense red, but few of the clays are strongly ferruginous; grayish yellow, cream white, and purple are the usual colors.

Full particulars of the occurrence of this clay are given in Professor Hilgard's excellent report. He says these clays are especially valuable for the manufacture of common earthenware and fireproof brick. In west Tennessee, notably in Henry county, these clays are extensively manufactured into pottery and drain tile; they are used also in southwestern Kentucky.

The geological distribution of sedimentary clays by geological age can be followed by aid of the table on page 480 and a geological map of the United States such as that made by Hitchcock, published in Vol. xv. of the Institute of Mining Engineers.

It may be said that the value of clay is in no way determined by its geological age, but, in general, the more valuable and available clay deposits are found in the formations in the later half of the geological column; the later mesozoic formations (Cretaceous age) contain the greatest diversity of plastic and fire clays, and the greatest quantity of our brick clays are produced from the recent and sub-recent alluvial deposits.

Occurrence of the sedimentary clays by States.—By the foregoing description it will be seen that the sedimentary clays occur in every State of the Union. Inasmuch as accurate geological surveys of the clay deposits have been made in very few of these, however, only a preliminary report can be made upon the clays of the country as a whole. Three or four states only have prepared special reports upon their clay deposits, and only one (New Jersey) has published a complete descriptive report of the clays of the State. Generally the clay deposits have failed to receive the consideration by the state surveys which they deserve. Besides in New Jersey, State officials in Minnesota, Indiana, New York, Wisconsin, Missouri, and Arkansas have published, or prepared for publication, papers upon their clay deposits. From these reports and such reliable data as this office has been able to collect, the statement of the residual clay deposits of each State has been prepared. Wherever the geological name of a formation is used its meaning will be found defined in the previous chapter, for inasmuch as these formations extend from one State into another, it is unnecessary to describe its geological position in each State.

ACCESSORY MINERALS USED IN THE CLAY INDUSTRIES.

Quartz, flint, and feldspar are largely used in clay industries for the purpose of mixing with plastic clays and kaolin to produce the desired product. Ordinary sand is largely used in brick making in certain localities where the clay is too plastic or "lean." Quartz and flint are principally used in china and queensware, after having been thoroughly pulverized. Feldspar is also used in these industries for glazing and mixing with clay.

The production of quartz and feldspar are given in other portions of this volume. The latter mineral is getting somewhat scarce, and new localities are desirable. They should be found in many States. Quartz occurs in all regions where there are granitic rocks.

FLINTS FROM THE CHALK FORMATIONS.

Siliceous cherts are common in the older limestone formations of the United States, but it has generally been supposed that the true flints of the Cretaceous or chalk formations, such as are largely imported from Europe for use in clay grinding and mixtures do not occur in this country.

Several years ago the writer called attention to the fact that there were many horizons of true chalks in the Cretaceous formations of the Texas region, and that in one of these, the so-called "Caprina limestone," there were enormous deposits of segregations of black flint nodules. This limestone and the accompanying flints occur extensively throughout central Texas in the counties of Hays, Edwards, Uvalde, Frio, Crockett, Burnet, Travis, Mason, Lampasas, Bell, Coryell, Brown, Williamson, Erath, Hamilton, Comanche, Hood, Coleman, Somervell, and others. The flint beds are usually found surmounting the high buttes and mesas of the region. The most accessible locality, however, is in the west portion of the city of Austin on the banks of the Colorado river, and in the numerous limestone quarries west of the city, where hundreds of tons of the flints have been thrown aside as a waste product in the quarrying industry.

Cretaceous flints are at present largely imported from Dieppe, France, and sell for $1.75 to $2.00 per ton in Trenton, New Jersey, where they are used in the clay-grinding industry. The small, round nodules, which have been water-worn, are used for grinding clay, by being placed in revolving vats of water and kaolin. They are also calcined to whiteness, and ground to mix with china clay to make fine porcelain clay. Quartz is largely substituted for flint in this country in china-clay making, but in the finer products flint is preferable and largely used in Europe.

It is doubtful if the flints of Texas can be profitably shipped to our present china potteries, but it would be very valuable for potteries which should be located in Texas.

OCCURRENCE OF CLAY MATERIAL, BY STATES.

Having given the geological origin of the clay deposits and a general outline of the formations most propitious for their occurrence, a brief account of the clay resources of the different States as far as they can be ascertained, will be given. The lists make no pretensions to completeness, for the clay resources have received very little attention, except in a few localities, and as a whole they have not previously been considered at all.

THE NEW ENGLAND STATES.

This division includes Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island.

Geologic outline.—The larger portion of the area of the New England States consists of feldspathic granites, gneisses, and schists, largely covered by glacial débris. The western portions of Connecticut, Massachusetts, and Vermont contain the shales of the older paleozoic sedimentary formations. Along the southern coast there are deposits of Cretaceous clays upon the outlying islands. The Triassic formation is also developed in Connecticut, Massachusetts, and Rhode Island. Alluvial deposits occur in the wide valleys of the Connecticut and a few other streams. The more valuable kaolins and sedimentary clays of New England are found in the great valley west of the Green mountains, which may be said to be more nearly related to the geological features of New York.

The sedimentary clays are not so prominent in these States as in other portions of the country, owing to the fact that the principal rocks of the region, except along the western and southern border, are of igneous or metamorphic character. The glacial drift affords fair building brick in many localities, although it is not used so extensively as lumber in the building industries. The alluvial deposits of the rivers of both recent and Columbian (late Pleistocene) age are extensively used for brick-making in Connecticut and western Massachusetts. It is generally a sandy, impure clay, which burns well, but does not stand a very high heat, nor is it very plastic. It is principally used for local trade.

Maine.—Irving, in his paper on the kaolins of Wisconsin, reports the occurrence of an excellent material for rock kaolin in the graphic granite of Brunswick, consisting of a mixture of very fine quartz and feldspar. Whether it is kaolinized or not he does not state, and the value of the material needs more elucidation. Feldspar for use in the china clay industry is mined at various places in this State, and there is no reason why good rock kaolin should not occur. Fair brick clays are found in the principal stream valleys.

New Hampshire.—This state is marked throughout by the occurrence of granites and other feldspathic rocks, but no kaolins of value have been reported. According to Messrs. Hitchcock and Upham, who have studied the geology of the State, there are extensive kilns for brick-making in the Merrimack valley, at Hooksett and Bow; also at Plaiston and other localities near the coast. Mr. Upham has described the clays of the modified glacial drift in a valuable paper, and Prof. Hitchcock has given a list of towns where brick are made from the same material in the State report.

Vermont.—White burning plastic clays and sedimentary kaolins are found in Vermont in deposits of Tertiary or later age, in Bennington, Rutland, Addison, and Windsor counties. It is sold as ball clay for use in the paper industry, the manufacture of common stoneware, and brick. The Cambrian shales of western Vermont are also well adapted for grinding into clay and pigment.

Connecticut.—Irving reports a graphic granite suitable for rock kaolin at Haddam, Connecticut, similar to that described by him from Maine. Good brick clays are found in the Connecticut valley and extensively manufactured.

Massachusetts.—Rock kaolin occurs at Andover, but is not extensively mined at present. The eastern attenuation of the Cretaceous clay beds of New Jersey is found on the islands south of the Massachusetts coast at Gay Head and near Narragansett. They are well adapted for making earthenware and tile products. Good brick clays are found in all the principal stream valleys, and extensively manufactured for local consumption. Fine art tile are manufactured at Chelsea from imported ingredients and New Jersey ball clays.

Rhode Island.—Good brick clays are found in Rhode Island, and the plastic clays similar to those of Massachusetts occur at Block Island. These, with those of Massachusetts islands and Long Island, belong to the Potomac or Amboy formation, or both (geologists have not agreed upon this point), and are suitable for making a fair article of pottery and fire brick. The Rhode Island clays also are adapted for earthenware and colored pottery. In general, however, with the exception of Vermont, New England possesses no great possibilities in the line of clay production.

THE ATLANTIC COASTAL STATES.

The eastern portions of the States of New Jersey, Delaware, Maryland, Virginia, South Carolina, Georgia, Mississippi, Alabama, Arkansas, and Texas lie within the region of gently sloping unconsolidated sediments, which were deposited around and against the base of the old Appalachian land and contain the greatest diversity and number of sedimentary deposits. Florida and Louisiana lie entirely within the coastal plain. The western or interior portions of all these States, except Florida and Louisiana, are composed of the older and more consolidated beds of the Appalachian region and upper valley of the Mississippi, with its granitic foundation.

NEW JERSEY.

Residual kaolins.—The so-called kaolins of this state are transported deposits of feldspar and not kaolins. (See New Jersey Geological Survey Report, page 7.)

Sedimentary clays.—New Jersey has published a full and exhaustive treatise upon the clay deposits of the State, which will serve as a ready manual for all interested, and a model volume for the other States of the Union, if they desire a proper appreciation of their clay resources. The sedimentary clays are found east of a line extending from Staten Island to Trenton, and embrace many useful varieties of plastic and brick clays, which are used in the extensive chinaware, pottery, earthenware, stoneware, fire brick, and building brick industries of that State. The plastic and fire clays are found in the Lower Cretaceous formations. Brick clays occur in all the principal stream valleys in the Columbian and Appomattox formations.

No State in the Union has shown such a proper appreciation of its humbler mineral resources as has New Jersey, and consequently the pottery and other clay industries excel those of any other State, and may be said to comprise its chief industrial resources.

PENNSYLVANIA AND DELAWARE.

Residual clay.—In both these States, near the common border, remarkably fine deposits of rock kaolin are found and extensively mined at Brandywine Summit and New Garden, in Delaware county, and at Hockessen, in Delaware, they are at present the chief source of American china clays. This kaolin is derived from the feldspathic gneisses of the region, and the beds are extensive. Excellent pictures of the deposits are given in Volume C 5 of the Pennsylvania (Second) Geological Survey. These beds have been the chief source of supply for American china clays for many years and are worked to their full extent.

Sedimentary clays.—Owing to density of population the clay industries are extensively developed in Pennsylvania. The shales of the Cambrian formation are ground at South Mountain and elsewhere for earthenware clays. The fire clays of the Carboniferous formation abound in the western portion of the State, while the plastic clay formations of the Cretaceous extend from New Jersey into the southwest corner of the State. The river valleys abound in Columbian clays, which in the eastern portion of the State are well adapted for making the celebrated red brick of the Philadelphia type. Higher up these streams contain brick-making clays, but are mostly productive of the less finely colored article from the residual limestone clays of the limestones and shales, through which the streams make their course.

The glacial clays are also developed along the northern half of the State and contain the erratic clay deposits for which the formation is noted throughout its extent.

Sedimentary clays occur in Delaware in the same formations as in New Jersey, although not in such great variety. Pottery, tile, and fire clays are extensively mined in Newcastle and Sussex counties, principally from the beds of the Potomac or Lower Cretaceous formation. The red burning or "Philadelphia" brick of the Columbian formation are also made in the principal stream valleys.

MARYLAND AND DISTRICT OF COLUMBIA.

Rock kaolin similar to that of Delaware exists in Maryland and is derived from the same masses of gneiss.

It is reported near the head of Big Elk creek, Cecil county, in granite; near Annapolis, Anne Arundel county; near Abington, Harford county, a large body; elsewhere in the region of feldspathic rocks in Montgomery, Howard, Carroll, Baltimore, Harford, and Cecil counties, but not in such extensive deposits.

Sedimentary clays.—The Potomac clays continue in the eastern half of this State, as far west as Washington city, and are the basis of an important tile and earthenware industry. The Columbian clays also furnish excellent quality brick. Large and extensive manufactories of fine pottery occur in Baltimore.

Drain and sewer pipe are also extensively made in western Maryland.

There are good fire clays in the Carboniferous formation, and also an abundance of clay-making shale.

Pottery clays and stoneware clays occur on the banks of Bohemia, Cape John, and Sassafras creeks, Cecil county.

The District of Columbia also contains both the plastic clays of the Potomac formation, which are manufactured into drain tile in the vicinity of Washington, and an abundance of excellent brick clay of the Potomac formation, from which most of the buildings of the city are constructed.

VIRGINIA.

Extensive kaolin beds have been reported in various counties in this State, but they are all sedimentary and are described under the head of sedimentary clays. Prof. W. M. Fontaine, of the University of Virginia, writes that he knows of no true residual kaolin deposits in the State.

The plastic clays of Maryland and the District of Columbia continue across Virginia and are suitable for the same industries. The Columbian brick clays are also well developed in the principal rivers, especially the Potomac, the brick yards opposite Washington producing most excellent qualities of the red or "Philadelphia" brick. The western portion of the State lies within the Appalachian or hard rock region where limestone prevails, and the peculiar red residual clays of that formation are exceedingly abundant. They are used for the manufacture of earthenware and brick, but the brick are not of the excellent red color of the Columbian alluvial clays. Professor Fontaine writes that "the most important pure clays approaching the nature of kaolins are in patches situated along the western base of the Blue Ridge. These clays are white and seem to have collected in patches in small lake basins on the surface of the Lower Cambrian shales. The clays come from the decay of Lower Cambrian argillaceous sandstone and are of course transported." A brief account of some of these clays was published in Hotchkiss's *Virginia*, a monthly publication now discontinued.

The Paleozoic shales and slates also occur in western Virginia, and also clays suitable for fire brick, but no record is available showing that they are used.

NORTH CAROLINA.

"Snow-white kaolin is found as the result of the decomposition of orthoclase at most of the mica mines in Mitchell, Yancey, Macon, and other counties. Good qualities are found 6 or 7 miles from Newton, Catawba county, also in Lincoln, Burke, and many other counties." (*a*)

The conditions existing in this state are very favorable for the occurrence of rock kaolin; but little data are procurable. A kaolin is reported in Dillsboro, Jackson county, "of a perfect white color before and after firing, having a plasticity equal to or superior to any clay in the United States." Over 4,000 tons were mine in 1890. The clay is used for the manufacture of fine porcelain wares.

Sedimentary clays.—South of Virginia the Potomac formation ceases to be the clay-producing terrane, and is overlapped and concealed in the Carolinas, Georgia, and Florida by the Tertiary deposits, which here produce a character of clays different from those along the northern half of the Atlantic coast, but equally valuable for commercial use.

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a Extract from the minerals and mineral localities of North Carolina, F. A. Genth and W. C. Kerr.

Little is known of the geology of the North Carolina clays, however. Clay alleged to be suitable for the manufacture of fine porcelain ware is reported from several counties. Fine plastic clay is reported from Dillsboro.

The sedimentary kaolins of North Carolina are probably a continuation of the beds of the adjacent States to the south.

The mountainous or western portion of the State and the Piedmont plain contain many shales and slate of value for grinding, and fire clay.

SOUTH CAROLINA.

In South Carolina the Eocene sediments are deposited directly upon the older Archæan feldspathic rock, and contain some most useful and productive beds of kaolin. These are suitable for china and refractory purposes, but at present are used solely in the wall-paper industry. They occur at Barnwell, Lexington, Richland, Abbeville, and Chester, and are extensively mined in the counties of Barnwell, Aiken, Lexington, Richland, Abbeville, Chester, Sumter, and York. These clays are a high grade china kaolin, but at present are used only in wall-paper manufacture and for brick. They are probably intimately related in origin to the Miocene kaolins of Florida.

Clay suitable for brick is found in nearly every neighborhood, and can be manufactured for $3 per thousand.

GEORGIA.

From Georgia Prof. J. W. Spencer writes: "I have seen kaolin in pockets in decayed gneisses, but there is always much quartz mixed with them." As has been shown, the latter is no objection if the clay is in great abundance. The extensive development of gneisses and granites in this State in contact with sedimentary formations indicates favorable conditions for the existence of undeveloped kaolinized rock.

The structural conditions of Georgia are in every way favorable for the occurrence of good clay sedimentary deposits, and the present State Geological Survey will no doubt soon publish the details concerning them. The kaolins of Florida and South Carolina should extend across the coastal plain portion of Georgia, as it no doubt does. In the northwest corner of the State there are the residual red clay deposits of the Paleozoic limestone, and also large feldspathic areas that should yield kaolin and material for good sedimentary clays. Fire clays should likewise occur in the Coal Measures and sub-Carboniferous deposits in the extreme northwestern portion of the State. Earthenware clays are plentiful. A good tough clay found within the city limits of Augusta is extensively used for the manufacture of bricks, one company having produced 12,000,000 bricks in 1890.

FLORIDA.

There are no granitic or original feldspathic rocks in this State.

The sandy clay of Tallahassee, Lake City, and Jacksonville is used in the manufacture of brick. The recent discovery of sedimentary kaolin in the Miocene formation of the State bids fair to be one of the most important events in the recent history of the china clay industry of this country. These deposits are in the vicinity of Villa City, Lake county, half way between Saint Augustine and Tampa on the Palatlakaha river. Prospecting shows the clay to be some 30 feet in thickness, and chemically similar to that of Limoges. They are convenient to water for washing, and the deposits seem to be extensive. The firing qualities of the material is now being tested in the potteries of Trenton.

The area of the deposit is quite extensive, according to Mr. Laurence C. Johnson, of the United States Geological Survey, who first reported them. There are also many beds of iron-bearing clay in the same region, which will be useful for earthenware products.

LOUISIANA.

There are no original granitic or feldspathic rocks in this State. Little development of the clay resources of the State has been made. Fair bricks are abundant along the streams, and the northwest corner of the state is underlain by the plastic clays of the Eocene formation, similar to those described under the states of Arkansas and Texas, which should be productive of good clays for all earthernware products. The Miocene formation, which is productive of good clays upon either side of the state in Florida and Texas also outcrops in the southwest corner and are worthy of investigation for clay material.

Brick are extensively manufactured in the city of New Orleans from the ordinary alluvium of the Mississippi river, and are known to the trade as county brick. While not of prepossessing appearance for exteriors, they have admirable fire-resisting qualities, and on that account are preferred for substantial structures. They sell in the city at $7 to $8 per 1,000. More ornamental red brick are made from the Eocene clays, some on the Jackson railway some 60 miles north of the city.

An extensive china and porcelain factory was established in New Orleans a few years since, but has lately been abandoned, owing, it is alleged, to the endeavor of the owners to ignore the established chinaware dealers and to sell to the consumers direct.

ALABAMA.

Prof. Eugene Smith, State Geologist, writes: "In the region of the crystalline rocks we have several localities of residual kaolins. The best examples I have seen are in the vicinity of the old village of Socapatoy, in Coosa county, not far from Kellyton, on the Georgia Central road. Tuomey also mentions, locality in Randolph county."

Sedimentary clays.—This State is usually rich in the sedimentary clays. The fire and plastic clays of the Carboniferous formation, as more fully described under the states of Iowa and Missouri, abound in the northern half of the state and are beginning to be extensively manufactured. The plastic clays of the Tuscaloosa (Potomac) formation are also abundant, but have not been developed. The Miocene belt of Florida also continues across the southern end of the State, and should contain the same clays found in Florida and Texas. The Eocene clays are also developed finely. Good brick are made in many localities, and the more chalky clays are admirably adapted for making London malm and Portland cement. With the rapidly increasing industrial population it is only a question of a few years when Alabama will rank among the first of our clay-producing States.

MISSISSIPPI.

The clay possibilities of this State are very similar to those of Alabama and Tennessee, the Carboniferous, Cretaceous, Eocene, Appomattox, and Miocene clays occurring in various places, as more fully mentioned in the discussion of the general distribution of clays. In addition the Loess and yellow-loam clays of the Glacial epoch are identical with those which constitute the valuable clay industries of Missouri and the Upper Mississippi States. Prof. Hilgard's valuable report on the Geology of Mississippi gives an abundance of detail concerning the local occurrence of the clay products of the State.

THE APPALACHIAN AND CENTRAL MISSISSIPPI VALLEY STATES.

In this group are included States which lie mostly within the area of the Paleozoic formations of the Appalachian type. They are New York, Pennsylvania in part, Ohio, West Virginia, Indiana, Kentucky (mostly), Illinois, Tennessee (east and middle), Missouri, Arkansas (in part), the Indian Territory, Kansas, and Iowa. New York is mostly composed of the older shale-bearing Paleozoic formations, and in some respects does not entirely belong in this classification. The western half of all the States of the Atlantic coastal division, except Louisiana and Florida, could also be logically placed in this division.

Of the States enumerated, only New York, Missouri, Arkansas, and the Indian Territory contain feldspathic, or igneous rocks, besides the sedimentaries. The Upper or clay-bearing Carboniferous formation, celebrated for its fire and plastic clays, is the chief clay-producing formation of Iowa, Missouri, Indiana, Illinois, Ohio, Tennessee, West Virginia, and Kentucky. They also occur in the Indian Territory and Arkansas.

New York possesses diverse geological features propitious for the clay industries. Kaolin is reported from East Fishkill, Dutchess county; Athol and Johnsburg, Warren county; near McInty, and near Old

Furnace, Essex county. Only the first-named beds are worked. The northern and eastern portions of the State are composed of kaolin-yielding feldspathic rocks, the western and eastern portions are underlaid by the clay shales of the older sedimentary formations. Long Island and Staten Island are the continuation of the Mesozoic clay deposits of the Atlantic coast, to which the New Jersey clays are characteristic, while the Hudson valley is in line with the late Columbian sediments of brick-making fame. The State possesses abundant resources in earthern ware, brick, and stoneware clays. Most of the feldspar, the chief accessory mineral of the china-clay industry, is produced by this State. The kaolin beds are not extensively worked.

The great deposits of shale which characterize the Paleozoic formations are ground into plastic clays for brick, pottery, and paint making, in Washington county. The chief clay industry of New York, however, is the Haverstraw brick industry along the Hudson. These produce enormous quantities of brick annually, which are used principally in the city of New York and shipped throughout the State. Brick clays are also made in the interior from the recent alluvial deposits derived from the glacial beds and the clay shales.

The native rock, which is a mixture of clay and siliceous limestone, is also largely used in New York State for the manufacture of natural cement, a subject which is treated in another portion of this volume.

The glacial drift clays are used for the manufacture of brick on Long and Staten Islands.

Fire clay is also found upon Staten Island, where there is a large manufactory at Kreischersville, which is said to produce $50,000 worth of brick annually.

OHIO.

Ohio abounds in pottery and brick clays, which are mined in many places, principally from the alluvium derived from the Paleozoic formations. The refractory clays of the Carboniferous are also abundant in the eastern half, and clay industries of all kinds are highly developed. Cincinnati is the seat of an extensive pottery for the manufacture of art ware. Fire brick, earthenware, tile and door knobs are extensively manufactured. There are several large kilns at Zanesville and elsewhere for the manufacture of encaustic tile.

Plastic clays suitable for the manufacture of brick and earthenware are found in Mahoning, Tuscarawas, Summit, Holmes, Columbiana, Jefferson, Muskingum, and Portage counties, also in Jackson and Berlin townships. These are extensively used in the potteries at East Liverpool and Wellsville.

KENTUCKY.

The eastern portion of this State is well supplied with excellent refractory clays of the Carboniferous formation. In the western portion the tile and earthenware clays of the Lafayette and Eocene formations are well developed and extensively manufactured. Good brick clays are plentiful throughout the State. The Loess formation occurs, as at St. Louis, Missouri, along the Mississippi valley, and is used for brick clays.

The portion of the State lying between the Tennessee river and the Mississippi is well supplied with a peculiar clay deposit largely used in the manufacture of ordinary pottery, terra-cotta lumber, etc. This material is highly siliceous and unquestionably represents a redeposition of the residuum from disintegrated chert. The more important deposits are in the Lafayette formation; they occur as lenticular layers or beds intercolated between strata of coarse sand and clay. The material occurs in even greater abundance and purity in western Tennessee and northern Mississippi; it is largely used in the manufacture of jugs, etc., about Jackson, Bolivar, and Grand Junction, Tennessee, and Oxford, Mississippi.

ILLINOIS.

Illinois possesses the same formations and conditions, more or less modified in areal extent, as Indiana, for the production of nearly all kinds of pottery, tile, fire brick, and earthenware, especially in Union, Pope, Madison, Scott, Brown, Schuyler, Fulton, Rock Island, and McDonough counties. The indianaite or residual porcelain clay is also found in the counties of Pope and Union, and is extensively used in the manufacture of fine white ware and for mineral paint.

The margin of the Mississippi valley abounds in brick-making material, principally the common loess of that region. Other brick clays abound throughout the State.

At Springfield the shale of the Carboniferous formation is ground into a brick clay, which, when fired, yields an article of great excellence for paving.

INDIANA.

Indiana is one of the few States that have appreciated the importance of making complete reports upon the geology of its clay deposits, and much can be learned from them in the publications of the State survey. Indiana lies partly in the field of the Carboniferous formations, and the clay is found in Putnam, Sullivan, Warrick, Posey, Perry, Montgomery, and Lawrence counties and is largely used. Clays for the manufacture of common stoneware, vitrified brick, sewer pipe, etc., are abundant.

The celebrated residual porcelain clays, or indianaite, have already been described upon a previous page. These are used for the manufacture of common granite ware, hollow ware, fire and paving bricks. The manufacturers of fine porcelain and china ware do not regard it as useful in their industries, as the State reports indicate.

Clays for building brick are abundant throughout the State.

MISSOURI.

Missouri, Indiana, Iowa, Illinois, and Ohio are the great clay States of the Mississippi valley, and perhaps Missouri excels the rest of the group in the quality and value of its clay beds and manufactures. These have been very thoroughly studied by Ladd and Broadhead of the former State surveys, but only partially published as yet. They consist of the refractory and potter's clay of the Carboniferous formation in the eastern and western half of the State, and sedimentary clays of the Tertiary and Cretaceous in the southeastern corner.

The chief clay industry in the State is the manufacture of fire, refractory, and common brick. The refractory products of Missouri are justly celebrated throughout the West and are the basis of a large industry. Brick are manufactured in many localities from the river alluvia, especially the Loess of the Mississippi and Missouri valleys. Earthenware clays also abound, but are not extensively worked.

The Carboniferous clays have been admirably described by Mr. G. E. Ladd in his report on the clay, stone, lime, and sand industries of Saint Louis city and county, Missouri. Concerning these the State geologist says: "Special attention has been given to the statistics of the production, and truly surprising results have been reached. Within the area discussed the value of the respective products during the year 1889 is as follows:

Structural brick	$2,288,795
Fire clays, sewer pipes, and pottery	1,722,685
Stone	665,761
Lime	103,000
Sand and gravel	76,229
Total	4,856,470

The principal object in obtaining these statistics was to demonstrate the magnitude of the industries dependent upon the natural products. The importance of the State of Missouri as a clay-producer is recognized in a general way; yet there are no figures available by which that importance can be measured, nor is any adequate provision made by State or National government for the gathering of such figures. Nearly $5,000,000 seems a large sum to represent the production of Saint Louis city and county alone, but this is undoubtedly far in excess of the value of the product from any other equal area in the State. Saint Louis is not only the largest center of population, but it has also an exceptional supply of the raw materials, and hence is a large manufacturing center.

The Quaternary clays.—The Quaternary deposits cover, as a mantle, nearly the whole area of the older formations in the city and county, and the great mass of the Quaternary is of the Bluff or Loess formation, which is composed essentially of clay and occasionally of sand. This Loess is what is known as yellow clay or common brick clay, and its supply for such brick-making, for which purpose it is well adapted, is inexhaustible, although it is being rapidly removed within the city limits. Bricks are made from it by both a dry and wet process, but most largely by the dry process. The clay is plowed up in fair weather to the depth of a few inches, and after several hours' drying in the sun it is scooped together and hauled to sheds, where it is stored for future use. It is usually of the proper composition for brick-making throughout, without special mixing, but occasionally it is too sandy near the bottom.

The residual clays.—Clays residual from limestone occur beneath the Loess or Drift. They are too plastic to be used alone, but are occasionally used by potters, mixed with other clays.

There is but little doubt that the product of these materials in the whole State is worth several times the amount given above. Similarly, with regard to the qualities of Missouri's clays: They have a high reputation and the refractory clays have been marketed in many States. But this reputation has been acquired through the use of clays handled by two or three firms which draw their supply from a very limited number of localities. Concerning the clay deposits of the State as a whole and qualities of the materials, little or nothing is known; hence among the considerations leading to an investigation of the Saint Louis clays, an important one was the fact that a determination of the composition and an experimental test of the properties of some of these familiar clays would furnish an excellent local standard by which to measure the properties of clays occurring elsewhere in the State which are only partially or not at all developed.

Mr. Ladd says: "Geologically speaking, Saint Louis has three local sources of clay. These are the Coal Measures, the Quaternary deposits, and the residuary products of decomposing limestones."

The Coal Measure clays.—The Coal Measures, which have an area approximating 200 square miles in Saint Louis city and county, carry practically an inexhaustible supply of potters', sewer-pipe, and fire clays, of which the best of the last have long been famous for their high refractory qualities. The mining and manufacturing of these clays has been carried on for many years, and to a large extent in the immediate neighborhood of Saint Louis, but so far as the writer knows there has been no worthy attempt to even prospect for them in the great stretch of Coal Measure formations in the northwestern part of the county.

Tile clays.—The clay which is used largely for the production of sewer pipes, though low down in the Coal Measure series, is one of the uppermost layers in that portion of the formation which occurs along the western border of Saint Louis. This tile-clay bed overlies the fire-clay bed described below, and is separated from it by shale and sandstone 6 to 20 or more feet thick. It is usually covered with several feet of Loess clays, and is occasionally capped with beds of decaying limestone which were not altogether denuded from above it before the Loess clays were deposited. It ranges in thickness from about 8 to 12 or more feet. Its color varies, but is usually mottled red and brown with bluish and greenish streaks. It is fissile, is quite free from grit, and has a soapy feel to the fingers. It is sometimes hard and shaly, but is usually soft when mined, growing hard on drying after being exposed to the air. Crystals and thin coatings of gypsum and nodules of limonite are scattered through the bed. The clay when used for sewer pipe is mixed, in varying proportions, with fire and other clays. Wherever produced at present it is dug in open pits.

Fire clays.—The fire clays occur in beds ranging from a few inches to 7 or more feet in thickness. They are occasionally so near the surface as to be mined by drifts, but usually they have to be sought by shafts. The deepest of these in Saint Louis (that of Parker & Russell) is 120 feet from the surface of the ground to the bottom of the clay bed. These clays, even in the same bed, vary largely in character and composition. They are usually grayish in color and are very hard when mined, but after exposure to the weather for a variable time the clay softens or slacks and falls into a loose mass of finely divided particles. Iron, an objectionable material in a fire clay, occurs largely in small pyrite crystals, called by the clay miners "shiners" and sometimes in large balls of pyrite. These "shiners" occur generally in aggregations and either close to the top or bottom of the clay bed, so that they may be avoided to a great extent.

At several of the works many kinds of sewer pipe and refractory materials are manufactured. In the entrance to the Laclede fire clay mine the bed of fire clay may be seen in relation to the bed of sewer-pipe clay. The entry is driven in the bed of fire clay; above it is 5 feet of solid sandstone with a few inches of intervening beds, and overlying the sandstone is the bed of clay and clay shale used so largely in the manufacture of sewer pipe and less extensively for terra cotta pottery and paint. Just at this point the Loess clay has been stripped off to be used in a mixture for the production of sewer pipes.

The production of terra cotta.—The terra cotta industry in Saint Louis is one of the few successes of its kind west of the Mississippi river. Local clay is used and an excellent grade of the ware is produced. The demand for the product is constantly increasing.

Structural brick.—The structural brick works, with one or two exceptions, are confined to the city, from which, however, they will be driven before long for want of available material. The Loess clays are used almost entirely and an excellent building brick is produced. Very fine face and ornamental brick are also made for local use and for shipment to distant points.

IOWA.

There are no feldspathic or igneous rocks in this State, but the sedimentary clays are well developed. According to Dr. C. A. White, "the clays of the State may be divided into the impure drift clays and those more or less pure, the latter being found occupying their original place of deposit among the strata, but softened and modified by exposure to the atmosphere and frost. The drift clays are always mechanically mixed with other materials as would be expected from the circumstances of their origin. The same circumstances have also insured their general distribution throughout the State. These clays evidently had their origin in the clayey strata which now underlie the drift of Iowa and of Minnesota, and in the feldspathic rocks of the latter state, having been comminuted and moved to their present position by glacial action. Thus, no considerable portion of Iowa is destitute of materials for the manufacture of good brick, although some parts are more plentifully supplied than others. Almost all the brick are made from the drift clays which are usually obtained upon or very near the surface. They vary greatly in character and value, according to the proportional amount of real clay they contain, their different degrees of fusibility, etc., but the failures that so frequently occur in their manufacture are due in a great degree to want of skill in the various processes from the preparation of the clay to the final burning. In the case of the Clermont clay the carbonic acid being expelled in the process of burning, the iron would be left in the form of a protoxide. Hence, probably the unchanged color of the brick, which remains like a clay, of a light, yellowish, buff hue. Judging from the few samples of these bricks that have been examined, they are much superior to any yet seen in the State.

The Coal Measure clays of Iowa, as well as most other clays yet seen in the State, contains so much lime and other fluxes that they are entirely unsuited to the production of fire-brick.

Potters' clay.—The Coal Measure clays are, however, the best and almost the only important pottery clays in Iowa. Among these are the potteries of Eldorado, in Hardin county; of Fairport, in Muscatine county; of Des Moines; of Vernon, in Van Buren county; of Danville, in Des Moines county, and of Boonesborough, in Boone county. Some of the clayey beds of the Cretaceous strata of Woodbury county have been successfully used for pottery, but those of the Coal Measures will always furnish the best and most abundant materials for that purpose.

Slate.—No true slate has been or is likely to be found in Iowa. The substance popularly called slate is black, carbonaceous shale, which in some cases readily splits into thin sheets, closely resembling roofing slate. It is found in various parts of the State occupied by the Coal Measure formations, and occurs in beds of a foot or two in thickness among the other strata."(*a*)

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a Report of the Geological Survey of the State of Iowa, by Charles A. White, Des Moines, 1870.

Since the publication of the foregoing report the development of the conditions therein mentioned has been very extensive, and throughout Iowa, especially at Des Moines, the manufacture of clay products has become one of the most important industries in the State. Tile, fire-brick, sewer pipe, and building brick are now produced in enormous quantities in Iowa. The Des Moines Board of Trade has in preparation a census of these products, which, it is regretted, is not yet available for use in this report, but will appear shortly.

KANSAS AND NEBRASKA.

These States, lie for the greater part, in the plains region. The later Carboniferous and the Permian clay-bearing formations are largely developed in the eastern portion, especially of Kansas. The Upper Cretaceous clays are also well developed, and these two formations should afford sufficient material for earthenware products. In Nebraska, clays suitable for the manufacture of common bricks and earthenware are reported in Cass, Dakota, Webster, Lancaster, Gage, and Jefferson counties. At Lincoln the Loess is manufactured into a superior brick.

In Kansas very fine pressed brick are manufactured in Junction City. Refractory clays have also been reported from the eastern counties, but no record of their having been used is obtainable.

WEST VIRGINIA.

This State is entirely composed of the later Paleozoic formation, and abounds in the refractory clays for which it is noted. All the stream valleys contain good brick clays of the dark colors peculiar to the product of the formations from which they are derived.

The fire clays of the Carboniferous formation are extensively worked and burned and used in the coke ovens and furnaces. The principal localities where they are used are: Nuzum's Mills, Marion county; Lost Run, Taylor county; Tunnelton, Preston county; Morgantown, Monongalia county; near Cassville, Wayne county; near Sageville, Braxton county; Hancock county, and other localities within the area of the Coal Measures. The manufacture of vitrified brick for paving has become an important industry in this state within the past few years, and they are shipped by water to many of the states of the Mississippi valley, the city of Evansville, Indiana, being paved with them.

INDIAN TERRITORY.

Feldspathic rocks occur in two localities in the Indian Territory. In the vicinity of Tishomingo there is an area of 100 square miles of white and red granites, excessively decayed and overlapped on its southern border by Potomac-Trinity formation, presenting favorable conditions similar to those of the Appalachian division. This field is worthy of careful investigation for kaolin.(*a*)

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a See Notes on a Reconnaissance of the Ouichita Mountain System of Indian Territory, by Robert T. Hill, Am. Jour. Sci., Aug., 1891.

The second locality of feldspathic rocks is in the Wichita mountains in the southwest corner of the State, upon the Comanche reservation. Here vast outcrops of granite and eruptive rocks occur, but no observations of kaolin have been reported.

Indian territory and Oklahoma present the clay-producing characters of the Appalachian Paleozoic formations which extend into its eastern half, of the Cretaceous formations of Texas, which occur south of the mountainous portion, and of the Red Beds and Great Plains formations, which mark its western third. The occurrence of the feldspathic rocks in the Wichita mountains on the Comanche reservation and in the Chickasaw nation should result in some very good clay deposits in the sedimentary beds which have been deposited around their margins. Good brick can be manufactured from any of the stream deposits, which are very abundant. Refractory clays also occur in abundance in the Coal Measures of the northeastern half of the territory.

TENNESSEE.

Professor Safford, the State Geologist, writes: "I know of no true nontransported kaolin rock in Tennessee. The line separating the conglomerate sandstones from the crystalline feldspar rocks very nearly coincides with the boundary between North Carolina and Tennessee, lying mostly in the former State; so our chances for rock kaolin are small.

Tennessee is similar to Kentucky in regard to its clay deposits. The Carboniferous fire clays are abundant in the eastern portion. Shale for grinding (not utilized) is also abundant. The pottery clays of the Lafayette and Eocene formation are extensively used and developed in the western part. Brick are manufactured throughout the state from the alluvium of the rivers which drain the western flank of the Appalachians and Cumberland plateau in east and middle Tennessee, and from the Loess and Lafayette clays in the western portion.

ARKANSAS.

The resources of this State have been recently portrayed by the excellent State survey under Dr. John C. Branner. According to his report, feldspathic rocks occur (1) in three small outcrops near Magnet cove, Benton, and Little Rock; (2) as an isolated volcanic formation in Pike county, the residual material of which is not reported.

The known kaolin deposits are sedimentary, and are described from notes kindly furnished by Dr. Branner under that head.

This State contains the sedimentary clays of both the Atlantic coastal plain and of the Paleozoic rocks of the Appalachian region type. The former occupy the eastern and southern two-thirds of the State, while the latter occur in the mountainous or northwestern third. Of the sedimentary clays of the later rocks those of the Eocene Tertiary are often quite pure and abundant, and suitable for fine stoneware, drain, and common pottery clays. It is highly plastic, and while usually containing too much iron for white burning, it sometimes affords a good white plastic or ball clay as used with kaolin in china-making. The ironware or jug industry has been carried on extensively in the State at Benton and elsewhere for many years, and the drain and title industries are beginning to be developed. The Cretaceous formations at Arkadelphia contain somewhat similar clays.

Good brick clays can be found in all the "second bottom" streams of the State, and are manufactured at Little Rock, Texarkana, Arkadelphia, and elsewhere.

Excellent deposits of sedimentary kaolins have recently been discovered by the State Geologist. He furnishes the following information:

Kaolin is known to occur in Pike, Pulaski, Saline, and Ouachita counties. The Pike county beds are on Vaughan's creek, in township 8 south, range 24 west, section 19. So far as these beds have been prospected they are too thin (2 feet) and too much stained with iron to have any value, but their geologic and topographic position leads to the belief that they may be found thicker and under a prospective covering that will render them valuable. The samples exhibited in the Agricultural department and labeled "Pulaski county" are from Pike county. Kaolin of this particular kind is not known in this State outside of Pike county.

Analysis of Pike county, Arkansas, kaolin.

	Per cent.		Per cent.
Silica	48.87	Magnesia	0.25
Alumina	36.54	Water	13.29
Iron (ferric) oxide	0.98		
Lime	0.19	Total	100.09

The Pulaski county kaolin is either modified bauxite or decayed granite. The localities of the bauxites have already been given. Other kaolin deposits occur in several localities in the vicinity of the Fourche mountain and Saline county granites, in 1 north, 12 west; 1 south, 12 west, and 2 south, 14 west. There are several localities in section 9, 1 south, 12 west. The following is an analysis of a sample of kaolin from section 9, 1 south, 12 west:

Analysis of Pulaski county, Arkansas, kaolin.

	Per cent.		Per cent.
Silica	46.27	Potash	0.23
Alumina	38.57	Soda	0.37
Iron (ferric) oxide	1.36	Water	13.61
Lime	0.34		
Magnesia	0.25	Total	101.00

The Ouachita county kaolin deposits form regular beds interstratified with other Tertiary rocks. One important bed has been examined in township 12 south, range 18 west, section 2, which has a thickness of more than 12 feet, the entire thickness not having been seen. The outcrop of this bed is exposed at but few places, but it is probably several miles in length. The true nature of this material would hardly be suspected from its general appearance or from an analysis of it as it comes from the ground, for it resembles a sandy clay. If the sand be washed out and the material analyzed it is found to have the same composition as some of the best kaolins. The following is an analysis of the Ouachita county kaolin after the greater part of the sand has been removed. An analysis of a washed sample of Pennsylvania kaolin from Brandywine Summit is given for comparison:

Comparative analyses of kaolin.

	Ouachita county kaolin.	Pennsylvania kaolin.
	Per cent.	*Per cent.*
Silica	48.62	47.24
Iron (ferric) oxide	1.74	1.94
Alumina	36.52	37.27
Water	13.40	13.62

The writer's attention has recently been called to a fire material in the Cretaceous formations in the vicinity of Okalona and Brownstown, which is extensively used by the residents in the construction of hearths and fireplace backs. This is a fine-grained calcareous sandstone with glauconitic grains, and known geologically as the Big Deceper rock. It is worthy of investigation.

TEXAS.

In Texas the conditions for the occurrence of rock kaolin are good. In the center of the State, in Burnet, Llano, Gillespie, and Mason counties there are extensive outcrops of granite which is much decomposed around its marginal contacts with the later sedimentary rocks, and also contains large veins of feldspar or pegmatite. This material has not been studied with a view to its value for pottery. To the south, in Edwards county, residual belts of very fine kaolin are known to exist, from which excellent grades of porcelain ware have been made in France. The beds are owned by a company, but owing to distance from transportation are not worked. Mr. T. B. Comstock reports the existence of kaolin as a mineral in this region but says nothing of the quantity.

The eastern half of the State possesses the Tertiary and Cretaceous clays of the Atlantic coastal plain, affording many useful clays. The newest of these is the strip of coast prairie region, corresponding in age to the Columbia terrace deposits of the northern States, but here in addition to the clay occurring as terrace alluvial deposits in the older stream valleys of the Brazos, Red, Colorado, and Trinity rivers is a strip of littoral deposition attenuated along the coast. It furnishes good brick at Houston and elsewhere, but is not very well colored. The terrace deposits extending up the streams interiorward from this coastal strip are more varied, owing to the different local conditions along the drainage areas of the streams. At Texarkana, Dallas, and Waco good brick are made, but of poor color, while at Austin very fine white brick of the Milwaukee type are manufactured.

At Dallas the Columbia river deposits of the Trinity valley are extensively burned. The product is both deep red and white. The writer is convinced from recent examination of the kilns that very superior brick could be made there by proper tempering and burning, although the product at present is not of the best.

The Miocene or Fayette formation of Mr. R. A. F. Penrose, occurs west of the coastal clays extending from the Sabine to the Rio Grande near Rio Grande city. According to Mr. Penrose the base of this formation is marked by clay beds, one of which is 55 feet in thickness. He states that "These clays vary from laminated, chocolate-colored beds to massive, light watery green, and pale sky-blue strata. They are hard, massive, of conchoidal fracture and cut like talc. They weather a pure white. Such clays underlie the town of Rio Grande city on the Rio Grande, and the climatic conditions are such that they have become indurated by the heat and the dryness of the region into a hard rock."

The geological horizon of these clays is very nearly related to that of the Tertiary clays of the Florida-Carolina region, and they deserve the fullest investigation. The writer remembers seeing very pure specimens of sedimentary kaolin in Texas, which were alleged to have been procured from this formation, and, even should the clays prove useless for china kaolin, it may be of the greatest value for pottery, earthenware, brick, and tile clays.

Outcropping to the westward, and geologically lying beneath the Fayette clay beds, comes the Eocene formation, which is a continuation of the same strata from the Arkansas and Mississippi region. This, as elsewhere, consists of unconsolidated deposits of alternations of sands and clays. The clay bands vary from a fraction of an inch to a foot or two in thickness, and are of irregular extent. These clays in Texas are whiter and more plastic than the writer has seen them elsewhere in the same formation in other States, and are most abundant near the base of the formation, outcropping at its interior margin, and are especially abundant in Cherokee, Henderson, Marion, Van Zandt, and other counties of northeastern Texas. At present they are burned in a few localities for stoneware, but they are often white in burning, and are admirably adapted for the tile, drain, and earthenware industries.

Excellent red pressed brick are now being manufactured at Elgin, east of Austin, from the Eocene clays.

Immediately west of and beneath the Eocene clay beds, which occupy eastern Texas or the timbered portion of the State, are the great Cretaceous formations for which Texas is noted. These occupy the area known as the Black and Grand Prairie regions and the Cross Timbers. In general, the clays are highly calcareous and of the nature of the material known in New England (not in New Jersey) as marl. In analyses and composition these clays are very similar to the marls of England, from which the common London stock brick or "malm" is made, although it is little, if at all, used in Texas.

Beneath the Austin chalk, whose western outcrop approximately corresponds with a line drawn through Sherman, Dallas, Waco, and Austin, there is another clay deposit (the Eagle Ford shales of the writer), which north of the latitude of Hillsboro contains a very dark, pure clay, which should be of great value. It resembles in texture, color, and geological horizon the fire-clay beds of similar geological age in Colorado, and should prove a fertile field of investigation. The beds are best exposed in the vicinity of Eagle Ford, but continue northward from that place, by the way of Denison, and thence eastward down Red river on both sides, in places, to the neighborhood of Clarkesville.

Like the Upper Cretaceous formation, the upper beds of the Lower Cretaceous, as seen in the vicinity of Fort Worth, are in general too calcareous except for building, and even these are not of good quality, the makers of Fort Worth preferring to use the alluvium of the Trinity valley. At the base of the Lower Cretaceous the plastic clays of the Potomac formation occur in thin layers in the Trinity sand in the country of the Upper Cross Timbers. Upon a recent expedition to Texas with Prof. L. F. Ward, of the U. S. Geological Survey, we found thin layers of plastic clay in the Trinity formation in the vicinity of Bluff Dale, Erath county, which gave rise to the opinion that proper investigation of the formation, which is predominantly sandy, would reveal some of the clay bands of sufficient thickness to be of value, as is their continuation into the Raritan clays of the New Jersey region.

The Carboniferous and Permian beds of Texas should afford good clays for pottery and refractory material.

Near Gordon, Palo Pinto county, a superior quality of red pressed brick is being made from these clays for the Dallas and Fort Worth trade. The western half of Texas consists of three principal formations: (1) the Red Beds, (2) the Great Plains Tertiaries, and (3) the Trans-Pecos mountain rocks.

The Red Beds are principally exposed in the Wichita, Tom Greene and Abilene country east of the eastern escarpment of the plains. They are composed of mixtures of clay, sand, gypsum, and iron; the general occurrence of the latter excludes them from the category of possible products, and they are only useful for brick and earthenware. These clays are of great value for the production of various shades of red and vermilion paints, which should be manufactured here. The general negative character of the Great Plains Tertiary formations for clay products has already been commented upon, and this formation covers the whole of the Staked Plains region of Texas.

In the Trans-Pecos mountainous region there are valuable clays for the manufacture of brick, adobe, and earthernware. The clays of the basin deposits along the Rio Grande below El Paso are well adapted for these purposes. Both brick and adobe are manufactured in this region for local uses.

The shales of the Cretaceous and Paleozoic formations of the region no doubt contain much valuable clay-making material. This is especially true of the Benton clays, which outcrop in the vicinity west of El Paso near the Round House, and the writer thinks them worthy of careful inquiry as to their refractory qualities.

The following description of Texas clays from the report of the State Geologist is worthy of reproduction:

"For pottery making there exist clays adapted to every grade, from common jug ware and tiling through yellow, rockingham, 'C. C.,' white granite, or ironstone china, to china or porcelain of the finest quality. Glass sands are also found of a high degree of purity, and many other materials of use or necessity in the manufacture of these various grades of goods are found here. While the subject of clays has not yet received the attention that it is proposed to give it, numerous specimens have been secured and analyzed, with the result of proving the facts as stated above. Among the clays of the division known as coast clay are some that will answer for the coarser stoneware, such as jugs, flower pots, drain tile, etc., and others which, from their refractory character are well adapted for the manufacture of charcoal furnaces, and possibly of sewer pipe. The Fayette beds, as was stated in their description in the First Annual Report of the Geological Survey of Texas, contain beds of light-colored clays, many of which are pure white. These beds of clay not only underlie and overlie the middle beds of Fayette sands, but are also found interbedded with that series. The excellent qualities of these clays were first stated by Dr. W. P. Riddell, of the First Geological Survey of Texas, under Dr. Shumard. His specimens were obtained from the Yegua, in Washington county, and in the vicinity of Hempstead. Since that time many analyses have been made of clays of various portions of these beds, and while some of them are too high in alkalies or fusible constituents, others are well suited to the manufacture of all grades of earthenware below that of porcelain, or French china, as it is called. Clays of this character have been secured in various localities from Angelina to and below Fayette county. There are beds in the Fayette sands that will be of value in glass-making. Some of the beds are composed of clear angular quartz grains without a tinge of iron, having only an occasional grain of rounded red or black quartz. In the Timber Belt beds there are other clays and sands well suited to the manufacture of earthenware and glass. Most of the beds of pottery clays of this division examined so far in eastern Texas are, however, only suited for the coarser grades of earthenware, but in Grimes and Robertson counties (and possibly in others as well), clays of higher grade are found. In Robertson county, not far from the town of Mexia, there is a deposit of sandy clay which is readily separated, by washing, into a kaolin of excellent quality and a perfectly pure quartz sand. This kaolin has been tested practically and produces a good porcelain.

"Potteries have been erected in various parts of the State within the limits of the Fayette and Timber Belt beds for the manufacture of common earthernware, flower pots, etc., and several are now in successful operation. Among localities of potteries may be mentioned Lavernia, Wilson county; Athens, Henderson county; Kosse, Limestone county; Burton, Washington county; and others.

"*Kaolin.*—In addition to the kaolin already mentioned in Robertson county, kaolins of excellent quality are found in Edwards and Uvalde counties. These are pure white in color, somewhat greasy to the touch, and are infusible in the hottest blow-pipe flame. Being practically free from iron, they are adapted to the making of the best grades of china. They are free from grit and every other objectionable impurity. A comparison of the analyses of these kaolins with those of established reputation will more fully show their value.

"Of the other materials needed in the manufacture of pottery there are deposits of feldspar well suited for glazing; gypsum for the manufacture of plaster of Paris for molds; clays suitable for the saggers, and cheap fuel in abundance."

MICHIGAN.

Michigan, Wisconsin, and Minnesota are the granite States of the northern tier, and, with the exception of the latter, contain little or no sedimentary clays of value except for brickmaking. The glacial deposits are also developed, but its material is poor except for occasional brick material of local value.

The granitic masses of the northern border region have been largely cleared of débris in some localities or covered in others by glacial deposits. Nevertheless the region presents good prospects of yielding many fine kaolin deposits.

Excellent red brick are largely manufactured near Grand Rapids and used for local and shipping trade. These brick are shipped in large quantities to Chicago and elsewhere.

WISCONSIN.

In Wisconsin residual kaolin deposits are found in the valley scarps of all the large streams in the so-called driftless area. This occurs entirely as a "kaolinized" rock, a residuum of the underlying gneisses and granites of Archæan age. The occurrence and extent of these deposits have been thoroughly described by Irving, whose paper (*a*) is an admirable practical manual of the subject for the State.

With the exception of the rock kaolin fully mentioned in the chapter on residual clays, Wisconsin is void of clays suitable for other than brickmaking, which is carried on in several localities.

Milwaukee has long been famous for its white brick, which are manufactured from the plastic clays of the vicinity and shipped to nearly every portion of the Union.

MINNESOTA.

According to the State geological report residual kaolin is found extensively in southwestern Minnesota, forming a layer at the top of the granite and beneath the Cretaceous deposits.

Most of this State is composed of formations unpropitious for the occurrence of large deposits of sedimentary clays, but the State Geologist has shown the occurrence of large deposits of pottery clays in the Cretaceous formation of Blue Earth, Brown, Goodhue, Olmstead, Redwood, and Steele counties in the southwest portion of the State. The clays vary in color from a light pink to a dark brown. Some of them contain too much lime to make them of service in the pottery industry. (See Geological Reports of Minnesota, 1872–'89.)

THE CORDILLERAN REGION.

The vast mountainous area of the western United States, including the Rocky mountains and the Sierra Nevada and Great Basin regions, are considered under this head, including (1) the eastern or Rocky mountain division, (2) the interior or Great Basin division, and (3) the Pacific coast division.

Here feldspathic rocks, both granitic and eruptive, abound, but because of the extreme aridity and the consequent scarcity of water (with local exceptions the chief agent in kaolin making) residual clays are rare, the rocks not having undergone the excessive decay previously noted in the eastern humid parts of the United States. In the swales or depressions of many high, timbered mountains, and on the Pacific margin, especially in Washington, where rainfall is greatest, residual kaolins should occur in great abundance.

The writer has been unable to find reported occurrences of kaolin in Montana, New Mexico, Trans-Pecos Texas, Dakota, Arizona, Nevada, Washington, and Oregon.

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a On kaolin in Wisconsin by Roland D. Irving, Transactions Wisconsin Academy of Sciences, Arts and Letters, Madison, 1876.

THE EASTERN OR ROCKY MOUNTAIN DIVISION.

MONTANA.

The ordinary resources of the States of the far West have not received the attention which will be given after an accession of greater population, interested in other pursuits than the development of the precious metals. This is especially true of Montana, and hence little is known of its clay resources. The shales of the Paleozoic and clays of the Cretaceous abound there, however, and theoretically there is no reason why they should not produce refractory and pottery material like that of Colorado. The same may be said of Wyoming, and the clay resources of these States are only awaiting the advent of clay-workers to be developed. Brick of inferior quality are now manufactured at several places in Montana.

WYOMING.

Kaolin is reported in Carbon county near Soda lakes in great purity and quantity. Its mode of occurrence is not stated.

Fair plastic and fire clays similar to those of the adjacent States occur in Wyoming. The brickmaking industry has not been largely developed as yet, but an abundance of material exists.

COLORADO.

The eastern half is principally covered by the Great Plains Tertiary formations, which, however, have been largely washed away, especially towards their western border, down to the underlying Cretaceous clays, which, in the vicinity of Denver and Golden, yield some of the finest refractory clays, for crucible and furnace work. Fine porcelain sedimentary clays, of a plastic nature, however, are reported from Jefferson and Garfield counties. Good brick, of weak colors, are made at Denver, Trinidad, and various places throughout the State.

Mr. Whitman Cross, of the U. S. Geological Survey reports the occurrence of a large bed of kaolinite near Silver Cliffs, Colorado, which is the residuum of decomposing pitch stone. It contains about 60 per cent. of soluble silica, which can be readily removed. The deposit should be of great value.

NORTH AND SOUTH DAKOTA.

With the exception of the Black Hills region, the Dakotas are underlaid by the Upper Cretaceous and Great Plains Tertiaries. The latter, as we have before mentioned, are of little value for clay-workers, but the former possesses many clays, which, although generally calcareous, are often found in sufficient purity for the manufacture of earthen and refractory brick. The Paleozoic shales of the Black Hills are also susceptible of being ground into brick and pottery clays.

NEW MEXICO.

This important Territory embraces a great diversity of geological features. The eastern border is a continuation of the Great Plains Tertiaries, through which the drainage has cut deeply in the north, exposing the underlying Cretaceous clays and the red beds in the southeast portion. The heart of the Territory is mountainous, the main Colorado division of the Rocky mountains terminating in the vicinity of Santa Fé, and isolated masses occurring thence southward to the Mexican border, intercepted by wide basin plains of recent or Pleistocene and Tertiary formation, which contain good brick and pottery clays.

The base of the mountains is marked by the outcrop of the same formation which produces the refractory clays of Colorado, while there is no doubt an abundance of all kinds of pottery material in the mountain areas.

At Socorro there is a large manufactory of fire-clay products and of building brick.

The oldest potteries in the country are those of the aborginal Indians of the region who manufacture the peculiar pottery and images, which have a large sale, and are used by the Indian and Mexican population for all kinds of domestic utensils. The excellent aboriginal pottery of New Mexico has been described by Mr. Frank Cushing in the third annual report of the Bureau of Ethnology. The cooking and ordinary red ware is made from the stream alluvia. The water jugs are produced from the excellent Cretaceous clays. All the pigments are also native to the country. Mr. Cushing also reports kaolin near the top of the mesas of western New Mexico.

Good adobes are made from all the valley soils and constitute the chief building material of the Territory.

Brick of fair quality are manufactured at Socorro, Las Vegas, Raton, Eddy, and elsewhere.

STATES OF THE PACIFIC SLOPE.

These States are marked by the great diversity of geological features, which have as yet been little studied in relation to the humbler resources.

WASHINGTON.

The State of Washington is principally composed of three conspicuous geologic formations: (1) The volcanic rock and débris which largely constitutes the mountains and overflows some of the valleys; (2) the Laramie-Eocene littoral deposits, which are the chief clay-bearing beds, and (3) the later lacustral or basin deposits, which have the general economic characteristics of the basin valleys of the Basin region. Little or nothing has been done to develop the clay resources, but there is a great abundance of valuable clays in the coal-bearing

Laramie-Eocene formation. In Washington are many distinct varieties of clay which may be made to become merchantable. Among the most important may be mentioned clay for brick, both pressed and rough, of the finest quality, which may be seen in use throughout the State, all of home manufacture. For the Washington product of this character there has this last year sprung up a keen and growing demand; clays for stonewares are as good and plentiful. For more detailed information concerning the clays of this State, the reader is referred to the recent report of the newly organized Geological Survey. (*a*).

IDAHO, UTAH, AND ARIZONA.

This region is in part mountainous, but the seat of the greater populations is in the wide areas of basin plains which cover much of their extent, and are composed of ancient lake sediments of the more recent geologic periods. In some cases these are comparatively free from injurious ingredients for brick and pottery clays, while in others they are excessive in lime and other injurious alkalies. Fair brick are manufactured in various places in Idaho, Utah, and Arizona, but the principal and most economical structural material is the useful adobe, which finds especial favor in Utah and Arizona. Lately it is claimed that good kaolins have been found in Idaho and will form a significant part of the mineral exhibit from that State at the World's Columbian Exposition.

Native Indian pottery is also manufactured in Arizona.

CALIFORNIA.

More attention has been paid to the study of the clay deposits in this than in the other Pacific States.

The vast areas of feldspathic rocks should produce good kaolins, and some of the valuable clay deposits of the State may be of this origin. Kaolin is reported near Calico, San Bernardino county. The following statement is by Cronise, in "The Natural Wealth of California":

"*Potteries.*—There are a number of potteries in and around San Francisco, and two or three in other parts of the State. The works at the Mission Dolores manufacture, from a clay obtained in Sacramento county, every description of stoneware, and also wares for acid factories, chemical works, etc. The establishment at North Beach is engaged chiefly in making sewer pipes. At San Antonio, Contra Costa county, there is quite an extensive pottery, where nearly every kind of stone and earthenware is made, the clay being obtained from a bed near by. There are also similar works in Sacramento, and at Antioch, Contra Costa county, firebricks and crucibles, besides stoneware, being

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a Mines and Minerals of Washington. Annual Report of George A. Bethune, First State Geologist, Olympia, 1891.

made at the latter, the material therefor being obtained from a seam of clay found in the Black Diamond Coal Mine.

"Clays suitable for making not only stone and earthenware, but also the finer kinds of crockery as well as fire bricks, crucibles, etc., are found in many parts of the State, and it is highly probable that nearly everything required in this line will in course of a few years be supplied by the local potteries."

The State Mineralogists' Report for the year 1889 contains an article, "Clays," by W. D. Johnston, M. D., chemist of the State Mining Bureau, which is a history of clay, fire brick, and of pottery since it was first manufactured. It contains the following:

"California contains within her borders deposits of those clays which, by proper washing, yield kaolin. Some of those which have been examined by the State Mining Bureau compare favorably with the foreign clays from which the noted porcelains are produced.

"Examinations were made of twenty clays which to the eye alone gave promise of merit; of these fifteen were finally taken for analysis, eleven of which are of a character worthy of being reported upon, the others being worthless for pottery.

"The eleven reported are: First, from near Jelon, Monterey county. It is white with a tinge of yellow; when moist has a yellowish brown color, semiplastic; suitable for the production of the finest grades of terra cotta.

"A sandy clay from Chico, Butte county; white with brownish tinge, when moist has a light brown color; it also is suitable for terra cotta work.

"A fine white clay from Amador county; very plastic; suitable for making finest grades of porcelain. This clay contains 73.63 per cent. of pure kaolin; 24.37 per cent. of the silica, is partially in the hydrated state, and combined with the other bases.

"A clay from Carbondale, Amador county; white and plastic; could be used for porcelain; contains 76.2 per cent. of pure kaolin and 20.83 per cent. of silica in the hydrated state.

"A fine clay from near Grass Valley, Nevada county; suitable for fine ware; white and plastic; can be made highly so by working.

"Another clay from Grass Valley; fine and white; suitable for any purpose, being plastic and soft; contains 94 per cent. of pure kaolin; 3 per cent. of silica is combined with the bases.

"A fire clay from the Clipper Coal Mine, near Lincoln, Placer county; it is nearly a pure kaolin, soft and unctuous; would hold a large percentage of siliceous material.

"A fire clay from Carbondale, Amador county; this is also nearly a pure kaolin; the original sample held 70 per cent. of coarse siliceous material.

"A clay from near Daggett, San Bernardino county; soft, white, and very plastic; contains a large percentage of alumina. In producing porcelain from this clay a large per cent. of silica would be required; also additions of lime. In experiments conducted at San Diego, porcelain of good character was made from clay beds found near Daggett.

"An aluminous clayey body from the sulphur banks of Lake county. It is soluble in sulphuric acid, the silica readily separating out; it could be cheaply manufactured into alum. This clay is well adapted, judged from our original sample, for use in sizing paper.

"The deposit in Carville, Trinity county, is not strictly a clay, though white, soft, and somewhat plastic; under intense ignition it slightly agglutinates, and after cooling feels sandy; it resembles more nearly in character the Japanese clays exhibited in the International Exhibition of 1876."

OREGON.

According to the official report of the State Board of Agriculture, published in 1888, upon the resources of the state, brick clays are common throughout the state. The Loess of the Willamette valley is used for brickmaking, and is found to answer the purpose tolerably, although it is very fusible. It furnishes the material for the Portland and the East Portland kilns. In Clatsop county a fine deposit of potters' clay occurs, which was lately worked by the Portland Pottery Company. The geological occurrence of this deposit is not given.

NATURAL AND ARTIFICIAL CEMENTS.

By Spencer B. Newberry.

Cements used for building purposes are compounds of lime with silica and alumina, obtained by subjecting natural or artificial mixtures of carbonate of lime and clay to a high heat, and grinding the product to a fine powder. The value of cements depends upon their property, after mixing to a paste with water and allowing this to set in air, of hardening under water to a stone-like mass.

Le Chatelier has shown that the chief active agent in all kinds of cement is a tricalcium silicate, Ca_3SiO_5, which with water becomes hydrated, and solidifies to a hard crystalline mass. Calcium aluminate and ferrate are also formed, but probably take little part in the setting of the cement. The above-mentioned silicate contains 26.4 per cent. of silica, and for its production a mixture containing 16.6 per cent. of silica and 83.4 per cent. of carbonate of lime would theoretically be required. As this silicate is very infusible, such a mixture could be heated to a white heat, and at this temperature all the silica and lime would combine, forming a Portland cement, showing maximum hardening properties. For cement-making purposes, however, silica is chiefly available in the form of clay, which contains also a large percentage of alumina and iron oxide; these can also combine with lime, and in general it may be said that a mixture of carbonate of lime and clay, in which the clay amounts to 20 to 22 per cent. of the whole, will, when burned at a very high temperature, yield a Portland cement.

Argillaceous limestones occur in various parts of the world, but are rarely found to contain the exact proportion of clay necessary to yield Portland cement. If the clay is present in small amount, the stone will slake after burning, yielding so-called hydraulic lime, which will harden to some extent under water. Usually the limestones containing a considerable proportion of clay show a much higher percentage than that required for Portland cement. Such stones, if burned at the high heat necessary to bring all the lime into combination, would fuse into a glassy slag, possessing no setting or hardening properties. If burned at a lower heat, however, a considerable combination takes place, the excess of clay and part of the lime remaining uncombined. The product does not slake with water, but after grinding to powder furnishes a quick-setting hydraulic cement, which, though greatly inferior to the slow-setting Portland in ultimate hardness and strength, is still very valuable for building purposes. Such cements form the chief supply of hydraulic material in this country, and are made from argillaceous limestones generally containing a large percentage of magnesia.

Practically all the Portland cement of the world is made from artificial mixtures of carbonate of lime (chalk, marl, etc.) with clay; for it is only by means of such artificial mixtures that it is possible to secure the exact proportions necessary to withstand the high temperature required, and to produce a perfectly-combined product.

Cements may then be divided into two general classes:

(1) Hydraulic cement, made from naturally-occurring argillaceous limestones, burned at a moderate heat.

(2) Portland cement, made from artificial mixtures of chalk, marl, etc., with clay or ground shale, and burned at a very high heat.

HYDRAULIC CEMENT.

Natural-rock cements are made in enormous quantities at various points in the United States, the product for 1891 having reached the total of 7,767,979 barrels. The most important centers of production are, in the order of their importance, the Ulster county region in New York; the Louisville region in Kentucky and Indiana; Erie county, New York; Lehigh county, Pennsylvania; Milwaukee, Wisconsin; and La Salle county, Illinois. Considerable quantities are also made in Onondaga county, New York; at Fort Scott, Kansas; near the Potomac river in Maryland and West Virginia; and in eastern Ohio, and smaller amounts in Georgia, Minnesota, New Mexico, Texas and Utah.

In most localities the rock used is a shaly limestone, usually containing a high percentage of magnesia. In New York the stone is found at the top of the Salina group, below the lower Helderberg. The outcrop of this rock extends northward along the Hudson nearly to Albany, then westward through the central part of the state to Buffalo. It is extensively worked at several points, chiefly in Ulster, Onondaga, and Erie counties. The same geological formation furnishes the material used on the Ohio river and at Milwaukee, Wisconsin. The cement rock of eastern Pennsylvania and La Salle, Illinois, belongs, however, to an older formation, being the limestone of the Calciferous, below the Trenton, and lying between the Cambrian and the ordinary Silurian rocks. In eastern Ohio, cement is made from a bed of limestone of the Carboniferous period, which lies between the Pittsburg and Meigs Creek coals.

The general character of the cement rocks may be seen from the following analyses, taken in part from the Geological Survey reports of the several States:

Analyses of hydraulic limestones.

	Rosendale, N. Y. (Gilmore.)	Rosendale, N. Y.	Cumberland, Md. (Gilmore.)	La Salle, Ill.	Bellaire, Ohio.	Harrison county, Iowa.	Coplay, Lehigh county, Pa.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Carbonate of lime	46.00	30.72	41.80	42.25	46.52	62.21	74.12
Carbonate of magnesia	17.76	35.10	8.60	31.98	26.40	....	2.41
Silica	27.70	19.64	24.74	} 22.18	16.41	30.35	15.03
Alumina	2.34	7.52	16.74	}	5.44	} 5.00	3.97
Oxide of iron	1.26	2.38	6.30	....	3.38	}	1.93

This table shows that the cement rocks used at the principal centers of production are generally very high in magnesia. This is not regarded as a disadvantage in the manufacture of common cement, but would be fatal to the use of these rocks in making Portland, in which more than 3 or 4 per cent. of magnesia is said to render the cement liable to lose its strength and crack to pieces after hardening. The analysis of the stone used at Coplay, Pennsylvania, however, shows little magnesia, and nearly the exact proportions of silica and alumina for a correct Portland cement mixture; in fact, Portland cement is actually made in large quantity from natural rock at that locality.

The manufacture of hydraulic cement is a comparatively simple operation. The stone is burned in vertical, continuous kilns. In some cases the fuel is charged with the rock into the kiln; it others the fuel is burned in separate fireplaces and the flame allowed to pass up through the charge. The clinker is drawn from the bottom, cooled, sorted, and finely ground between horizontal or vertical millstones. Such cement, when mixed with water to a stiff paste, will generally set in less than one-half hour, and after seven days in water should show a tensile strength of 60 to 100 pounds per square inch.

The production of hydraulic cement in this country during 1891 shows a slight increase over that of 1890. The price of the product in most localities has, however, fallen decidedly, and at some points has reached so low a figure as twenty to twenty-five cents per barrel (in bulk) at the mill. It is impossible that the manufacture at this price can yield a profit. The cause of this depressed condition of the industry is perhaps in part the increased use of Portland cement, the importations of which for 1891 show an increase of more than 400,000 barrels over those of 1890. In Ulster county, New York, the production shows a slight increase, one new company at Rosendale having been added to the list of producers. In Onondaga county and Erie county, New York, the production has also increased. Moderate increase is also to be observed in Illinois, Ohio, and Wisconsin, and a very decided gain in Pennsylvania, while in the Louisville region and in Kansas and Maryland the production has declined. The only new works established during the year are that at Rosendale, mentioned above, one at Cumberland, Maryland, and one at Salt Lake City, Utah, the last of which produced 5,000 barrels near the close of the year.

The following notes are appended, referring to the present state of the cement industry in various localities.

Alabama.—No cement is at present made in this State. A company at Birmingham formerly attempted to make cement from blast-furnace slag and imported Portland, but these experiments have been abandoned.

Kansas.—The old works at Fort Scott, which have been owned for many years by a succession of companies, are now operated by the Kansas City and Fort Scott Cement Company. This company also has works at Kansas City, Missouri, but has not produced cement at that point for two years. New works were built at Fort Scott about two years ago by the Fort Scott Cement Manufacturing Company. These two companies now make all the cement produced in Kansas.

Maryland.—The Cumberland and Potomac Cement Company began operations at Cumberland in December, 1891.

Missouri.—The works at Silica are now standing idle.

Ohio.—Cement is manufactured at Bellaire, Belmont county, and New Lisbon, Columbiana county, in the eastern part of the State; none is now produced in the neighborhood of Sandusky.

Tennessee.—No cement is now made in the State. The works of the Howard Company, of Chattanooga are at Cement, Georgia. At a point 2 miles north of Erin, Houston county, a considerable quantity of cement rock, claimed to be of good quality, has been quarried, but the manufacture has not yet been commenced.

Virginia.—Companies are being organized to develop large deposits of cement rock in Botetourt county, and at Savernake.

The following table gives the total amounts and values of hydraulic cement produced in the various districts during the years 1890 and 1891. (The values given include the price of barrels.)

Product of hydraulic cement in 1890 and 1891.

	No. of works.	1890.		1891.	
		Barrels.	Value.	Barrels.	Value.
Georgia, Cement, Bartow County	1	40,000	$40,000	40,000	$40,000
Illinois, Utica, and La Salle	2	363,117	292,784	409,877	276,931
Indiana and Kentucky	12	1,533,579	1,150,184	1,513,009	983,456
Kansas and Missouri	2	175,000	122,500	135,000	94,000
Maryland	4	223,209	203,785	213,900	195,955
Minnesota	1	87,650	65,737	101,875	76,406
New Mexico	1	33,750	33,750	33,750	33,750
New York:					
Onondaga County	8	292,086	190,968	300,941	197,344
Ulster County	17	2,683,579	2,213,982	2,815,010	2,252,008
Schoharie County	1	25,357	20,286	27,055	21,644
Erie County	4	765,734	560,277	788,300	575,283
Ohio	2	57,000	56,000	70,000	68,000
Pennsylvania	6	555,000	484,900	695,000	536,600
Texas	1	40,000	40,000	40,000	40,000
Utah	1	....	....	5,000	10,000
Virginia and West Virginia	2	50,000	45,000	40,000	33,000
Wisconsin	2	516,055	206,422	539,262	179,145
Total	67	7,441,116	5,676,575	7,767,979	5,613,522

PORTLAND CEMENT.

The manufacture of Portland cement is carried on in Europe, chiefly in England, Germany, and France, on an enormous scale. The production in Germany during the past year is estimated to have been over 10,000,000 barrels. The demand for this valuable product in the United States is rapidly increasing, as is shown by the increased imports, about 3,000,000 barrels having been imported during 1891. The manufacture of Portland cement in this country is still in its infancy, but is undoubtedly destined to become an industry of the greatest importance. Returns from manufacturers show the total production in the United States to have been about 450,000 barrels, but much of this is probably not, strictly speaking, true Portland cement. In view of the probable future importance of the industry, a brief sketch of the materials and processes generally employed, and of the history and growth of the manufacture in this country up to the present time, may not be without interest.

Materials.—For the manufacture of Portland cement some comparatively pure form of carbonate of lime and a siliceous clay, free from sand, are required. In England chalk and clay from the river Medway are generally used; in Germany calcareous marls, which are mixtures of carbonate of lime and clay, or marly limestones, form the most common material. As a source of carbonate of lime, limestone is not generally advantageous, owing chiefly to the cost of quarrying and grinding it and to the high percentage of magnesia which it often contains. Some soft and pulverulent material, like chalk or shell marl, is preferable for many reasons. Clay for cement-making must be siliceous, like ordinary blue clay, not rich in alumina like kaolin or china clay, and must also be free from sand or grit. Materials suitable for Portland cement manufacture occur in great quantities in various parts of the United States.

Process of manufacture.—The carbonate of lime and clay are intimately mixed, in such proportion that the cement after burning shall contain from 60 to 64 per cent. of lime. This variation is not arbitrary, but depends upon the composition of the clay employed; highly siliceous clays requiring, in general, the use of a higher proportion of lime than those richer in alumina. The proper composition of the mixture must be determined with great accuracy by experiment, and closely adhered to, since a variation of one per cent. of lime in the charge will greatly affect the properties of the resulting cement. The material is mixed in a wet, semi-wet, or dry condition. The operation of mixing must be most thorough, and carelessness in this regard is one of the most common causes of failure. With certain materials it is sometimes necessary to add a small percentage of flux, such as soda-ash, in order to bring about proper combination during the burning.

The mixture is usually molded into bricks and dried, then charged with the proper proportion of coke into vertical kilns, somewhat like those used for burning lime, and burned at an intense white heat for several hours. These kilns are usually intermittent, and require several days for each operation of charging, burning, and cooling. In Germany the Hoffmann ring-furnace is largely used; this consists of a series of chambers connected with a central stack. The chambers are filled and emptied successively, the heat of the burned clinker in one chamber being utilized to dry the moist fresh material in another. This form of furnace is especially applicable where fuel is costly and labor cheap.

Various forms of continuous furnaces have been designed, and have been used with varying degrees of success. In these the material and fuel are charged at the top, and the burned clinker periodically withdrawn from the bottom, as is usually done in burning common hydraulic cement. The Dietzsch kiln, or Etagen-ofen, is one of the most successful furnaces operating on this plan. The great obstacle to the use of continuous kilns is the tendency of the charge, at the high temperature employed, to cake together and stick to the walls of the shaft, refusing to descend regularly, and necessitating frequent stoppages to cut out the obstructions formed.

Within a few years many efforts have been made to burn the cement mixture, in the form of dust, in an inclined rotary cylinder heated by a blast of air and gaseous fuel, the material being continuously run in at one end, and issuing as burned clinker at the other. This process was patented by Mr. Frederick Ransome, in England, in 1885, and has been subsequently modified and improved by others. Many difficulties have been met with in carrying out this plan, and the process can not be said, as yet, to have been completely successful at any of the several localities where it has been tried. It would seem, however, to be the most rational method of carrying on the burning of cement, since it effects an enormous saving in time and labor, and allows the temperature to be regulated far more exactly than is possible in the older processes. The rotary furnace has been introduced at three or four points in the United States, but its success has not yet been definitely proved. If it can be made successful, it is undoubtedly the process for this country, owing to the very great saving of labor which it accomplishes, and it remains with American engineers to overcome the difficulties which have thus far barred the progress of this promising process.

After burning, the clinker must be crushed, and ground to an extremely fine powder.

Only the finest dust has any value as a cement material, the coarser particles showing no hardening power, and acting like so much sand. Horizontal buhrstones, like those formerly used in flour-mills, are found to be most effective in producing a maximum of dust. The operation of grinding is a somewhat costly one, as great power is required and the stones must be frequently dressed. The following table, taken from the records of the cement-testing laboratory of the College of Civil Engineering, Cornell University, shows the results of tests of the fineness of some of the best known brands of cement.

Per centage remaining on sieves of various degrees of fineness.

Number.	Meshes per square inch.	Dykerhoff's (German).	K. B. & S. (English).	White's (English).	Millen's (American).	Saylor's (American).
1	2,500	0.6	10.8	7.2	4.3	0.5
2	6,400	6.2	12.5	10.8	10.1	14.1
3	32,000	23.5	14.3	14.9	19.4	26.0
4	Dust.	62.7	62.4	67.1	66.2	59.4

History of the Portland cement industry in America.—Although Portland cement has been manufactured in England since 1824, the date of Aspdin's patent, it is only within the past twenty years that attempts have been made to introduce the industry into this country. The first efforts in this direction were those of the late Mr. D. C. Saylor, who in 1872 began to experiment on the manufacture of Portland cement at Coplay, Pennsylvania. These experiments proved successful, and in 1875 the first American Portland was placed on the market. The process was subsequently greatly improved, and the manufacture is now carried on, on a considerable scale, by the original company, and by several other firms in the same neighborhood. The material used is the natural cement rock, which contains approximately the required proportions of lime and clay. The composition of the mixture is made uniform by suitable additions of a pure limestone. Portland cement is now manufactured at six works in Lehigh county; the product for 1891 amounted to about 250,000 barrels, or more than one-half of the total American production.

Another name closely connected with the history of Portland cement manufacture in this country is that of Mr. D. Millen, originally of Syracuse, New York. While engaged in the manufacture of sewer pipe at South Bend, Indiana, in 1874, his attention was attracted to the deposits of shell marl which are of frequent occurrence in that neighborhood, and he began experiments on the manufacture of cement. In 1877 the first kiln was built, and in the following year cement was supplied from the works to the United States Government, and used in the construction of the Rock Island arsenal. In 1886 Mr. Millen returned to Syracuse, and purchased a large bed of marl and clay at Warner's, 12 miles west of the city, the existence of which had been revealed many years before by the work of widening the Erie canal. The works at South Bend were subsequently sold to the company at present operating them. At Warner's a large plant was put up, at which during the past year 60,000 barrels of cement were made. The works have lately been purchased by a Pennsylvania company, and Millen and Sons have removed to Wayland, Steuben county, New York, where they are said to have found a deposit of white marl and clay covering more than 300 acres. They are building a large plant at this point, and expect to produce 300 barrels a day by October, 1892. Large works have lately been erected at Warner's by a Syracuse company, at a point about one mile west of the older factory. At these works the process of burning the cement in rotary furnaces, using a jet of petroleum as fuel, is in operation, and appears now to be completely successful, though many obstacles have been encountered. At the other works at Warner's the old form of vertical kilns is employed.

Several smaller Portland cement works have also been established in other States, as follows:

Ohio.—At Harper, near Bellefontaine, Logan county, an immense bed of shell marl exists, covering at least 500 acres. Works were built there in 1887, and have since been in successful operation. At this factory a large Dietsch continuous kiln is used, the only one in this country. Portland cement is also made by a company in Columbus, from limestone and clay, with addition of blast-furnace slag.

Pennsylvania.—In addition to the extensive works in Lehigh county, already mentioned, a factory has lately been established by a Pittsburg company at Wampum, Lawrence county. The materials used at that point are limestone, marl, and clay.

California.—The works at Santa Cruz, started five years ago, are not now in operation. The material which occurs in great abundance at this point is a so-called "coralline rock," which is quite soft, and contains over 90 per cent. of carbonate of lime. It is undoubtedly an excellent cement material. Efforts are being made to reëstablish the works on an enlarged scale. At Jamul, San Diego county, the manufacture of Portland cement was begun during the past year, but has not yet reached any considerable proportions.

Oregon.—The works at Portland have not been in operation for about three years, owing to litigation among the stockholders of the company. This cement was formerly made from natural rock, the burning of which was carried on in a rotary furnace.

Dakota.—Works were established at Yankton, South Dakota, in 1890, and produced over 30,000 barrels during the past year. The materials used are stated to be chalk and clay.

Colorado.—The works of the Denver Portland Cement Company have been in operation for several years, and their capacity has lately been largely increased. The material used is a finely-divided calcareous marl, brought from the foothills near Morrison, 12 miles from Denver. This marl is found in extensive deposits resulting from the disintegration of a shaly lime rock through atmospheric influences. It contains about 60 per cent. of carbonate of lime. The deficiency of lime is supplied by the addition of a suitable proportion of finely ground, pure limestone.

New York.—Works have been established within the past year at Tompkins Cove, Rockland county, but are working thus far only on an experimental scale. A plant has been erected by one of the large Pennsylvania companies at Jordan, a few miles west of Warner's. At the works of the Buffalo Cement Company the harder portions selected from the ordinary hydraulic cement clinker furnish a Portland cement, more than 20,000 barrels of which were produced in 1891.

The following table shows the amount and value of Portland cement produced in the United States during 1890 and 1891:

Product of Portland cement in 1890 and 1891.

States.	No. of works.	1890.		1891.	
		Barrels.	Value.	Barrels.	Value.
California	1	....	....	5,000	$15,000
Colorado	1	12,500	$40,000	12,500	40,000
Dakota	1	....	....	31,813	71,579
Indiana	1	15,000	36,000	15,000	36,000
New York	5	65,000	140,000	87,000	290,250
Ohio	2	22,000	49,000	35,000	82,000
Pennsylvania	6	221,000	439,050	268,500	532,850
Total	17	335,500	704,050	454,813	1,067,429

Le Chatelier's researches on cements.—A very interesting series of experiments on the active constituents of cements, and the cause of hardening, have been published by Le Chatelier (Annales des Mines, 1887, 388, 413, 465). Full abstracts of these papers will be found in the Journal of the Society of Chemical Industry (1888, 567, 847). Experiments were made on the properties of different calcium silicates and aluminates. It was found that the monosilicate CaO,SiO_2, which occurs in nature as Wallastonite, possesses no hardening properties; the dicalcium silicate, $2CaO,SiO_2$, falls to powder on cooling, owing to a change in the crystalline form, and is the cause of the "dusting" often noticed in cement clinker, especially in that containing too much clay. Tricalcium silicate, $3CaO,SiO_2$, or Ca_3SiO_5, hardens to a stone-like mass in water, and is the chief active constituent in all classes of cements. This silicate is very infusible, and can not be obtained by the direct combination of silica and lime, but only by the agency of some fusible silicate, such as clay. Microscopic examination of good cement-clinker shows the presence of quantities of colorless doubly-refracting crystals resembling sections of cubes. These consist of the above-mentioned tricalcium silicate. The interstices between these crystals are filled with reddish or greenish-brown substances, which are probably silicates of lime, alumina, and iron. After hardening in water, cement shows the presence of numerous hexagonal plates, consisting of calcium hydroxide, mixed with a translucent white mass composed of interlaced groups of slender crystals of hydrated calcium silicate, $CaSiO_3,2.5H_2O$. Le Chatelier expresses the hardening of cement by the following reaction:

$$2Ca_3SiO_5 + 9\ H_2O = 2CaSiO_3\ 2.5\ H_2O + 4Ca(OH)_2,$$

according to which the tricalcium silicate is decomposed by water, forming a hard crystalline mass of hydrated monosilicate and calcium hydroxide.

The changes which take place in burning cements are thus described: At about 600° the clay is dehydrated and decomposed; at 800° to 900° the carbonate of lime gives off its carbon dioxide, and the lime remaining begins to combine with the silica and alumina of the clay. Fusible slags containing little lime are first formed; these become gradually more basic by combination with more lime, forming the mono- and dicalcium silicate, and finally the all-important trisilicate and the fusible tricalcium aluminate. The only aluminate which is stable in the presence of water, and likely to be met with in hardened cements, the author considers to be $4CaO,Al_2O_3,12H_2O$.

TESTING CEMENTS.

Accounts of the latest conclusions in regard to methods of testing are given in Dingler's Polytechnische Journal (*281*, 114, 138, 163. Full abstract in the J. Soc. Chem. Ind., 1891, 927). In order to ascertain any tendency to "blow" or expand in air, it is recommended to prepare pats of wet cement on sheets of glass, and after setting for twenty-four hours to expose them for two or three hours to a temperature of 120° C. in an air bath. Radial cracks around the edge of the pat show the cement to be unfit for use. Erdmenger has proposed a high-pressure test, which consists in exposing test-pieces of cement and sand to a steam-pressure of 10 to 20 atmospheres. It is claimed that this method shows in a few hours the strength which would be developed by several weeks immersion in water. The injurious effect of magnesia is also shown by this test. In regard to the influence of magnesia, it is claimed by Dykerhoff and others that as little as 4 per cent. causes the cement to show dangerous expansion.

The author takes pleasure in acknowledging his indebtedness to Mr. U. Cummings, of New Haven, Connelly & Shafer, of Eddyville, New York, and others, for valuable information used in compiling this report.

Cement imported and entered for consumption in the United States, 1868 to 1891.

Years. (*a*)	Quantity.	Value.	Years. (*a*)	Quantity.	Value.
	Barrels.			*Barrels.*	
1868	....	$10,168	1880	....	$373,264
1869	....	9,855	1881	....	441,512
1870	....	18,057	1882	370,406	683,684
1871	....	52,103	1883	456,418	802,294
1872	....	172,339	1884	*b* 585,768	825,095
1873	....	209,097	1885	554,396	874,070
1874	....	286,429	1886	915,255	962,689
1875	....	261,741	1887	1,514,095	1,470,846
1876	....	247,200	1888	1,835,504	1,731,456
1877	....	201,074	1889	1,740,356	1,704,253
1878	....	184,086	1890	1,940,186	2,249,741
1879	....	212,719	1891	3,988,313	4,411,330

a Calendar years ending December 31 from 1886; previous years end June 30.
b Classed simply as cement; kind not specified since 1883. It is probable, however, that about 95 per cent. of the total imports is Portland cement.

PRECIOUS STONES.

By George Frederick Kunz.

Introduction.—Since the last report on this subject was prepared, definite and systematic mining has been carried on at seven places in the United States, viz: Near Los Cerrillos and in Grant county, New Mexico, for turquoise with much success and profit; extensively for sapphire in connection with gold on the Missouri river, near Helena, Montana, with what commercial success is not known; for opal, with fair success, at Gem City, Washington State; for tourmaline at Mount Apatite and Mount Mica, both in Auburn, Maine, and for emeralds and lithia emerald in Alexander county, North Carolina, during 1891, but with little success.

Production.—The following table gives the output of the various gems and precious stones during 1891:

Product of rough gems before cutting, for the year 1891.

Gems.	Value.	Gems.	Value.
Turquois	$150,000	Agatized and jasperized wood	$2,000
Opal	5,000	Pyrite	1,500
Sapphire	10,000	Chlorastrolite	500
Tourmaline	3,000	Thomsonite	200
Garnet	3,000	Fossil coral	1,000
Peridot	1,000	Catlinite (pipestone)	5,000
Emerald and lithia emerald	1,000	Ornaments	15,000
Aquamarine	1,000	Topaz	100
Quartz	10,000	Miscellaneous	15,000
Smoky quartz	5,000		
Gold quartz	6,000	Total	235,300

Estimated production of precious stones in the United States from 1884 to 1891.

Species.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Value.	Value.	Value.	Value.	Value.	Value.	Value.	Value.
Diamond	$800	....	$60	....	....	....	....	....
Sapphire gems	1,750	$500	750	$500	$500	$6,725	$6,725	$10,000
Chrysoberyl	25	....	....	....	....	....	....	....
Topaz	500	1,250	1,000	2,000	600	400	....	100
Beryl	700	750	5,500	3,500	800	....	....	....
Phenacite	....	....	....	....	650	200	....	....
Emerald	....	3,200	3,200	....	100	450	....	*a*1,000
Hiddenite	....	2,500	4,500	....	....	....	....	....
Tourmaline	2,000	600	5,500	500	....	2,250	2,250	3,000
Smoky quartz	12,000	7,000	7,000	4,500	4,000	4,232	2,225	5,000
Quartz	11,500	11,500	11,500	11,500	11,150	14,000	14,000	10,000
Silicified wood	10,500	6,500	1,500	36,000	16,000	....	....	....
Garnet	4,000	2,700	3,250	3,500	3,500	2,308	2,308	3,000
Anthracite	2,500	2,500	2,500	2,000	1,500	....	....	....

a For cabinets, museums, etc.

Estimated production of precious stones in the United States from 1884 to 1891—Cont'd

Species.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Value.	Value.	Value.	Value.	Value.	Value.	Value.	Value.
Pyrite	$3,000	$2,000	$2,000	$2,500	$2,500	$2,000	$2,000	$1,500
Amazonstone	2,750	2,750	2,250	1,700	1,700	500	500	
Catlinite (pipestone)	10,000	10,000	10,000	5,000	5,000	5,000	5,000	5,000
Arrow points	1,000	2,500	2,500	1,500	1,500			
Trilobites	500	1,000	1,000	500	500			
Sagenitic rutile	1,000	250	1,750					
Hornblende in quartz	600	300	200	100				
Thomsonite	750	750	400	750	500	400	400	200
Diopside		100		50				
Agate	4,500	2,000	2,000	4,000	4,000			
Chlorastrolite	1,500		1,000	800	800	500	400	500
Turquois	2,000	3,500	3,000	2,500	3,000	23,675	28,675	150,000
Moss agate	3,000	2,500	2,000	950	950			
Amethyst	2,250	2,100	2,100	2,100	2,500	98		
Jasper	2,500				100			
Sunstone	450	350	300	150				
Fossil coral	750		1,000	2,000	3,000	700	700	1,000
Rutile		750	750					
Aquamarine						747		1,000
Rose quartz						600	200	
Gold quartz	140,000	140,000	40,000	75,000	75,000	9,000	9,000	6,000
Rutilated quartz						30		
Dumortierite in quartz						250	250	
Quartz coated with chalcedony						4,000	2,000	
Chrysoprase						200	200	
Agatized and jasperized wood						53,175	6,000	2,000
Banded and moss jasper						630		
Fluorite						500	500	
Azurite and malachite						2.037		
Zircon (*a*)						16,000		
Gadolinite, fergusonite, etc. (*a*)						1,500		
Monazite (*a*)						1,000		
Spodumene (*a*)						200		
Wooden ornaments decorated with minerals (*b*)						15,500	15,500	15,000
Opal								5,000
Peridot								1,000
Miscellaneous minerals (*c*)						20,000	20,000	15,000
Total	222,825	209,850	118,850	163,600	139,850	188,807	118,833	235,300

a Including lithia emerald.
b Used to extract the rarer elements for chemical purposes.
c Such as clocks, horseshoes, boxes, etc.

Diamonds.—In connection with the occurrence of diamonds in the United States, mention should be made of certain recent discoveries in the Northwest. In the Engineering and Mining Journal, December 13, 1890, page 686, a communication appeared from Mr. G. H. Nichols, of Minneapolis, Minnesota, stating that in a review of Gems and Precious Stones of North America, published in that journal, no reference had been made to the occurrence of diamonds in Wisconsin, where he had found several small stones. The writer immediately put himself in communication with Mr. Nichols, and from him obtained the following particulars:

In the summer of 1887 Mr. Nichols was engaged in prospecting for gold on Plum creek, Rock Elm township, Pierce county, Wisconsin, in company with Mr. W. W. Newell and Mr. C. A. Hawn, of Rock Elm. While sluicing for gold one of their workmen detected a bright stone, which proved to be a diamond, in gravel taken from the bank of the stream at a depth of some few feet below water level. Bad weather interrupted the work at that time, but subsequently they resumed the search, and several more diamonds were found by other members of the party. Nothing more was done in 1887, but in panning three miles farther up the stream Mr. Newell found another diamond, much distorted and off color. In the summer of 1888 actual sluicing for gold was begun, and in three weeks' time in the gravel at the washout four diamonds were found. One came from the surface of the gravel bed and one from a pit some 30 rods distant, at a depth of 5 or 6 feet below water level. The most perfect stone was obtained by a workman, who secreted it. In 1889 prospecting was resumed on the west branch of Plum creek, and here Mr. Nichols found another diamond in gravel taken from the sluice. Two or three small ones were also found in the tailings.

Gold occurs all along the main branches of Plum creek, as well as along the smaller runs of their extreme headwaters from 2 to 5 miles from their junction. From Mr. Nichols the writer received a series of specimens both of the gold-bearing sands in which the diamonds sent to him for examination were reported to have been found, and three of the diamonds weighing, respectively, $\frac{25}{32}$ of a carat (160.5 milligrammes), $\frac{7}{16}$ of a carat (46 milligrammes), and $\frac{3}{32}$ of a carat (19.25 milligrammes). Only the largest of these would cut into a stone of any value. It is a hexoctahedral crystal with rounded faces, white, with a slight tinge of grayish green, and could be cut into a perfect brilliant of about $\frac{3}{16}$ of a carat. On one side is an L-shaped depression with rounded faces in which there are minute grains of sand. The next in size is a slightly yellowish elongated hexoctahedron. The surface is less smooth than that of the larger one and is entirely covered with small crystalline markings. The smallest one is an elliptical hexoctahedral twin, with a dull surface. In color it resembles the second.

The sand sent by Mr. Nichols, when examined by the microscope, was found to contain the following minerals besides the quartz grains: magnetic iron, titanic iron, almandite garnet in grains and in minute perfect dodecahedrons, small transparent brilliant crystals, none more than one-third the size of a pin's head, of what appeared to be spessartite or essonite garnet, numerous grains and rolled crystals of monazite and one small grain reported to the platinum, but this was lost before the writer could examine it. The whole material is thus seen to resemble in many particulars the gold-bearing sands of Burke county, North Carolina, and Hall county, Georgia. This matter is interesting as a new locality for diamonds, but it is very doubtful if these sands will be more prolific or the discovery have any greater commercial value than the gold sands of the southern Alleghenies up to the present time.

Diamonds in meteorites.—A remarkable account has been published by Prof. George A. Koenig, of the University of Pennsylvania, regarding the discovery of what appears to be diamond, or at least the diamond form of carbon, in a meteorite from Cañon Diablo, Arizona, sent to him for examination by Prof. A. E. Foote, of Philadelphia, who obtained it at the locality in 1891. The following is a summary of this account: (*a*)

The piece examined weighed about 16 pounds; it was one of a number, some of which were very large. On attempting to cut it, remarkable hardness was at once observed, and the edge of the half-inch chisel was repeatedly broken. Presently an intensely hard spot was reached where a black powder was produced instead of chips. This powder carefully collected amounted to about four-tenths of a grain. The spot was found to be a round cavity, about half an inch across, through which the cutting machine had passed, leaving the halves on both sides lined with a black mammillary coating, resembling black diamond. On attempting to polish the sections of the meteorite on an emery wheel, the latter was cut to pieces where it met with this cavity, and corundum was easily cut into grooves by the black coating. The powder dissolves in nitric acid, yielding a red solution resembling iron carbide and leaving a black residue. The latter with sodium hydrate yields an intense amber yellow or gold-colored liquid, from which acids give no further precipitate. The residue, fused with hydrosodium sulphate, left a substance in which the microscope revealed minute particles, some black and others partially transparent, and one white spherical grain. These had no effect on polarized light. Unfortunately, however, they were lost by an accident before further examination could be made.

During 1891 work was carried on for a number of months at Isons Mills, Elliott county, Kentucky, at the periodotite dikes previously examined by Dr. Diller and the writer by direction of the U. S. Geological Survey. It was supposed at that time that as these dikes contained carbonaceous shale under conditions similar to those at the south African fields diamonds might also be found there. Although it was suggested previously (*b*) that the paucity of the carbon in the Kentucky shale precluded the possibility of its containing diamonds, yet a number of gentlemen have carried on operations there during 1890 and 1891 with the hope that diamonds may at some time be obtained. These efforts have not yet met with success.

Sapphire.—The sapphire locality in Montana is being developed. The mineral is found to be somewhat abundant in the gravel bars of the Missouri river for a distance of some 6 miles. The principal points are those known as Ruby bar, French bar, Spokane bar, and Eldorado bar. Of these, the central point is the Spokane bar, at Stubbs ferry on the Missouri, some 12 miles east from the city of Helena. Although these bars had been partially sluiced for gold, no systematic attempt had been made to work them for gems until 1891. Some of the sapphires had occasionally been sent to large cities, but they never

a Am. Jour. Sci., 3d ser., vol. XLII, 1891, p. 413.
b Science, October 29, 1886, and September 16, 1887.

until recently received much recognition, owing to the high price of cutting sapphire gems and the small demand existing for stones other than of deep color, such as true ruby red or sapphire blue. In 1889 an area of about 4,000 acres (6¼ square miles) was purchased, or the option obtained upon it, by a company capitalized at £450,000, which contemplates working Eldorado bar and the other bars for a distance of about 6 miles.

The company has had the property examined by mining engineers, whose estimate is that Eldorado bar will yield some 2,000 ounces of sapphires to the acre. Only a part of these, however, may be of such quality as to warrant cutting for gems. The stones found exhibit a great variety of colors, chiefly the lighter shades of red, yellow, blue, and green. The latter tint is found quite pronounced, being rather a blue green than an emerald green. Nearly all them, when finely cut, have an apparent metallic luster, strikingly peculiar to the stones from this locality. No true red rubies, nor true blue sapphires, the colors demanded by the public, have been found, the other shades having thus far been only sought by the collectors. It is claimed that there is an abundance of gold, and time only can tell whether the enterprise can be a success.

Several minor companies have been formed or are contemplated. One, known as the Spokane Sapphire Company, embraces that part of the river, near Stubbs ferry, and on what is known as Spokane bar, and one is said to have been formed to protect the interest of the Montana Sapphire and Ruby Company. At all these bars the sapphires are principally found in a layer of auriferous glacial gravel a few inches in thickness, which reposes directly on a slaty bed rock. While work was going on at Ruby bar, a mastodon tusk, 3 feet in length, was found in the sapphire layer.

Among some of the associated minerals observed were white topaz in brilliant crystals not over one-fourth of an inch in length, similar to those from Thomas mountain, Utah; rounded grains of garnet, sometimes as large as a pea and rich ruby red in color, often erroneously called rubies; cyanite in broken translucent crystals, which are white with blue patches, one-half an inch in length and one-eighth of an inch in diameter; cassiterite (stream tin) in rolled concentric nodules, none over one-fourth of an inch in diameter; limonite pseudomorph after iron pyrites, in a variety of imitative and concentric shapes, showing a radiated structure when broken; chalcedony in small irregular and imitative pieces, often an inch in length; and white calcite in small rolled masses.

In regard to the original source of the sapphire itself it is worthy of note that during the winter of 1889 and 1890 an eruptive dike was found cutting the slaty rock at Ruby bar, on which rests the glacial gold gravel. In this eruptive rock were found crystals of sapphire, pyrope garnet, and sanidine feldspar. There seems little doubt that all the sapphire along the bars of the Missouri river has come from the breaking down of a rock similar to this. It is evident that some outcroppings have been eroded by glacial action north of all the bars, but from what precise locality is not yet known. It can not have come from the dike at Ruby bar, as this locality is 6 miles south of Eldorado bar, where a quantity of sapphires were found, but rather from some others now worn away or covered over farther to the north. Mining in this district will probably bring to light other dikes, as did the drifting of a level at Ruby bar some hundreds of feet from the outcrop of the original 4-foot dike. The rock is shown by Mr. H. Miers to be a vesicular mica-augite-andesite, containing an abundance of brown mica and porphyritic crystals of augite.(*a*) The ground mass consists chiefly of feldspar microlites with a considerable amount of glassy interstitial matter and much magnetite. Many of the cavities are occupied by a brown glass which appears yellow in thin sections and displays a spherulitic structure originating in the sides of the cavities.

It is of course difficult to say whether or not the sapphires have been caught up by the augite-andesite from schists or other rocks cut through in coming up, as may have been the case in the occurrences in the Eifel Laacher See, at Unkel, and in Auvergne at Espailly, France.

Owing to the prominence given to the Montana sapphires by the press some thousands of these stones have been sent east and to other centers by the people residing in the vicinity of the district where they are found, for cutting. The result has been that many of them have been cut in the belief that they have a value as gems far beyond their true commercial one. With them many garnets also have been sent frequently exceptionally fine in color.

Emerald.—The mining for emerald and lithia emerald has been carried on for ten years by the Emerald and Hiddenite Mining Company, organized in 1881, with a nominal capital of $100,000. Work was carried on for some time during the summer of 1891, and about 1,500 carats of lithia emerald (hiddenite) and a few small emeralds were obtained, although all were of little value.

Turquois.—During 1890 and 1891 turquois of fine quality and of gem value has been found in the United States. The main locality is the one near Los Cerrillos, New Mexico; the others known are in Grant county, New Mexico.

During the early part of 1890, what is known as the Castilian turquois mine was leased and a number of men put to work by Mr. J. A. Allen, of Chicago, Illinois. This mine is 7 miles from Los Cerrillos, New Mexico, on the road from that place to Santa Fé, and about 1½ miles from Bonanza, with another one adjacent to it. At both these places an immense amount of working was done centuries ago by the Indians, as the hundreds of stone hammers observed by the writer indicate. This property has been opened during the past year, a shaft has been sunk 75 feet, and a lode opened for about 40 feet. The vein or

a Mineralogical Magazine, vol. 9, No. 44, 1891, p. 396.

lode is nearly due east and west. Although the rock is the same, the color of the turquois is superior to that found at the old mine, and a number of other mines have been opened in this vicinity. Thousands of stones were obtained during the two years' operations. Many of them are of fine blue color, quite equal to the best Persian, and material has been obtained choice enough to insure a sale amounting to fully $200,000. A single stone has been sold for about $4,000. The discoveries have proved especially valuable at a time when the Persian mines have almost ceased to yield.

Two new localities for turquois have been discovered in the Burro mountains, near the old Paschal smelting works, about 15 miles southwest of Silver City, in Grant county, New Mexico. This discovery resulted in the forming of an eastern company, which is finding fine material.

This company, organized in October, 1891, under the name of the Azure Mining Company, under the laws of the State of New York and incorporated, has a number of turquois mines in New Mexico, but up to the present has paid especial attention to but one mine, the Azure. This has been steadily worked and several thousands of dollars' worth of turquois have been sold. The colors range from a deep sky-blue to a blue with a faint tint of green, the fine material being limited in quantity. The stones produced at this mine always have a tint of green, due either to a partial change in the mineral or to a local variation. They are not by any means an ideal turquois blue, but they furnish good merchantable material, and if they continue to keep their color it is believed that they will eventually drive out of the market the Egyptian and the poorer quality of American stones. Up to the present time the output of good turquois has not much more than paid for the expenses of the enterprise. After selling the turquois for seven months the owners claim that thus far they do not know of a single stone that has changed color.

The turquois traverses the rocks in seams and streaks, one mass of which measured 8 inches in diameter and was one-eighth to one-fourth of an inch in thickness. A heap of débris 50 feet in height and quantities of small fragments of weathered turquois show that this locality, like the other New Mexican ones, was extensively worked by the aborigines.

About 12 miles from this deposit is an Indian graveyard. In every grave that has been opened a few polished or irregular-shaped turquois beads have been found.

As to the use of turquois by the aborigines, the writer observed some interesting facts in New Mexico recently while witnessing the annual "festa," which is held on August 4 in honor of the patron saint of the Indians of the pueblo of Santo Domingo, a point lying about three miles west by south from Wallace Station, on the Atchison, Topeka and Santa Fé railroad. This "festa" is attended by many Indians of the neighborhood, including the San Felipe, Navajo, Isleta, Acoma, and Jicorilla Apache tribes, and a curious custom is maintained. A carved wooden image of the saint, about four feet high, which is said to date from the time of the reconquest in 1692, is carried in procession through the principal streets to a small tent made of the finest Navajo blankets. Here it is placed on an improvised altar and various offerings are presented to it. Among these are strings of turquois beads, both round and flat, of the choicest color, which are suspended from the ears of the figure and from a string which encircles its neck, while on its breast is hung one of the curious turquois-encrusted marine clamshells, similar to one which Lieut. F. H. Cushing found in the excavations near Tempe, Arizona.(*a*) With the exception of a black band of obsidian running across the center, the entire exterior of the shell is covered with a sort of miniature pavement of little squares of turquois cemented to it with a black shellac-like substance obtained from the "grease-wood" plant common in New Mexico and Arizona.

Tourmaline.—The Mount Apatite Mining Company, organized in 1891, kept a small force of men at work at Mount Apatite, Auburn, Maine, during that summer and obtained a large quantity of material in the form of mineral specimens, but few gems of any value. The operations carried on by private parties yielded during 1890 about $1,000.

In September, 1881, the Mount Mica Tin and Mica Company was organized under the laws of the State of Maine, proposing to explore and mine the deposits in Oxford county, which were believed to be rich in tin, mica, tourmaline, and the minerals of the lithia group. Their principal property was the Bowker farm, situated on the famous Mount Mica, in the town of Paris, Oxford county, Maine, about 4 miles distant from South Paris station, on the Grand Trunk railroad. The company was organized with a nominal capital, the stock being entirely held by the directors and officers. Work has been carried on from time to time at this locality, generally when the farm hands in the vicinity were not otherwise employed. This is true as well of the mine at Hebron, Maine, also secured by the company. Single gems have been obtained valued at over $500 each, and in all at least $15,000 worth have been found since 1881. A number of these have been sold and others retained by the directors, in whose collections they have been placed. The bulk of the crystals—the famous Hamlin collection of tourmalines—has been sold by Dr. A. C. Hamlin and presented by Mr. James A. Garland to the mineralogical cabinet of Harvard University. This collection will be more fully described and figured in colors in a publication which Dr. Hamlin is now preparing. It contains the finest crystals of tourmaline on the matrix found at Mount Apatite, and the finest collection of minerals found associated with tourmalines at this locality, collected by Mr. Thomas F. Lamb, of Port-

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a Gems and precious stones of North America, p. 61.

land; also, a series of nearly one hundred crystals from the same place, collected by the late Prof. N. H. Perry, and a number of other crystals from other Maine collections. Harvard University, therefore, now possesses the finest known series of colored tourmalines in the world.

A new locality for pink tourmaline is given by Mr. Orcutt in a report on the minerals of the Colorado desert.(*a*) It is found in the mountains of Lower California, south of the Alamo mines (though whether within the actual limits of the desert or not, he does not specify), in an identical association with that from Rumford, Maine, and from Rozena, Moravia, viz, rose-colored tourmalines in lepidolite.

Quartz.—An interesting discovery has been made at Placerville, Eldorado county, California, by Mr. James Blackiston, in a quartz ledge running north and south and dipping eastward from 45 to 50 degrees. The rock of the ledge, which is partly decomposed and partly compact, is traversed for perhaps 100 feet by a vein of crystallized quartz varying in width from 6 inches to over a foot. This vein is also decomposed, and is filled in with a reddish earth or sand and can be dug into with a stick or board. It was full of quartz crystals of all sizes, from that of a man's finger up to large dimensions, some of the crystals weighing as much as 80 or 90 pounds.

Several of these, over 50 pounds in weight, were pellucid and free from flaws; while others have peculiar interest from remarkable inclusions of chlorite, 3 to 5 millimeters in thickness, at several depths in the crystal, thus marking successive stages of crystal growth and making very striking "phantoms," generally of green chlorite on white quartz layers. Of still greater interest, however, are other quartz crystals, 2 to 4 inches in length and half as much in diameter, containing at or near their centers inclusions resembling groups or clusters of dolomite or siderite crystals cream-white to brown in color, and consisting of many curved rhombohedra from 2 to 4 millimeters in diameter.

Quartz crystals containing inclusions of goethite crystals, have been found in the Tarry All range, 40 miles west of Colorado Springs, and cut into beautiful ornaments resembling quartz penetrated by crystals of black rutile.

Smoky quartz.—Fine crystals of smoky quartz, one of them 3½ inches in length and 1¾ inches in diameter, have been found in Three-Mile gulch, 3 miles southeast of Helena, Montana.

Hydrolites.—Thin shells of chalcedony filled with water and containing a moving bubble, measuring from ½ to 1½ inches in diameter, are frequently found on the Oregon coast near Yaquina bay and Astoria.

In a report on the minerals of the Colorado desert, Mr. C. R. Orcutt mentions "water-agate" (hydrolite) from Canyon Springs, and beautiful agates and chalcedonies in the drift of the desert and scattered over the mesa-like formations that border the depressed plains.

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a C. R. Orcutt, Tenth Annual Report of the State Mineralogist of California, 1890.

Agate.—Agate in bowlders from a few inches to a foot across, of rich red, brown, and mottled tints, is found in the vicinity of Austin Bluffs, near Colorado Springs and Colorado City, Colorado.

Agatized wood.—In the eighth annual report of the U. S. Geological Survey for 1886–87, Prof. Lester F. Ward, has contributed the most exhaustive treatise on the geological distribution of fossil plants throughout the world, including silicified and agatized wood, that has appeared up to the present time. He says:

"These remarkable petrifactions are believed to occur in the Shinarump group of Powell, and their mode of occurrence is described by him in his 'Geology of the Uintah mountains,' 1876, p. 69. These great trees of stone are believed by the Indians to be the shafts of their thunder-god, Shinauav, and from this Major Powell named the group, which he regards as of Cretaceous age."

On visiting Chalcedony Park, the nearest of the three so-called forests in this formation on the Atlantic and Pacific railroad, the writer found it to be about a mile square and inclosed by table lands from 50 to 100 feet in height. Nearly all the agatized wood is found on the flat plain below these table lands, and rests on layers of sandstone. The lower layer is chocolate-red, another white, another black, and another a compact sandstone, gray, and on these rests a layer of white sandstone in which all the wood at this locality originally belonged. By the washing and weathering away of this formation, the tree trunks have rolled down to the level plain below, and none of them were ever in place there. In the upper layer, where they belong, no trunks occur in the upright position, nor were any roots visible; and since none of the trees retain any of the original bark, it seems very probable that all this deposit was once the bed of an inland sea or lake.

There exist two more deposits of jasperized wood, distant respectively 8 and 16 miles from Chalcedony Park; and also a number of outcrops of this material are seen along the line of the Atlantic and Pacific railroad, although the quality is not as fine as that of the three original deposits.

Within 3 miles of Los Cerrillos, New Mexico, there is a small fossil forest of agatized and jasperized wood, closely resembling that of the Chalcedony Park in Arizona. Two sections from this locality, weighing about a ton each, are to be seen in the collection of the Historical Society of New Mexico, at Santa Fe.

Dr. Alexis A. Julien, who has made a careful microscopic study of the jasperized wood, made the following communication to the New York Microscopical Society at the January meeting, 1892: "In the jasperized wood from Arizona, many of the wood cells are traversed by the well-preserved mycelium of a fungus, secreting iron oxide, of which the still living species has already been described.—[Jour. of the N. Y. Microscopical Society.] The fine threads are silicified and heavily coated with yellowish to reddish brown ferric oxide, and, by their minute and close branching, form spongy masses of cylindrical shape, often somewhat curved or spiral, and of a little less diameter than the wood cells along which they lie. It was often noticed in a sliced thin section of the silicified wood that these spongy cylinders of iron oxide adhered mostly to the same side of the wood cells which inclosed them. In other cases, the walls of several wood cells appeared to be broken down in the vicinity of the larger ocherous cylinders, as if by erosion, through the agency of the organism, producing irregular cavities, now filled with clear quartz.

"Another mode of growth of the fungus was well shown in many branching plants which have insinuated themselves within the thin lamellæ, which make up the walls of the wood cells, and so have crossed over several cells through and inside of their walls, but without entering the cells.

"The mode of introduction of the fungus into the wood is clearly shown in many thin veins of agate, which cross the sections and indicate cracks in the trunk of the original tree. In these veins, as well as in the erosion cavities referred to above, many fungus spores were observed sprouting into mycelium, of which some of the branches were noticed penetrating through the walls of the neighboring wood cells. From these, as well as from other facts observed on the plant now living, the following conclusions were drawn:

"1. That the tree fell and was submerged in a shallow sheet of gently running water, such as that which oozes through the cedar swamps of the Atlantic coast down to the sea, at the present day.

"2. The wood tissue of the tree was attacked by the water fungus immediately after its fall, and this growth mainly progressed on the lower side of the cells in the prostrate tree. After the decay and loosening of the bark, the floating spores of the fungus evidently made their entrance into the tree, through the cracks in its trunk.

"3. The slowly moving current under the swamp brought by infiltration into the wood cells a constant supply of water, charged with organic salts of iron, etc. The coloration of the wood has been effected, not by chemical or mechanical agency, but entirely by organic secretion and deposit of ferric oxide, etc., by this interesting species of water fungus.

"4. The complete silicification of the wood finally ensued, with a deposit of the chalcedonic and crystalline quartz, producing varieties of jasper, banded chalcedony, ruin agate, etc.

"In the silicified wood from Barillas Springs, Texas, still more delicate and complex forms of the same fungus were detected in a perfect state of preservation."

Opal.—In August, 1890, Mr. James Allen, a jeweler, of Yonkers, New York, detected what proved to be fire opal in a heap of rocks thrown out in digging a well, from a depth of 22 feet, on the farm of William Leasure, near Whelan, 20 miles southwest of Colfax, in Washington

State, lat. 47 north, long. 117 west. This point is about midway between the Cœur D'Alene and the Nez Perces Indian reservations, near Moscow, Idaho, almost on the line of Idaho and Washington. The material was rather plentiful, as the last 4 feet of the rock contained cavities filled with precious opal. The rock is a basalt in which most or nearly all the feldspar and pyroxene, as well as the green mass, appears to have been altered. Some original constituent may have changed, but whether or not it is olivine it is difficult to determine, because of the crystalline aggregate character of the pseudomorphic mass. The pieces vary from the size of a half pea to that of a hen's egg, and are found in vasicular lava; the smaller nodules are very rich in color, but the larger ones often have little or no play of colors. The quality of some of the specimens examined was very fine, and if the material is as abundant as supposed, and is properly worked, it is likely to be one of the most promising of our precious stones, from a financial point of view. Mine buildings have been erected and the locality has been named Gem City. A company was organized in June, 1891, under the laws of Colorado, with a capital of $250,000, and the operations commenced in July. Up to the first of October about $280 was expended for mining and supplies, and after paying for lapidary work and other expenses, the yield was $3,500 worth of opals, which were sold at from $30 to $55 a carat. Some of these prices were in excess of that of Hungarian material of equal or finer quality. This spring, owing to the unusual weather, about three weeks' time was lost, and work was interrupted by water and snow three times; still, with an expenditure of about $1,200 up to date, the results have more than doubled in both quantity and quality, one very superior stone having been found and sold at an extraordinary figure—much higher than the prices quoted above. The work is carried on by about 20 men, and is much in the nature of an open quarry. As it progresses into the hill the top soil becomes deeper, but the layer of black basaltic rock next to it and overlying the softer opal-bearing rock remains of about the same thickness. Considerable veins of ocher are met with and various kinds of clay; and good opals are often found embedded in so-called "soap holes," in a greasy, fine-grained, and very tenacious clay. Kernels of opal, all of good quality, are found in hollow amygdules in the rock, the cavities being generally larger than the opal.

Hyalite.—Hyalite, transparent and in great quantity, breaking with an apparent starch-like fracture, has been found in Lake county, California, by Mr. H. H. Myer. Very fine hyalite in thick seams was observed in the trap rock at the falls of the Willamette river, at Oregon City, Oregon, and in beautiful botryoidal masses in the Weiser valley lava fields, about 20 miles north of Weiser, Idaho; at both the latter localities it is equal to the hyalite from Waltsch, Bohemia.

Garnet.—Large quantities of purple almandine garnet, in the form of rolled fractured pieces, have been found along the Columbia river in

Washington and Oregon. These vary in weight from one-half a carat to one-half an ounce. Many of them are good for gem purposes or for watch jewels, and their color is often equal to the best Indian "almandine" garnet.

Malachite.—From the Copper Queen mine at Bisbee, Arizona, fully a ton and a half of beautiful specimens of malachite have been obtained, many of which were polished and sold in Colorado for mineral specimens.

Titanite, Sphene.—A very remarkable discovery of titanite has been made by Mr. Ernest Schernikow at the celebrated Tilly Foster iron mine at Brewster's, Putnam county, New York. Several hundred magnificent crystals have been obtained, varying in size from 1 to 2 inches in length; nearly all have highly polished faces, and some are beautifully twinned. They are of fine yellow shades; many are transparent and several are large enough to cut into gems of from 1 to 15 carats each. These were found during the removal of the upper surface in the new excavations at the mine.

Aboriginal lapidary work.—A visit to Oregon City elicited the fact that Mr. H. O. Stevens and others had found about 150,000 small arrow points on the beaches of the Willamette river at Oregon City, Oregon, between the years 1860 and 1890, principally in two places. One is on the east bank of the Willamette, 300 or 400 feet north of the bridge, where the banks are 15 to 30 feet high, and covered with a dense growth of fir and ash trees, some of them 3 feet in diameter. The arrow points are found in a layer from 1½ to 3 feet below the surface. The other locality is what is known as Green Point, half a mile above the bridge, where a small creek enters the Willamette river; there the banks have receded some 250 feet since 1861, and during the freshet of 1890 over 200 feet. As a result, an island 100 feet in length has been formed in the middle of the river. At both these places the arrow points are gathered by boys and local collectors immediately after a freshet. In the débris of the river are to be found large quantities of broken fragments of obsidian, agatized wood, jasper, and other materials from which the arrow points were made; also large diorite hammers, weighing from 2 to 10 pounds each. There is every indication that these arrow points were not made by the modern Indians, or they would not have existed in such quantities, nor at such depth as the large growth of the trees would indicate. Arrow points, equally fine, are found under similar conditions along the Columbia river. The modern Oregon Indians do not know how to make even rude ones, and have never offered arrow points for sale.

ABRASIVE MATERIALS.

By E. W. Parker.

BUHRSTONES.

The production continued to decrease. The number of pairs of buhrstones made from domestic stone in 1891 was 596, with an aggregate value of $16,587. This is a decrease in value from that of 1890 of $7,133. The product in 1891 distributed by States was: New York, esopus stone, 353 pairs, worth $8,806; Pennsylvania, cocalico stone, 94 pairs, worth $3,801, and Virginia, Brush Mountain stone, 149 pairs, worth $3,980. The value of the annual product since 1883 is shown in the following table. It is probable that the figures for 1888 and previous years are in excess of the actual product, the reports having been based on the estimates by operators of the total yield of their respective regions, and not from a compilation of individual returns.

Value of buhrstones produced in the United States since 1883.

Years.	Value.	Years.	Value.
1883	$150,000	1888	$81,000
1884	150,000	1889	35,155
1885	100,000	1890	23,720
1886	140,000	1891	16,587
1887	100,000		

Value of buhrstones and millstones imported into the United States from 1868 to 1891.

Years ended—	Rough.	Made into millstones.	Total.	Years ended—	Rough.	Made into millstones.	Total.
June 30, 1868	$74,224	....	$74,224	June 30, 1880	$120,441	$4,631	$125,072
1869	57,942	$2,419	60,361	1881	100,417	3,495	103,912
1870	58,601	2,297	60,898	1882	103,287	747	104,034
1871	35,406	3,698	39,104	1883	73,413	272	73,685
1872	69,062	5,967	75,029	1884	45,837	263	46,100
1873	60,463	8,115	68,578	1885	35,022	455	35,477
1874	36,540	43,170	79,710	Dec. 31, 1886	29,273	662	29,935
1875	48,068	66,991	115,059	1887	23,816	191	24,007
1876	37,759	46,328	84,087	1888	36,523	705	37,228
1877	60,857	23,068	83,925	1889	40,432	452	40,884
1878	87,679	1,928	89,607	1890	32,892	1,103	33,995
1879	101,484	5,088	106,572	1891	23,997	42	24,039

GRINDSTONES.

The value of grindstones produced in the United States increased from $450,000 in 1889 to $476,113 in 1891. The quantity represented by this value in 1891 was about 60,000 tons. Practically all of the product is from Michigan and Ohio, the portion obtained from California and South Dakota, the only other producing States, being insignificant in comparison. The annual production of grindstones since 1880 may be seen by the following table:

Value of grindstones produced in the United States, 1880 to 1891, inclusive.

Years.	Value.	Years.	Value.
1880	$500,000	1886	$250,000
1881	500,000	1887	224,400
1882	700,000	1888	281,800
1883	600,000	1889	439,587
1884	570,000	1890	450,000
1885	500,000	1891	476,113

Grindstones imported and entered for consumption in the United States, 1868 to 1891 inclusive.

Years ended—	Finished.		Unfinished or rough.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
June 30, 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	3,957.15	60,935	104,716
1872	1,202	13,453	10,774.80	100,494	113,947
1873	1,437	17,033	8,376.84	94,900	111,933
1874	1,443	18,485	7,721.44	87,525	106,010
1875	1,373	17,642	7,656.17	90,172	107,814
1876	1,681	20,262	6,079.34	69,927	90,189
1877	1,245	18,546	4,979.75	58,575	77,121
1878	1,463	21,688	3,669.41	46,441	68,129
1879	1,603	24,904	4,584.16	52,343	77,247
1880	1,573	24,375	4,578.59	51,899	76,274
1881	2,064	30,288	5,044.71	56,840	87,128
1882	1,705	30,286	5,945.61	66,939	97,225
1883	1,755	28,055	6,945.63	77,797	105,852
1884					86,286
1885					50,579
Dec. 31, 1886					(*a*)39,149
1887					(*a*)50,312
1888					(*a*)51,755
1889					(*a*)57,726
1890					(*a*)45,115
1891					(*a*)21,028

(*a*) Classed as finished or unfinished.

OILSTONES AND WHETSTONES.

This industry is controlled practically by one firm, the Pike Manufacturing Company, of Pike Station, New Hampshire. Through the courtesy of Mr. E. B. Pike, vice-president, the following report concerning the business for 1891 has been furnished: The novaculite form which oilstones are made is obtained from Garland county, Arkansas, and Orange county, Indiana. Of the former there are two varieties, the Arkansas, which is of bluish-white color, semitransparent, and very finely grained, and the Washita, not so finely grained, more opaque, and of pure white color. The Indiana stone is known as Hindostan or Orange stone, and varies in color from white to a buff or orange. The total amount of rough stone produced in Arkansas in 1891 was 1,029,840 pounds and in Indiana 514,000 pounds, nearly all of which was shipped to Pike Station, New Hampshire, for manufacture. In addition to this a small amount of Labrador stone from Truxton, New York, and chocolate stone from Lisbon, New Hampshire, was produced. To complete the list must be added sandstone from Indiana made into kitchen and shoemakers' rubstone, and Indian Pond and Lanesville scythestones quarried at Haverhill and Piermont, Grafton county, New Hampshire, and Orleans county, Vermont. Besides the domestic stone, the Pike company handles Water-of-Ayr stone from Scotland, some Turkish oilstone, and Belgian and German razor hones.

The company reports the following domestic product marketed:

	Value.
Washita stone, 460,000 pounds	$55,000
Arkansas stone, 15,000 pounds	20,000
Labrador stone, 2,000 pounds	200
Hindostan stone, 300,000 pounds	11,500
Sandstone, 120,000 pounds	1,800
Chocolate stone, 15,000 pounds	1,500
Sythestones, 14,000 gross	60,000
Total	150,000

Of the above sales the following is furnished as as estimate of the quantity exported. It should also be stated that the foregoing, as well as the following, figures are not taken from the books, but are sufficiently correct to serve all practical purposes.

The exports were about:

Estimated exports of whetstones in 1891.

	Value.
Scythestones, 8,000 gross	$20,000
Washita stone, 160,000 pounds	18,000
Arkansas stone, 7,500 pounds	10,000
Hindostan stone, 100,000 pounds	3,500
Total	51,500

Estimated imports of whetstones in 1891.

	Value.
Turkey stone, 1,500 pounds	$300
Scotch stones (all kinds), 6,000 pounds	600
Razor hones, 800 dozen	1,200
English scythestones, 50 gross	300
Norway Ragg scythestones, 10 gross	50
German emery scythestones, 25,000	500
Total	2,950

Imports of hones and whetstones for the years 1880 to 1890.

Years ended June 30—	Value.	Years ended December 31—	Value.
1880	$14,185	1886	$21,141
1881	16,631	1887	24,093
1882	27,882	1888	30,676
1883	30,178	1889	27,400
1884	26,513	1890	37,454
1885	21,434	1891	35,344

EMERY AND CORUNDUM.

Corundum and emery are distinguished from each other in that the former is oxide of aluminum alone, while the latter is an intimate mixture of oxide of aluminum with oxide of iron. Corundum is by far the more valuable mineral, being harder and of greater durability. Both minerals are used chiefly for the manufacture of abrasive wheels, the production of which is controlled by a few firms.

The product in 1891 consisted of 1,513 tons of emery and 752 tons of corundum, worth together $90,230. The combined tonnage is in excess of the product of 1890, but the value decreases $965, the difference being due to an increased production of emery and a decrease in the output of corundum.

The product is from Rabun county, Georgia; Macon and Jackson counties, North Carolina; Westchester county, New York; Chester county, Pennsylvania, and Hampden county, Massachusetts.

The following table shows the annual product of corundum and emery since 1881:

Annual product of corundum and emery since 1881.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1881	500	$80,000	1887	600	108,000
1882	500	80,000	1888	589	91,620
1883	550	100,000	1889	2,245	105,567
1884	600	108,000	1890	1,970	89,395
1885	600	108,000	1891	2,247	90,230
1886	645	116,190			

Emery imported into the United States from 1867 to 1891, inclusive.

Years ended—	Grains.		Ore or rock.		Pulverized or ground.		Other manufactures.	Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Tons.*		*Pounds.*			
June 30, 1867	....	....	428	$14, 373	924, 431	$38, 131	....	$52, 504
1868	....	....	85	4, 531	834, 286	33, 549	....	38, 080
1869	....	....	964	35, 205	924, 161	42, 711	....	77, 916
1870	....	....	742	25, 335	644, 080	29, 531	....	54, 866
1871	....	....	615	15, 870	613, 624	28, 941	....	44, 811
1872	....	....	1, 641	41, 321	804, 977	36, 103	....	77, 424
1873	610, 117	$29, 706	755	26, 065	343, 828	15, 041	$107	70, 919
1874	331, 580	16, 216	1, 281	43, 886	69, 890	2, 167	97	62, 366
1875	487, 725	23, 345	961	31, 972	85, 853	2, 990	20	58, 327
1876	385, 246	18, 999	1, 395	40, 027	77, 382	2, 533	94	61, 653
1877	343, 697	16, 615	852	21, 964	96, 351	3, 603	....	42, 182
1878	334, 291	16. 359	1, 475	38, 454	65, 068	1, 754	34	56, 601
1879	496, 633	24, 456	2, 478	58, 065	133, 556	4, 985	....	87, 506
1880	411, 340	20, 066	3, 400	76, 481	223, 855	9, 202	145	105, 894
1881	454, 790	22, 101	2, 884	67, 781	177, 174	7, 497	53	97, 432
1882	520, 214	25, 314	2, 765	69, 432	117, 008	3, 708	241	98, 695
1883	474, 105	22, 767	2, 447	59, 282	93, 010	3, 172	269	85, 490
1884	143, 267	5, 802	4, 145	121, 719	513, 161	21, 181	188	148, 890
Dec. 31, 1885	228, 329	9, 886	2, 445	55, 368	194, 314	8, 789	757	74, 800
1886	161, 297	6, 910	3, 782	88, 925	365, 947	24, 952	851	121, 638
1887	367, 239	14, 290	2, 078	45, 033	*a*144, 380	6, 796	2, 090	68, 209
1888	430, 397	16, 216	5. 175	93, 287	....	....	8, 743	118, 246
1889	503, 347	18, 937	5, 234	88, 727	....	....	111, 302	218, 966
1890	534, 968	20, 382	3, 867	97, 939	....	....	5, 046	123, 367
1891	90, 658	3, 729	2, 530	67, 573	....	....	....	71, 302

a To June 30, only; since classed with grains.

FERTILIZERS.

PHOSPHATE ROCK.

The total product of phosphate rock in the United States during the calendar year 1891 was 587,988 long tons of phosphate rock, which went into consumption. The stocks increased by 90,269 tons, not counted in the above. The product realized a gross total of $3,651,150. Florida furnished 112,482 tons of the product, which was nearly equally divided between land rock and river pebble. The stocks accumulated in Florida at January 1, 1892, were not noticeably larger than in South Carolina. In price the South Carolina rock averaged $6.20, and Florida $6.25 per ton.

SOUTH CAROLINA.

The product comprised 344,978 tons of land rock, worth $2,187,160, and only 130,528 tons of river rock, worth $760,978. This decrease in the river rock was due to the action of the phosphate commissioners, who brought about a much curtailed product from the Coosaw Company by insisting upon the right of the State to discontinue the contract for river dredging at a royalty of $1 per ton, and this right was confirmed by the United States Supreme Court. Further curtailment of the shipments of river rock was due to the necessity of the river miners meeting the competition of the Florida rock to a much greater extent than the land miners. The shipments were reduced, but dredging continued actively, with an accumulation of stocks. The average price obtained for land rock was $6.33 per long ton, and for river rock $5.88. The total amount mined in South Carolina in 1891 nearly equaled the product of 1889, which was the year of greatest product, the total then reaching 541,645 long tons. The product of 1891 was slightly greater than that of 1890. The product since the beginning of the industry is summarized by years in the following table:

Phosphate rock (washed product) mined by the land and river mining companies of South Carolina.

Years ending May 31—	Land companies.	River companies.	Total.
	Long tons.	*Long tons.*	*Long tons.*
1867	6		6
1868	12,262		12,262
1869	31,958		31,958
1870	63,252	1,989	65,241
1871	56,533	17,655	74,188
1872	36,258	22,502	58,760
1873	33,426	45,777	79,203
1874	51,624	57,716	109,340
1875	54,821	67,969	122,790
1876	50,566	81,912	132,478
1877	36,431	126,569	163,000
1878	112,622	97,700	210,322
1879	100,779	98,586	199,365
1880	125,601	65,162	190,763
1881	142,193	124,541	266,734
1882	191,305	140,772	332,077
1883	219,202	159,178	378,380
1884	250,297	181,482	431,779
1885	225,913	169,490	395,403
1885 (June 1 to December 31)	149,400	128,389	277,789
1886 (calendar year)	253,484	177,065	430,549
1887	261,658	218,900	480,558
1888	290,689	157,878	448,567
1889	329,543	212,102	541,645
1890	353,757	110,241	463,998
1891	344,978	130,528	475,506

A more detailed statement below shows the disposition made of the product. The local consumption has increased quite remarkably.

Detailed statement of total foreign and coastwise shipments and local consumption since July 1, 1874.

Periods.	Shipments and consumption.	Beaufort.	Charleston.	Total.	Total for each year.
		Long tons.	*Long tons.*	*Long tons.*	
June 1, 1874, to May 31, 1875	Foreign ports	44,617	25,929	70,546	122,790
	Domestic ports	7,000	25,560	32,560	
	Consumed		19,684	19,684	
June 1, 1875, to May 31, 1876	Foreign ports	50,384	25,431	75,815	132,896
	Domestic ports	9,400	28,831	38,231	
	Consumed		18,850	18,850	
June 1, 1876, to May 31, 1877	Foreign ports	73,923	28,844	102,767	163,220
	Domestic ports	6,285	40,768	47,053	
	Consumed		13,400	13,400	
June 1, 1877, to May 31, 1878	Foreign ports	100,619	21,123	121,742	208,323
	Domestic ports	8,217	60,729	68,946	
	Consumed		17,635	17,635	
June 1, 1878, to May 31, 1879	Foreign ports	97,799	21,767	119,566	199,365
	Domestic ports	8,618	52,281	60,899	
	Consumed		18,900	18,900	
June 1, 1879, to May 31, 1880	Foreign ports	47,157	14,218	61,375	190,763
	Domestic ports	13,346	94,002	107,348	
	Consumed		22,040	22,040	
June 1, 1880, to May 31, 1881	Foreign ports	62,200	8,568	70,768	266,734
	Domestic ports	65,895	91,929	157,824	
	Consumed		38,142	38,142	
June 1, 1881, to May 31, 1882	Foreign ports	89,581	22,905	112,486	332,077
	Domestic ports	65,340	111,314	176,654	
	Consumed		42,937	42,937	
June 1, 1882, to May 31, 1883	Foreign ports	94,789	28,251	123,040	378,380
	Domestic ports	62,175	150,545	212,720	
	Consumed		42,620	42,620	
June 1, 1883, to May 31, 1884	Foreign ports	132,114	20,539	152,653	431,779
	Domestic ports	41,040	181,363	222,403	
	Consumed	5,800	50,923	56,723	
June 1, 1884, to May 31, 1885	Foreign ports	111,075	11,495	122,570	395,403
	Domestic ports	44,130	161,700	205,833	
	Consumed	12,000	55,000	67,000	
June 1, 1885, to Dec. 31, 1885	Foreign ports	105,761	8,581	114,342	277,789
	Domestic ports	16,321	112,126	128,447	
	Consumed	5,000	30,000	35,000	

Detailed statement of total foreign and coastwise shipments and local consumption since July 1, 1874—Continued.

Periods.	Shipments and consumption.	Beaufort.	Charleston.	Total.	Total for each year.
		Long tons.	*Long tons.*	*Long tons.*	
	Foreign ports	153,443	5,926	159,369	
Jan. 1, 1886, to Dec. 31, 1886	Domestic ports	14,622	187,558	202,180	430,549
	Consumed	9,000	60,000	69,000	
	Foreign ports	189,995	9,740	199,735	
Jan. 1, 1887, to Dec. 31, 1887	Domestic ports	15,905	181,918	197,823	480,558
	Consumed	13,000	70,000	83,000	
	Foreign ports	124,474	3,611	128,085	
Jan. 1, 1888, to Dec. 31, 1888	Domestic ports	20,404	212,078	232,482	448,567
	Consumed	13,000	75,000	88,000	
	Foreign ports	137,102	5,900	143,002	
Jan. 1, 1889, to Dec. 31, 1889	Domestic ports	60,000	248,643	308,643	541,645
	Consumed	15,000	75,000	90,000	
	Foreign ports	72,241	55,000	127,241	
Jan. 1, 1890, to Dec. 31, 1890	Domestic ports	15,000	213,757	228,757	463,998
	Consumed	13,000	85,000	98,000	
	Foreign ports	94,528	4,655	99,183	
Jan. 1, 1891, to Dec. 31, 1891	Domestic ports	22,000	252,083	274,083	475,506
	Consumed	14,000	88,250	102,250	

For comparison with the methods which have been developed in Florida for mining phosphate rock, and which are being improved constantly, the following excellent description, by Mr. W. de L. Benedict, of the methods used in mining South Carolina land phosphate is abstracted from the Engineering and Mining Journal. It is particularly valuable as the most intelligent as well as exact description of the principal method in use there. South Carolina land phosphate rock is found as lumps or nodules, of irregular shapes and sizes, grayish in color, moderately hard and tough, and containing, when thoroughly dried, from 55 to 62 per cent. of tri-calcium phosphate, $Ca_3(PO_4)_2$, the compound which is found in bones and in all natural varieties of phosphates. The lumps of land phosphate are found in beds or strata of varying extents and thicknesses, lying horizontally or nearly so. The strata average, perhaps, 9 inches in thickness, and are sometimes practically continuous for several thousands of acres in extent. They sometimes appear at the surface of the ground, and again are covered to a depth of 50 feet or more. It is doubtful, however, whether it will pay to extract the phosphate from a greater average depth than about 10 feet unless the bed is unusually thick, or the market price for the product unusually high.

The operations of mining the phosphate and its subsequent treatment are substantially as follows (the methods about to be described being those adopted by one of the largest and most successful companies): The land is first "sounded" with a pointed steel rod to determine the depth of the stratum below the surface; then pits are dug to ascertain the thickness of the bed. The variations in the depth of the phosphate are due to the undulations in the surface rather than to any dip in the stratum. As the cost of mining is proportionate to the thickness and hardness of the "overburden," as well as the thickness of the phosphate, and as it is desirable to keep this cost at about the same figure from year to year, it is of great importance to have an accurate survey of the property, in order that deep and shallow places may be selected to balance each other.

Mining.—After suitable tracts of several acres each have been chosen, the trees are felled, the underbrush is cleared away, and trenches are dug around each one in the form of a rectangle to drain off the water to a depth greater than that of the phosphate. The land is so flat and so near the level of the river that it is frequently necessary to pump the water out of the drain trenches. A railroad track is laid along the middle of the rectangular tract and the land is then ready for the mining operations proper.

To obtain the phosphate, trenches 6 feet wide are dug adjoining the drain trenches on the long sides of the rectangle, the earth is thrown over the drains, and the phosphate is piled on the bank toward the railroad, to which it is wheeled in barrows before the next trench is commenced. The earth from the second mining trench is thrown into the space made by the first trench, and the phosphate is piled on the inner bank, as before, and wheeled to the railroad. This is repeated till the track is reached, when that part of it which is within the limits of the rectangle is taken up, and mining is then commenced on that part which was formerly covered by the track, starting, as before, from the end farthest from the railroad. The mining is divided into "tasks," each task being a space 15 feet long and 6 feet wide and as deep as the phosphate stratum, which averages 5 or 6 feet. Miners are paid 25 cents to 30 cents per vertical foot, according to the hardness and thickness of the overburden. For a depth of 6 feet, therefore, the pay would amount to $1.50 to $1.80 per task (equivalent in this instance to 15 by 6 by 6 feet = 540 cubic feet, or 20 cubic yards), or at the rate of 7½ to 9 cents per cubic yard. The miners earn from $1 to $1.25 each per day. The stratum is made up of phosphate, more or less mixed with clay and sand, and for each foot in thickness (which is about its average thickness on this property) it will yield about 1½ tons of marketable phosphate to the task; in this case equal to 15 by 6 by 1 foot, or 90 cubic feet of stratum, or say 60 cubic feet to the ton. A ton of this phosphate occupies about 24 cubic feet, so the stratum may be said to yield 40 per cent. of phosphate, or 726 tons per acre.

After this mixture is mined it is loaded into cars holding about 4 tons each, and hauled by a locomotive to the washer. Here the cars are drawn up an incline to the top of the building and their contents are dropped into hoppers which discharge into the crusher. The latter consists of pairs of rolls about 4 feet long, which are set about 4 inches apart. The object of these crushers is simply to break up the larger masses and pieces of phosphate so as to have nothing more than about 4 inches in diameter pass into the washers. Most of the nodules are smaller than this, but they are sometimes cemented together in larger masses, containing also clay and sand, which it is necessary to remove in order to keep up the grade of the phosphate.

Washing.—From the crushers the material is discharged into the washers. Two kinds are used, but the one called a log washer seems to do the cleaner work. This consists of an octagonal piece of wood about 27 feet long and 15 inches in diameter, having cast-iron teeth, each about 9 inches high by 5 inches wide, bolted to four of the eight sides in the form of a broken helix. This log revolves in a trough, and both are slightly inclined, so that the phosphate is screwed up against a current of water, which cleanses it from the sand and clay. The material to be washed is fed in at the lower end and water is discharged into the trough at various places, a strong stream being directed against the phosphate near the point of discharge to give it a final washing. The cleaned phosphate falls on an inclined screen of cast iron, having square perforations three-fourths of an inch in diameter. All that passes through this falls on a second screen with meshes one-fourth of an inch in diameter, and that which passes through this screen—a very small proportion—contains so much sand that it is wheeled away as waste.

The water from the washers carries off the finer sand and clay, and deposits them on the mud flats of the river, on the bank of which the washer building is placed. The other kind of washer consists of a boiler-iron cylinder slightly inclined (or, sometimes, a truncated cone), having teeth similar to those just described bolted to the inside of the shell in the form of a broken helix. As the cylinder revolves the material to be washed is forced up against a down-flowing current of water, as before. This style of washer is said to do more work than the other, but the product is perhaps not so thoroughly cleaned.

Drying.—The phosphate is now ready for calcination. This is effected in kilns, which consist simply of rectangular brick structures, each about 100 feet long by 40 feet wide. The floor is of brick also, and in it flues are arranged about 5 feet apart and running parallel to the shortest sides to supply the air for the combustion of the wood. The walls are about 10 feet high, and are braced on the outside with wooden buckstays. A roof of wood covers the kiln. Each kiln holds 1,000 to 1,200 tons of phosphate, and 35 to 40 cords of wood are required to calcine it, or at the rate of about 30 tons per cord. The wood is piled on the bottom of the kiln and the phosphate wheeled from the washers in barrows and dumped on the wood until the proper amount is charged, the finer phosphate being reserved to go on the top as a cover. The wood obtained in clearing the land is usually sufficient for calcining the phosphate and for fuel for the locomotives and the "washers." It takes from two to five days for the fires in the kilns to burn out, and then the phosphate is ready for market.

The water in the river is deep enough for some of the smaller sailing vessels to come directly to the washer, but when the phosphate is to be shipped in larger vessels or steamers it is loaded into lighters and towed down into deep water. The ease and simplicity with which the thickness and depth of the South Carolina deposits can be determined and the uniform grade of the phosphate enables one to estimate very closely the quantity of material in any given tract of land, as well as its value and the cost of mining, all of which stands out in strong contrast with the extreme irregularity of the Florida deposits of rock phosphate.

FLORIDA.

Production was very active in Florida—more active than the development work or the available capital or the condition of the fertilizers market justified. Land rock (hard rock, land pebble, and some soft rock) was marketed to the extent of 57,982 long tons, and also 54,500 tons of river pebble, making 112,482 tons of phosphate rock added to the general supply, which was not only already equal to the demand, but was practically arranged for in advance. If the crops had been remunerative this new supply might have simply expanded the business of manufactured fertilizers, but the low price of cotton was sufficient to contract the trade, and hence the marketing of the Florida phosphates, especially the land rock, had a most depressing effect on phosphate prices at the close of the year and in 1892. Its worst effect was felt by the small mining companies with only sufficient capital to set a small plant in operation, and who depended upon quick and profitable returns for means for further operations. As the returns were not profitable, and in many cases even a downright loss, these smaller producers strove, but vainly, to effect a combination of interests. They were not sufficiently supported by the larger and more conservative producers, and the combination failed. It was partially replaced by the present tendency to unite the selling agencies. The effect of all this, in so far as any effect can be produced, is to reduce mining costs by all possible mining contrivances, including the introduction of a modified form of hydraulic mining machine, and to shorten the speculative period in this new field. The production will increase, even if the prices continue low; this, however, is by no means certain, since the demand fluctuates very largely with the crops.

Total product of phosphate rock in Florida to December 31, 1891.

Years.	Product.	Value.
	Long tons.	
1888	3,000	$25,000
1889	4,100	32,800
1890	46,501	338,190
1891	112,482	703,013
Total	166,083	1,094,203

Phosphates imported and entered for consumption in the United States, 1868 to 1891 inclusive.

Calendar years ending December 31, from 1886 to 1890; previous years end June 30.	Guano.		Crude phosphates and other substances used for fertilizing purposes.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
1868	99,668	$1,336,701	....	$88,864	$1,425,625
1869	13,480	217,004	....	61,529	278,533
1870	47,747	1,414,872	....	90,817	1,505,689
1871	94,344	3,313,914	....	165,703	3,479,617
1872	15,279	423,322	....	83,342	506,664
1873	6,755	167,711	....	218,110	385,821
1874	10,767	261,085	....	243,467	504,552
1875	23,925	539,808	....	212,118	751,926
1876	19,384	710,135	....	164,849	874,984
1877	25,580	873,459	....	195,875	1,069,334
1878	23,122	849,607	....	285,089	1,134,696
1879	17,704	634,546	....	223,283	857,829
1880	8,619	108,733	....	317,068	425,801
1881	23,452	399,552	....	918,835	1,318,387
1882	46,699	854,463	133,956	1,437,442	2,291,905
1883	25,187	537,080	96,586	798,116	1,335,196
1884	28,090	588,033	35,119	406,233	994,266
1885	20,934	393,039	40,068	611,284	1,004,323
1886	13,520	306,584	82,608	1,179,724	1.486,308
1887	10,195	252,265	53,100	644,301	896,566
1888	7,381	125,112	36,405	329,013	454,125
1889	15,991	313.956	35,661	403,205	717,161
1890	4,642	59,580	31,191	252,787	312,367
1891	11,937	199,044	29,743	214,671	413,715

SULPHUR.

By E. W. Parker.

The total product reported for 1891 was from the Territory of Utah, and amounted to 1,200 short tons, valued at $33 per ton. This product was obtained from the property formerly operated by the Dickert and Myer Sulphur Company, under an option held by a syndicate of Eastern capitalists. The property is now in charge of Mr. J. H. Burfeind, of Black Rock, Utah, under whose supervision extended improvements are being made, new machinery added to the plant, and preparations made for largely increased output in the future. During 1891 one new cylinder for grinding sulphur ore was added to the mill plant, and two more were in course of construction at the beginning of 1892. The deposits of sulphur are what is known as the Cove creek sulphur beds in Beaver county. The largest of these on which the present work is being prosecuted has been prospected over an area 2,900 feet square, and mining is being carried on by means of open cuts from 18 to 20 feet deep. The sulphur is extracted from the ore by steam heating in an air-tight retort. It is then molded into rolls or blocks convenient for shipping, or ground at the mill for making sheep dip and other preparations.

Work is reported as still being pushed on the Louisiana sulphur beds near Lake Charles, and the owners claim that actual production will be commenced at an early day.

The condition of the sulphur market, after a period of great debility and instability, became much firmer in 1891, sufficiently so to encourage the development of American properties. This is in all probability due to the decadence of the sulphur industry in Sicily, heretofore the chief source of supply. In addition to this the English alkali makers have formed a combination for maintaining the price of recovered sulphur at a uniform figure. These influences have caused the rise in the sulphur market, which the increasing use of pyrites in the manufacture of acid for fertilizers, etc., has not been sufficient to counteract.

Imports.—The following tables show the total amount of sulphur imported into the United States from 1867 to 1891, and the countries from which received and customs districts through which imported since 1876:

Sulphur imported and entered for consumption in the United States, 1867 to 1891, inclusive.

Years ended—	Crude.		Flowers of sulphur.		Refined.		Ore. (*a*)	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Value.	
	Long tons.		*Long tons.*		*Long tons.*			
June 30, 1867...	24,544.10	$620,373	110.05	$5,509	250.55	$10,915	....	$636,797
1868...	18,150.55	446,547	16.48	948	64.75	2,721	....	450,216
1869...	23,589.69	678,642	96.59	4,576	645.04	27,149	....	710,367
1870...	27,379.60	819,408	76.34	3,927	157.24	6,528	$1,269	831,132
1871...	36,131.46	1,212,448	65.54	3,514	92.26	4,328	754	1,221,044
1872...	25,379.55	764,798	35.97	1,822	56.94	2,492	....	769,112
1873...	45,533.27	1,301,000	55.29	2,924	35.97	1,497	....	1,305,421
1874...	40,989.55	1,260,491	51.08	2,694	56.68	2,403	....	1,265,588
1875...	39,683.10	1,259,472	17.83	891	....	....	....	1,260,363
1876...	46,434.72	1,475,250	41.07	2,114	43.87	1,927	....	1,479,291
1877...	42,962.69	1,242,888	116.34	5,873	1,170.80	36,962	....	1,285,723
1878...	48,102.46	1,179,769	158.71	7,628	149.51	5,935	....	1,193,332
1879...	70,370.28	1,575,533	137.60	6,509	68.94	2,392	....	1,584,434
1880...	87,837.25	2,024,121	123.70	5,516	158.36	5,262	....	2,034,899
1881...	105,096.54	2,713,485	97.66	4,226	70.96	2,555	....	2,720,266
1882...	97,504.15	2,627,402	158.91	6,926	58.58	2,196	....	2,636,524
1883...	94,539.75	2,288,946	79.13	3,262	115.33	4,487	....	2,296,695
1884...	105,112.19	2,242,697	178.00	7,869	126.00	4,765	....	2,255,331
1885...	96,839.44	1,941,943	120.56	5,351	114.08	4,060	....	1,951,354
1886...	117,538.35	2,237,989	212.61	8,739	116.05	3,877	....	2,250,605
1887...	96,881.55	1,688,360	278.56	9,980	83.54	2,383	....	1,700,723
Dec. 31, 1888...	98,252.15	1,581,583	127.67	4,202	27.02	734	....	1,586,519
1889...	135,933.00	2,068,208	15.34	1,954	10.00	299	....	2,070,461
1890...	162,674.00	2,762,953	12.06	1,718	103.00	3,060	....	2,767,731
1891...	116,971.00	2,675,192	206.00	6,782	10.00	1,997	133,250	2,817,221

a Latterly classed under head of pyrites.

Statement by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each fiscal year from 1876 to 1891.

Countries whence exported and customs districts through which imported.	1876.		1877.		1878.		1879.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
Dutch West Indies and Guiana	1,515	$15,427	......	....	......	....	......	....
England	30	1,211	425	$14,631	(?)	$16	2	$335
Scotland	24	910	472	13,231	160	3,961	806	19,287
Gibraltar	......	....	290	7,789	......	....	......	....
Quebec, Ontario, Manitoba, etc.	......	....	......	....	12	264	......	....
Italy	46,941	1,439,839	41,819	1,194,000	47,494	1,161,367	64,420	1,453,138
Japan	456	16,291	437	13,137	256	7,548	224	4,528
Portugal	......	....	......	....	......	....	467	10,410
Total	48,966	1,473,678	43,443	1,242,788	47,922	1,173,156	65,919	1,487,698
DISTRICTS.								
Baltimore, Md	5,157	$157,828	3.882	$105,175	5,455	$138,202	6,969	$157,243
Barnstable, Mass	......	....	......	....	......	....	600	13,780
Boston and Charlestown, Mass	5,031	154,883	3,931	101,215	5,795	131,945	7,841	173,506
Charleston, S. C	......	....	......	....	526	12,267	605	13,812
Delaware, Del	450	13,500	......	....	......	....	890	21,907
Huron, Mich	......	....	......	....	12	264	......	....
Newark, N. J	......	....	1,071	31,802	462	13,240	443	10,175
New Orleans, La	172	5,705	150	4,750	......	....	100	2,087
New York, N. Y	24,524	721,092	21,867	654,997	28,240	690,989	36,543	827,193
Philadelphia, Pa	12,549	385,671	9,216	256,224	6,657	167,222	11,704	263,467
Providence, R. I	600	18,232	1,739	45,487	519	11,479	......	....
San Francisco, Cal	483	17,367	862	27,768	256	7,548	224	4,528
Savannah, Ga	......	....	725	15,370	......	....	......	....
Total	48,966	1,473,678	43,443	1,242,788	47,922	1,173,156	65,919	1,487,698

Statement by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each fiscal year from 1876 to 1891—Continued.

Countries whence exported and customs districts through which imported.	1880.		1881.		1882.		1883.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
England	1	$22	....	....	....	....	13	$379
Scotland	1,664	36,444	1,668	$43,311	755	$20,294	3	88
France	988	23,580	....	....	526	13,770	34	858
French West Indies	....	....	....	....	2	8	....	....
Greece	....	....	....	....	500	13,927	....	....
Italy	80,301	1,862,712	102,771	2,645,293	92,944	2,504,862	92,861	2,248,870
Japan	282	4,744	691	16,253	2,980	66,356	1,038	23,714
San Domingo	....	....	....	....	240	7,875	....	....
Spain	....	....	308	8,637	....	....	500	12,856
Spanish Possessions in Africa and adjacent islands	....	....	....	....	9	310	87	2,030
Total	83,236	1,927,502	105,438	2,713,494	97,956	2,627,402	94,536	2,288,795
DISTRICTS.								
Baltimore, Md	13,827	$313,342	16,477	$430,917	13,781	$364,384	11,977	$286,438
Beaufort, S. C	....	....	....	....	540	13,889	....	....
Boston and Charlestown, Mass	8,207	183,486	8,860	226,801	7,467	194,317	7,756	173,569
Charleston, S. C	1,061	25,398	3,065	78,741	6,025	161,281	4,051	106,235
Middletown, Conn	....	....	....	....	9	310	....	....
New Orleans, La	280	7,121	100	2,646	220	6,516	428	10,378
New York, N. Y	46,657	1,083,784	57,608	1,463,082	46,531	1,260,222	45,385	1,110,313
Philadelphia, Pa	10,679	254,892	17,987	477,547	14,839	408,611	22,772	549,095
Providence, R. I	1,255	31,155	650	17,507	1,244	33,036	535	13,830
Richmond, Va	....	....	....	....	660	17,760	....	....
San Francisco, Cal	1,270	28,324	691	16,253	6,054	151,234	1,072	24,572
Savannah, Ga	....	....	....	....	586	15,842	560	14,365
Total	83,236	1,927,502	105,438	2,713,494	97,956	2,627,402	94,536	2,288,795

Countries whence exported and customs districts through which imported.	1884 (*a*).		1885.		1886.		1887.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
Belgium	....	....	190	$4,766	60	$1,718	....	....
Danish West Indies	....	....	....	....	....	....	861	$5,250
England	....	....	606	15,084	81	2,535	162	4,437
France	....	....	....	....	....	....	290	6,951
Quebec, Ontario, Manitoba, and the Northwest Territory	....	....	....	....	....	9	....	....
Italy	....	....	94,370	1,894,858	112,283	2,166,565	89,924	1,588,146
Japan	....	....	1,541	25,683	4,972	66,505	6,146	83,576
Spain	....	....	134	1,552	....	....	....	....
Total	105,143	$2,242,678	96,841	1,941,943	117,396	2,237,332	97,383	1,688,360
DISTRICTS.								
Baltimore, Md	15,037	303,226	14,505	285,006	19,307	364,958	12,547	225,669
Barnstable, Mass	650	16,163	480	11,040	1,617	35,385	1,152	22,816
Beaufort, S. C	600	13,259	610	12,847	....	....	....	....
Boston and Charlestown, Mass	5,294	112,152	5,125	99,712	3,681	69,898	4,850	85,575
Champlain, N. Y	....	....	....	....	....	9	....	....
Charleston, S. C	6,125	132,570	8,525	169,564	13,350	265,265	12,420	220,598
New Orleans, La	....	....	102	2,282	250	5,102	....	....
New York, N. Y	52,478	1,135,725	45,537	909,123	58,758	1,115,519	46,711	792,114
Philadelphia, Pa	18,786	401,568	18,696	381,010	15,568	300,749	15,267	269,216
Providence, R. I	651	15,517	1,840	37,422	1,265	25,930	600	11,291
San Francisco, Cal	5,522	112,598	1,421	33,937	3,600	54,517	3,176	50,521
All other customs districts	....	....	....	....	....	....	660	10,560
Total	105,143	2,242,678	96,841	1,941,943	117,396	2,237,332	97,383	1,688,360

a Sources not reported.

Statement by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each fiscal year from 1876 to 1891—Continued.

Countries whence exported and customs districts through which imported.	1888.		1889.		1890.		1891.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRIES.	*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
Belgium	83	$1,993	180	$4,086	182	$3,995	267	$6,576
Danish West Indies					550	9,076		
England	310	7,200	305	8,337	4,898	101,100	5,613	127,976
Scotland					20	487		
France								
Quebec, Ontario, etc								
Italy	92,528	1,499,720	123,260	1,935,368	115,240	1,800,585	101,660	2,140,516
Japan	6,332	72,729	6,446	77,853	21,031	221,316	12,763	168,073
Spain								
Other countries							501	8,372
Total	99,253	1,581,582	130,191	2,025,644	141,921	2,136,559	120,804	2,451,513
DISTRICTS.								
Baltimore, Md	11,989	182,769	15,791	234,693	21,198	322,018	9,339	247,324
Barnstable, Mass								
Beaufort, S. C	500	9,000	600	9,213			1,300	26,951
Boston and Charlestown, Mass	3,760	62,298	6,446	104,257	7,410	135,044	6,381	136,402
Champlain, N. Y								
Charleston, S. C	12,005	199,048	23,377	364,859	15,752	255,106	28,281	557,384
Mobile, Ala							750	14,863
New Orleans, La	200	3,845			200	3,397	1,300	30,474
New York, N. Y	50,486	816,286	60,922	959,872	66,359	983,754	44,027	910,075
Pensacola, Fla							1,399	23,206
Philadelphia, Pa	10,519	173,699	13,288	202,357	13,919	210,576	10,842	216,763
Providence, R. I	1,310	21,012	570	8,581	1,240	19,160		
San Francisco, Cal	6,352	78,732	4,539	57,925	8,223	87,391	8,819	115,637
Savannah, Ga			2,345	44,244	5,560	86,826	5,245	99,717
Willamette, Oregon							288	11,852
Wilmington, N. C	1,532	25,893	1,753	28,443	2,040	32,800	2,832	60,843
All other customs districts	600	9,000	560	11,200	20	487	1	22
Total	99,253	1,581,582	130,191	2,025,644	141,921	2,136,559	120,804	2,451,513

The Sicilian sulphur industry.—Mr. Horace C. Pugh, United States consul at Palermo, Sicily, has sent to the State Department the following report of the sulphur-mining industry of that island. It contains matters of considerable interest, and it should be borne in mind that not only does the United States look to Sicily for its main supply of brimstone, but that it is the chief market for the Sicily production, consuming nearly as much as Germany and Italy (the next largest consumers) together, or about 30 per cent of the total product:

"The Sicilian brimstone industry has lately passed through a crisis that, on the one hand, was most serious in its effect, and on the other, might be considered really beneficial in its results, notwithstanding the fact that many operators have lost heavily on account of overproduction, expensive system of mining, and a general decline in prices. This was partially due to the fact that so many had embarked in sulphur mining, to the neglect of all other avenues; partially to the expensive system of mining without mechanical appliances, by which the miners ascended circuitous steps from the bottoms of pits 300 to 500 feet deep, carrying the ore to the surface in bags on their shoulders, and partially to the excess of supply over the demand; as a result of all which there was such a decline in prices that mines were either operated at a loss or closed. Many abandoned their mines, and the production would have shown greater decrease had not many owners and lesses set fire to their mines, extracting melted sulphur, in order to reduce expenses, regardless of waste and damage to their property.

"The result of the crisis, that might be considered really a benefit, consisted in forcing Sicilian brimstone miners to supplant the old system with more modern means. In the second half of 1890 prices began an unexpected and brisk rise, the industry to show more activity, and naturally the first consideration, in view of former experiences, was the means of operating at less expense, resulting in numerous instances in the adoption of steam power and mining machinery, strange as it may seem, hitherto unused.

"Sicilian ignorance of modern inventions was shown in the case of a mine at Lercara, in the center of the island, wherein the lessees agreed, by the usual form of indenture, among other things, to put in at their own expense a means of bringing the ore to the surface; but the lessees—an enterprising American and an Englishman—instead of a "scala" (the steps above mentioned), opened a shaft and installed mining machinery at an expense of several thousand dollars, enabling them to produce several times the quantity per day that would be possible by means of a scala, and, although the lessor received a royalty per ton on the production, his prejudices against an innovation of machinery were so strong that, contrary to his own interests, he claimed the terms of the contract violated by the failure to establish a scala, found a court concurring in this antiquated view, ousted the lessees, removed their machinery, and, after nearly two years' litigation, they have just obtained possession of their property by virtue of a judgment of a higher court.

"Since the latter part of 1890 prices have maintained a steady and apparently healthy rise, sulphur now commanding an average of $25 per ton at the mines, stimulating an increasing activity throughout the brimstone districts. And yet this chief branch of Sicilian industries is not exempt from fears and dangers. It is not overproduction alone that causes alarm; there is also the danger of losing their American market through the strong competition of pyrites. This has been found so advantageous that most of the sulphur used in England is produced from pyrites, and it is viewed here as the gravest aspect of the industry.

"There is one peculiarity of the sale of sulphur to the United States to which buyers' attention should be called, *i. e.*, that of this vast amount annually sold to Americans, not one-hundredth part is purchased direct from Sicilian producers or dealers, but is purchased through London houses, who simply place their American orders with Sicilian producers, the brimstone in all cases being shipped direct to the United States, the American purchaser paying an additional price to cover commissions of the English houses. The English houses have no interest whatever either in the mines or the products thereof—simply a correspondence with dealers and brokers, which the American consumers might easily establish and save commissions heretofore paid.

"The export of brimstone is confined to the ports of Palermo, Girgenti, Licata, and Catania. The amounts exported from the ports named during the five years ended December 31, 1891, together with the countries to which it was exported, were as follows:"(a)

Total exports of sulphur from Sicily since 1883.

Countries.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
United States	96,629	94,929	99,378	98,590	89,419	128,265	109,008	106,656	97,520
France	63,602	65,098	58,264	54,280	56,222	52,083	67,340	71,790	56,168
Italy	66,810	56,292	49,415	48,658	48,997	47,664	43,523	40,231	42,212
United Kingdom	41,788	40,760	33,402	30,236	30,007	35,634	39,203	26,213	23,408
Greece	10,494	7,033	13,664	19,697	18,370	5,809	10,158	18,103	11,414
Portugal	15,298	11,018	17,760	30,943	16,587	15,851	16,799	16,695	11,439
Russia	10,413	12,831	13,420	10,570	13,441	22,043	17,678	17,158	11,930
Germany	7,232	6,622	6,103	8,689	9,700	12,402	15,401	15,703	10,629
Austria	4,915	6,037	5,965	5,800	6,702	8,942	8,984	8,746	10,575
Turkey	3,043	1,285	3,077	4,598	6,238	1,457	2,231	4,231	3,000
Spain	5,242	3,920	2,243	5,890	5,873	3,433	6,586	5,679	3,845
Belgium	7,660	6,793	9,516	6,580	5,318	6,951	7,752	7,279	5,089
Holland	1,256	696	1,237	2,999	1,747	2,793	2,424	....	....
Sweden	1,010	744	328	1,916	1,169	3,004	3,899	3,314	2,252
South America	....	....	....	....	710	95	23	....	....
Australia	....	....	....	....	600	885	....	....	....
Denmark	....	....	810	....	202	464	443	400	300
Other countries	....	....	....	....	....	....	....	2,565	3,542
Total	335,392	314,058	314,582	329,446	311,302	347,775	351,451	344,763	293,323

The ports in the United States to which such shipments were made, together with the amount shipped to each since 1883, and the quality of the shipments since 1886, are shown in the following tables:

Ports in the United States receiving Sicilian sulphur and the amount received by each.

Ports.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
New York	41,238	46,460	50,814	49,952	45,979	60,706	55,939	37,390	49,023
Charleston	5,425	7,706	12,416	10,556	14,324	22,496	12,399	27,563	21,646
Philadelphia	23,123	19,234	12,153	15,662	11,764	11,793	14,334	11,094	6,856
Baltimore	16,175	13,986	16,435	15,680	10,306	17,330	15,316	16,700	11,365
Boston	5,864	4,723	4,200	3,800	3,300	6,300	4,950	2,500	1,950
Wilmington, N. C	....	....	....	....	1,020	2,355	2,040	1,309	2,600
Savannah	....	....	....	....	....	3,545	3,240	5,920	1,550
Pensacola	....	....	....	....	....	....	....	1,390	....
Port Royal	600	610	680	660	1,000	600	....	600	700
Providence	650	1,140	1,370	1,180	630	1,250	590	650	....
Sundries	670	....	....	....	600	480	....	....	....
San Francisco	1,884	500	....	....	296	....	....	....	....
New Orleans	350	100	250	....	200	250	200	800	1,200
Woods Holl	650	470	1,060	1,100	....	1,160	....	....	....
Mobile	....	....	....	....	....	....	....	740	....
Delaware Breakwater	....	....	....	....	....	....	....	....	630
Total	96,629	94,929	99,378	98,590	89,419	128,265	109,008	106,656	97,520

a The quantities quoted in Mr. Pugh's report are expressed in cantars, and in the accompanying tables the figures given by Mr. A. S. Malcomson, importer, New York, are substituted for Mr. Pugh's.

Quality of the Sicilian sulphur received at the different ports of the United States since 1886.

Ports.	1886.		1887.		1888.		1889.		1890.		1891.	
	Best unmixed seconds.	Best thirds.	Best unmixed seconds.	Best thirds.	Best unmixed seconds.	Best thirds.	Best unmixed seconds.	Best thirds.	Best unmixed seconds.	Best thirds.	Best unmixed seconds.	Best thirds.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
New York	36,352	13,600	29,919	16,060	35,573	25,133	32,983	22,956	20,801	16,589	29,358	19,665
Charleston	7,506	3,050	8,875	5,449	15,485	7,011	6,325	6,074	20,873	6,690	17,196	4,450
Philadelphia	4,660	11,002	2,127	9,637	3,050	8,743	2,000	12,334	1,000	10,094	450	6,406
Baltimore	7,325	8,355	4,463	5,843	11,380	5,950	7,656	7,660	5,930	10,770	4,510	6,855
Boston	600	3,200	200	3,100	700	5,600	750	4,200	200	2,300	1,300	650
Savannah	......	......	......	......	2,130	1,415	2,790	1,450	2,750	3,170	850	700
Wilmington, N. C	......	......	1,020	......	2,355	......	2,040	......	1,309	......	1,900	700
Other ports	1,180	1,760	106	2,620	1,500	2,240	200	590	1,540	2,640	1,200	1,330
Total	57,623	40,967	46,710	42,709	72,173	56,092	53,744	55,264	54,403	52,253	56,764	40,756

Pyrites.—The total amount of pyrites produced for its sulphur contents in 1891 was 119,320 long tons, valued at $338,880, against 111,836 short tons or 99,853 long tons in 1890, valued at $273,745. The stocks on hand January 1, 1891, amounted to 31,850 long tons, and on January 1, 1892, 29,500 long tons, making the total sales 121,670 long tons, valued at $356,340. Except for the steadily increased production, there was little to note of interest concerning the industry during 1891; the product was from the two localities in Virginia and Massachusetts, mentioned in previous reports, and prices remained about stationary.

During the early part of 1892 a company was formed in Washington, D. C., under the style of The Washington Pyrite Company, for the purpose of developing pyrite properties near Mineral City, Va. The developments, as reported by Mr. C. F. Griffing, treasurer of the company, consist of several open crosscuts on the vein, and two shafts, about half a mile apart. The first is sunk to the depth of 50 feet, showing, it is claimed, a fine, close-grained ore, which is expected to assay about 50 per cent. sulphur. The second shaft is sunk on what is known as the Arminius vein to a depth of 65 feet, and shows the same grade of ore as that now being mined in the locality.

The prospectors hope to prove the continuance of the pyrites veins south of the Chesapeake and Ohio railroad at Mineral City. The company owns about 3,000 acres, and will push the developments as rapidly as can be done intelligently.

Production of pyrites in the United States from 1882 to 1890.

Years.	Quantity.	Value.
	Short tons.	
1882	13,440	$72,000
1883	28,000	137,500
1884	39,200	175,000
1885	54,880	220,500
1886	61,600	220,000
1887	58,240	210,000
1888	60,851	167,658
1889	104,950	202,119
1890	111,836	273,745
1891	119,320	338,880

Imports of pyrites containing not more than 3½ per cent. of copper. (*a*)

Years.	Quantity.	Value.
	Long tons.	
1884	16,710	$50,632
1885	6,078	18,577
1886	1,605	9,771
1887	16,578	49,661

a Previous to 1884 classed among sulphur ores; subsequent to 1887 classed among other iron ores.

SALT.

Data received from the various salt-producing localities give 9,987,945 barrels, valued at $4,716,121, as the production of salt in the United States during the calendar year 1891, which shows an increase of 1,210,954 barrels, as compared with the figures for 1890, when the product was 8,776,991 barrels. There is, however, a decrease in the value of the output, declining from $4,752,286 in 1890, to $4,716,121 in 1891, a loss of $36,165. This is the actual difference between the amount received by the producers for their output in the two years, but it does not represent the actual loss. With prices averaging the same as in 1890, the value of the product in 1891 would have been $5,403,478 instead of $4,716,121, so that the actual loss to the trade was $687,357 as compared with the results of the previous year's business. The losses have been chiefly sustained by the producers in New York, where the product increased from 3,837,632 barrels to 3,966,784 barrels, while the value declined from $2,302,579 to $2,037,289.

The following table shows the salt product of the United States by States and Territories during the year 1891:

Quantity and value of salt produced in the United States during the year 1891.

States and Territories.	Production.	Value.
	Barrels.	
Michigan	3,966,784	$2,037,289
New York	2,839,544	1,340,036
Louisiana	173,714	102,375
California	200,949	90,303
Utah	969,000	265,350
Kansas	855,536	304,775
Illinois	39,670	34,909
Virginia	70,442	70,425
Nevada	60,799	39,898
Other States and Territories estimated	811,507	430,761
Total	9,987,945	$4,716,121

Comparative table of production of salt in States and Territories during years 1883 to 1891.

States and Territories.	1883.		1884.	
	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*	
Michigan	2,894,672	$2,344,684	3,161,806	$2,392,536
New York	1,619,486	680,638	1,788,454	705,978
Ohio	350,000	231,000	320,000	201,600
West Virginia	320,000	211,000	310,000	195,000
Louisiana	265,215	141,125	223,964	125,677
California	214,286	150,000	178,571	120,000
Utah	107,143	100,000	114,285	80,000
Nevada	21,429	15,000	17,857	12,500
Kansas	....	....	....	....
Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories (*a*)	400,000	377,595	400,000	364,443
Total	6,192,231	4,251,042	6,514,937	4,197,734

a Estimated.

Comparative table of production of salt in States and Territories during years 1883 to 1891—Continued.

States and Territories.	1885.		1886.	
	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*	
Michigan	3, 297, 403	$2, 967, 663	3, 677, 257	$2, 426, 989
New York	2, 304, 787	874, 258	2, 431, 563	1, 243, 721
Ohio	306, 847	199, 450	400, 000	260, 000
West Virginia	223, 184	145, 070	250, 000	162, 500
Louisiana	299, 271	139, 911	299, 691	108, 372
California	221, 428	160, 000	214, 285	150, 000
Utah	107, 140	75, 000	164, 285	100, 000
Nevada	28, 593	20, 000	30, 000	21, 000
Kansas	....	....	....	....
Illinois, Indiana, Virginia, Tennessee, Kentucky, and other States and Territories (*a*)	250, 000	243, 993	240, 000	352, 763
Total	7, 038, 653	4, 825, 345	7, 707, 081	4, 825, 345

a Estimated.

States and Territories.	1887.		1888.	
	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*	
Michigan	3, 944, 309	$2, 291, 842	3, 866, 228	$2, 261, 743
New York	2, 353, 560	936, 894	2, 318, 483	1, 130, 409
Ohio	365, 000	219, 000	380, 000	247, 000
West Virginia	225, 000	135, 000	220, 000	143, 000
Louisiana	341, 093	118, 735	394, 385	134, 652
California	200, 000	140, 000	220, 000	92, 400
Utah	325, 000	102, 375	151, 785	32, 000
Nevada	....	....	....	....
Kansas	....	....	155, 000	189, 000
Illinois	....	....	....	....
Virginia	....	....	....	....
Other States and Territories (*a*)	250, 000	150, 000	350, 000	143, 999
Total	8, 003, 962	4, 093, 846	8, 055, 881	4, 374, 203

a Estimated.

States and Territories.	1889.		1890.		1891.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*		*Barrels.*	
Michigan	3, 856, 929	$2, 088, 909	3, 837, 632	$2, 302, 579	3, 966, 784	$2, 037, 289
New York	2, 273, 007	1, 136, 503	2, 532, 036	1, 266, 018	2, 839, 544	1, 340, 036
Ohio	250, 000	162, 500	231, 303	136, 617	(*a*)	(*a*)
West Virginia	200, 000	130, 000	229, 938	134, 688	(*a*)	(*a*)
Louisiana	325, 629	152, 000	273, 553	132, 000	173, 714	102, 375
California	150, 000	63, 000	62, 363	57, 085	200, 949	90, 303
Utah	200, 000	60, 000	427, 500	126, 100	969, 000	265, 350
Nevada	....	....	....	....	60, 799	39, 898
Kansas	450, 000	202, 500	882, 666	397, 199	855, 536	304, 775
Illinois	....	....	....	....	39, 670	34, 909
Virginia	....	....	....	....	70, 442	70, 425
Other States and Territories (*b*)	300, 000	200, 000	300, 000	200, 000	811, 507	430, 761
Total	8, 005, 565	4, 195, 412	8, 776, 991	4, 752, 286	9, 987, 945	4, 571, 121

a Included in "other States."

b Estimated.

MICHIGAN.

The salt product of Michigan in 1891 amounted to 3,927,671 barrels, valued at $2,037,289, being an increase in production of 90,039 barrels over that for the previous year. There were 98 companies operating in the State, with a producing capacity of 5,890,000 barrels.

The various grades of salt made in Michigan during the year is shown, by districts, in the following table:

Location of each salt-producing district in Michigan and the number and capacity of the works.

Districts.	Counties.	Companies operating.	Steam blocks.	Pan blocks.	Producing capacity.
					Barrels.
1	Saginaw	24	40	5	1,400,000
2	Bay	30	32	....	1,300,000
3	Huron	12	4	8	150,000
4	Saint Clair	10	8	4	1,000,000
5	Iosco	6	6	....	300,000
6	Midland	2	2	....	75,000
7	Manistee	10	9	2	1,250,000
8	Mason	3	2	1	400,000
9	Gratiot	1	1	....	15,000
	Total	98	104	20	5,890,000

Product of Michigan salt in 1891, by districts.

Counties.	Fine.	Bulk.	Fine packers'.	Packers'.	Solar.	Second quality.	Total.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Saginaw	686,885	231,083	502	317	17,335	26,832	962,954
Bay	626,482	158,395	265	4,800	....	21,848	811,890
Manistee	984,961	67,879	11,670	2,742	....	58,444	1,125,696
Mason	404,921	29,324	50	....	....	9,936	444,231
Huron	30,675	16,719	....	13	....	....	47,407
St. Clair	206,614	47,297	972	3,528	....	1,114	255,525
Iosco	239,365	....	....	....	....	....	239,365
Midland	36,758	750	....	....	....	3,095	40,603
Total	3,212,661	551,447	13,559	11,400	17,335	121,269	3,927,671

The statistics of salt production in Michigan are for the fiscal year ending November 30, 1891, and are obtained from inspectors' reports. The variance between the total in the foregoing table and that stated as the product for the year is due to the difference between the amount in the bins at the close of the year. This amount on November 30, 1891, was 1,103,810 barrels, and on November 30, 1890, 1,064,697 barrels, a difference of 39,113, and the same difference as between the total product and that given in the preceding table.

Grades of salt produced in Michigan, as reported by the inspectors, from 1869 to 1891, inclusive.

Years.	Fine.	Packers'.	Solar.	Second quality.	Common coarse.	Total for each year.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1869	513, 989	12, 918	15, 264	19, 117	....	561, 288
1870	568, 326	17, 869	15, 507	19, 650	....	621, 352
1871	655, 923	14, 677	37, 645	19, 930	....	728, 175
1872	672, 034	11, 110	21, 461	19, 876	....	724, 481
1873	746, 702	23, 671	32, 267	20, 706	....	823, 346
1874	960, 757	20, 090	29, 391	16, 741	....	1, 026, 979
1875	1, 027, 886	10, 233	24, 336	19, 410	....	1, 081, 865
1876	1, 402, 410	14, 233	24, 418	21, 668	....	1, 462, 729
1877	1, 590, 841	20, 389	22, 949	26, 818	....	1, 660, 997
1878	1, 770, 361	19, 367	33, 541	32, 615	....	1, 855, 884
1879	1, 997, 350	15, 641	18, 020	27, 029	....	2, 058, 040
1880	2, 598, 037	16, 691	22, 237	48, 623	....	2, 685, 588
1881	2, 673, 910	13, 885	9, 683	52, 821	....	2, 750, 299
1882	2, 928, 542	17, 208	31, 335	60, 222	....	3, 037, 307
1883	2, 828, 987	15, 424	16, 735	33, 526	....	2, 894, 672
1884	3, 087, 033	19, 308	16, 957	38, 508	....	3, 161, 806
1885	3, 230, 646	15, 480	19, 849	31, 428	....	3, 297, 403
1886	3, 548, 731	22, 221	31, 177	71, 235	3, 893	3, 677, 257
1887	3, 819, 738	19, 385	13, 903	73, 905	17, 378	3, 944, 309
1888	3, 720, 319	18, 126	26, 174	87, 694	13, 915	3, 866, 228
1889	3, 721, 099	19, 780	17, 617	93, 455	4, 978	3, 856, 929
1890	3, 655, 331	20, 337	18, 896	143, 068	....	3, 837, 632
1891	3, 764, 108	11, 400	17, 335	121, 269	13, 559	3, 927, 671

NEW YORK.

The salt product of the State of New York, which is derived from the Onondaga reservation and the Warsaw district, amounted in 1891 to 2,839,544 barrels, valued at $1,340,036, being an increase of about 300,000 barrels as compared with the production for the previous year. The Onondaga district shows a decided falling off in production; the returns from the producers of the Warsaw district, however, give an increase of 500,000 barrels.

The following table gives the production of salt in New York during the years 1883 to 1891, inclusive, by bushels:

Product of salt in New York for the years 1883 to 1891.

	1883.	1884.	1885.	1886.	1887.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Onondaga reservation	7, 497, 431	6, 942, 270	6, 934, 299	6, 101, 757	5, 695, 797
Warsaw district	600, 000	2, 000, 000	4, 589, 635	6, 056, 060	6, 072, 000
Total	8, 097, 431	8, 942, 270	11, 523, 934	12, 157, 817	11, 767, 797

	1888.	1889.	1890.	1891.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*
Onondaga reservation	5, 657, 367	5, 365, 039	4, 928, 122	3, 948, 914
Warsaw district	5, 935, 000	6, 000, 000	7, 732, 060	10, 248, 505
Total	11, 592, 367	11, 365, 039	12, 660, 182	14, 197, 419

Onondaga salt springs reservation.—The quantity of salt manufactured in the Onondaga salt springs reservation during the year 1891 amounted to 3,948,914 bushels, valued at $315,913. Of this amount 1,735,186 bushels were made in fine-salt works by artificial heat and 2,113,727 bushels in the coarse-salt works by solar evaporation. The inspection of the several districts into which the reservation is divided has been as follows:

Product of Onondaga reservation in New York, by districts, in 1891, according to inspectors' returns.

Districts.	Fine.	Solar.	Solar ground.	Ground dairy.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*
Syracuse, No. 1	608, 268	575, 742	16, 738	144, 332
Salina, No. 2	413, 865	103, 544	....	....
Liverpool, No. 3	322, 439	798, 801	....	....
Geddes, No. 4	230, 866	718, 902	15, 416	....
Total	1, 575, 438	2, 196, 989	32, 154	144, 332

Production of the Onondaga district, 1797 to 1891.

[Bushels of 56 pounds.]

Years.	Solar.	Fine.	Total.	Years.	Solar.	Fine.	Total.
	Bushels.	*Bushels.*	*Bushels.*		*Bushels.*	*Bushels.*	*Bushels.*
1797	....	25, 474	25, 474	1845	353, 455	3, 408, 903	3, 762, 358
1798	....	59, 928	59, 928	1846	331, 705	3, 507, 146	3, 838, 851
1799	....	42, 704	42, 704	1847	262, 879	3, 688, 476	3, 951, 355
1800	....	50, 000	50, 000	1848	342, 497	4, 394, 629	4, 737, 126
1801	....	62, 000	62, 000	1849	377, 735	4, 705, 834	5, 083, 569
1802	....	75, 000	75, 000	1850	374, 732	3, 894, 187	4, 268, 919
1803	....	90, 000	90, 000	1851	378, 967	4, 235, 150	4, 614, 117
1804	....	100, 000	100, 000	1852	633, 595	4, 288, 938	4, 922, 533
1805	....	154, 071	154, 071	1853	577, 947	4, 826, 577	5, 404, 524
1806	....	122, 577	122, 577	1854	734, 474	5, 068, 873	5, 803, 347
1807	....	175, 448	175, 448	1855	498, 124	5, 584, 761	6, 082, 885
1808	....	319, 618	319, 618	1856	709, 391	5, 257, 419	5, 966, 810
1809	....	128, 282	128, 282	1857	481, 280	3, 830, 846	4, 312, 126
1810	....	450, 000	450, 000	1858	1, 514, 554	5, 518, 665	7, 033, 219
1811	....	200, 000	200, 000	1859	1, 345, 022	5, 549, 250	6, 894, 272
1812	....	221, 011	221, 011	1860	1, 462, 565	4, 130, 682	5, 593, 247
1813	....	226, 000	226, 000	1861	1, 884, 697	5, 315, 694	7, 200, 391
1814	....	295, 000	295, 000	1862	1, 983, 022	7, 070, 852	9, 053, 874
1815	....	322, 058	322, 058	1863	1, 437, 656	6, 504, 727	7, 942, 383
1816	....	348, 665	348, 665	1864	1, 971, 122	5, 407, 712	7, 378, 834
1817	....	408, 665	408, 665	1865	1, 886, 760	4, 499, 170	6, 385, 930
1818	....	406, 540	406, 540	1866	1, 978, 183	5, 180, 320	7, 158, 503
1819	....	548, 374	548, 374	1867	2, 271, 892	5, 323, 673	7, 595, 565
1820	....	458, 329	458, 329	1868	2, 027, 490	6, 639, 126	8, 666, 616
1821	....	526, 049	526, 049	1869	1, 857, 942	6, 804, 295	8, 662, 237
1822	....	481, 562	481, 562	1870	2, 487, 691	6, 260, 422	8, 748, 113
1823	....	726, 988	726, 988	1871	2, 464, 464	5, 910, 492	8, 374, 956
1824	....	816, 634	816, 634	1872	1, 882, 604	6, 048, 321	7, 930, 925
1825	....	757, 203	757, 203	1873	1, 691, 359	5, 768, 998	7, 460, 357
1826	....	811, 023	811, 023	1874	1, 667, 368	4, 361, 932	6, 029, 300
1827	....	983, 410	983, 410	1875	2, 655, 955	4, 523, 491	7, 179, 446
1828	....	1, 160, 888	1, 160, 888	1876	2, 308, 679	3, 083, 998	5, 392, 677
1829	....	1, 129, 280	1, 129, 280	1877	2, 525, 335	3, 902, 648	6, 427, 983
1830	....	1, 435, 446	1, 435, 446	1878	2, 788, 754	4, 387, 443	7, 176, 197
1831	....	1, 514, 037	1, 514, 037	1879	2, 957, 744	5, 364, 418	8, 322, 162
1832	....	1, 652, 985	1, 652, 985	1880	2, 516, 485	5, 482, 265	7, 998, 750
1833	....	1, 838, 646	1, 838, 646	1881	3, 011, 461	4, 905, 775	7, 917, 236
1834	....	1, 943, 252	1, 943, 252	1882	3, 032, 447	5, 307, 733	8, 340, 180
1835	....	1, 209, 867	1, 209, 867	1883	2, 444, 374	5, 053, 057	7, 497, 431
1836	....	1, 912, 858	1, 912, 858	1884	2, 353, 860	4, 588, 410	6, 942, 270
1837	....	2, 167, 287	2, 167, 287	1885	2, 439, 332	4, 494, 967	6, 934, 299
1838	....	2, 575, 033	2, 575, 033	1886	2, 772, 348	3, 329, 409	6, 101, 757
1839	....	2, 864, 718	2, 864, 718	1887	3, 118, 974	2, 576, 823	5, 695, 797
1840	....	2, 622, 305	2, 622, 305	1888	3, 115, 314	2, 542, 053	5, 657, 367
1841	220, 247	3, 120, 520	3, 340, 767	1889	2, 916, 922	2, 448, 117	5, 365, 039
1842	163, 021	2, 128, 882	2, 291, 903	1890	2, 726, 471	2, 201, 651	4, 928, 122
1843	318, 105	2, 809, 395	3, 127, 500	1891	2, 113, 727	1, 735, 186	3, 948, 914
1844	332, 418	3, 671, 134	4, 003, 552				

LOUISIANA.

The production of salt at the Petite Anse mine in 1891 was 173,714 barrels, valued at $102,375, as against 273,553 barrels in 1890, a decrease of nearly 100,000 barrels.

Production of the Petite Anse salt mine from 1882 to 1891.

Years.	Short tons.	Years.	Short tons.
1882	25,550	1887	47,750
1883	37,130	1888	55,214
1884	31,355	1889	45,588
1885	41,898	1890	39,079
1886	41,957	1891	24,320

UTAH.

The salt production of Utah during 1891 amounted to 969,799 barrels, valued at $265,350. About one-fourth of the product went for milling purposes, and the balance for dairy and stock.

Production of salt in Utah, 1883 to 1891.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Barrels.			*Barrels.*	
1883	107,143	$100,000	1888	151,785	$32,000
1884	114,285	80,000	1889	200,000	60,000
1885	107,140	75,000	1890	427,500	126,100
1886	164,285	100,000	1891	969,000	265,350
1887	325,000	102,375			

IMPORTS AND EXPORTS.

Salt imported and entered for consumption in the United States, 1867 to 1891, inclusive.

[Calendar years ending December 31 from 1886 to 1891; previous years end June 30.]

Years.	In bags, barrels, and other packages.		In bulk.		For the purpose of curing fish.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
1867	254, 470, 862	$696, 570	229, 304, 323	$336, 302			$1, 032, 872
1868	308, 446, 080	915, 546	219, 975, 096	365. 458			1, 281, 004
1869	297, 382, 750	895, 272	256, 765, 240	351, 168			1, 246, 440
1870	288, 479, 187	797, 194	349, 776, 433	507, 874	68, 597, 023	$87, 048	1, 392, 116
1871	283, 993, 799	800, 454	274, 730, 573	355, 318	64, 671, 139	66, 008	1, 221, 780
1872	258, 232, 807	788, 893	257. 637, 230	312, 569	57, 830, 929	60, 155	1, 161, 617
1873	239, 494, 117	1, 254, 818	388, 012, 132	525, 585	86, 756, 628	86, 193	1, 866, 596
1874	358, 375, 496	1, 452, 161	427, 294, 209	649, 838	105, 613, 913	126, 896	2, 228, 895
1875	318, 673, 091	1, 200, 541	401, 270, 315	549, 111	110, 249, 440	119, 607	1, 869, 259
1876	331, 266, 140	1, 153, 480	379, 478, 218	462, 106	118, 760, 638	126, 276	1, 741, 862
1877	359, 005, 742	1, 059, 941	444, 044, 370	532, 831	132, 433, 972	140, 787	1, 733, 559
1878	352, 109, 963	1, 062, 995	414, 813, 516	483, 909	160, 794, 611	96, 898	1, 643, 802
1879	375, 286, 472	1, 150, 018	434, 760, 132	532, 706	94, 060, 114	95, 841	1, 778. 565
1880	400, 970, 531	1, 180, 082	449, 743, 872	548, 425	109, 024, 446	119, 667	1, 848, 174
1881	412, 442, 291	1, 242, 543	529, 361, 041	658, 068	133, 395, 065	144, 347	2, 044, 958
1882	329, 969, 300	1, 086, 932	399, 100, 228	474, 200	134, 777, 569	147, 058	1, 708, 190
1883	312, 911, 360	1, 035, 946	412, 938, 686	451, 001	142, 065, 557	154, 671	1, 641, 618
1884	340, 759, 010	1, 093, 628	441, 613, 517	433. 827	126, 605, 276	122, 463	1, 649, 918
1885	351, 276, 969	1, 030, 029	412, 322, 341	386, 858	140, 067, 018	121, 429	1, 538, 316
1886	319, 232, 750	966, 993	366, 621, 223	371, 000	103, 360, 362	94, 721	1. 432, 714
1887	275, 774, 571	850, 069	343, 216, 331	328, 201	105, 577, 947	107, 089	1, 285, 359
1888	238, 921, 421	620, 435	272, 650, 231	246, 022	113, 459, 083	111, 120	977, 577
1889	180, 906, 293	627, 134	234, 499, 635	249, 232	97, 960, 624	100, 123	976, 489
1890	172, 611, 041	575, 260	243, 756, 044	252, 848	98, 279, 719	96, 648	924, 756
1891	150, 033, 182	492, 144	220, 309, 985	224, 569	103, 990, 324	89, 196	805, 909

Salt of domestic production exported from the United States from 1790 to 1891, inclusive.

Fiscal years ending September 30 until 1842, and June 30 since.	Quantity.	Value.	Calendar years ending December 31 from 1886 to 1891; previous years end June 30.	Quantity.	Value.
	Bushels.			*Bushels.*	
1790	31, 935	$8, 236	1860	475, 445	$129, 717
1791	4, 208	1, 052	1861	537, 401	144, 046
1830	47, 488	22, 978	1862	397, 506	228, 109
1831	45, 847	26, 848	1863	581, 901	277, 838
1832	45, 072	27, 914	1864	635. 519	296, 088
1833	25, 069	18, 211	1865	589, 537	358, 109
1834	89, 064	54, 007	1866	670, 644	300, 980
1835	126, 230	46, 483	1867	605, 825	304, 030
1836	49, 917	31, 943	1868	624, 970	289, 936
1837	90, 133	58, 472	1869	442, 947	190, 076
1838	114, 155	67, 707	1870	298, 142	119, 582
1839	264, 337	64, 272	1871	120, 156	47, 115
1840	92, 145	42, 246	1872	42, 603	19, 978
1841	215, 084	62, 765	1873	73, 323	43, 777
1842	110, 400	39, 064	1874	31, 657	14, 701
1843 (nine months)	40, 678	10, 262	1875	47, 094	16, 273
1844	157, 529	47, 755	1876	51, 014	18, 378
1845	131, 500	45, 151	1877	65, 771	20, 133
1846	117, 627	30, 520	1878	72, 427	24, 968
1847	202, 244	42, 333	1879	43, 710	13, 612
1848	219, 145	73, 274	1880	22, 179	6, 613
1849	312, 063	82, 972	1881	45, 455	14, 752
1850	319, 175	75, 103	1882	42, 085	18, 265
1851	344, 061	61, 424	1883	54, 147	17, 321
1852	1, 467, 676	89, 316	1884	70, 014	26, 007
1853	515. 857	119, 729	1885	*a*4, 101, 587	26, 488
1854	548, 185	159. 026	1886	4, 828, 863	29, 580
1855	536, 073	156, 879	1887	4. 685, 080	27, 177
1856	698, 458	311, 495	1888	5, 359, 237	32, 986
1857	576, 151	190, 699	1889	5. 378, 450	31, 405
1858	533, 100	162, 650	1890	4, 927, 022	30, 079
1859	717, 257	212, 710	1891	4, 448, 846	23, 771

a Pounds from 1885.

BROMINE.

The considerable amount of mother liquor remaining from the manufacture of salt in West Virginia, Ohio, and Michigan results in the production of a large supply of bromine, amounting in 1891 to 343,000 pounds. There is a demand for a moderate amount of this substance, and hence some salt manufactories are equipped with necessary apparatus for treating the mother liquor and obtaining bromine from the bromides which the complex solution contains. Besides this, separate establishments are supported by this bromine manufacture, and to these most of the mother liquor goes. As the supply of mother liquor goes steadily on, entirely without reference to the demand for bromine, it is not surprising that stocks accumulate. As a control, the National Bromine Company has represented the principal producers for several years past, practically as a sales agency. In March of 1891 this combination expired, because of the inability of the company to renew expiring contracts with the consumers. As a consequence of the effort to market the surplus which followed, shipments were made abroad, although an agreement had existed with the German producers from the Stassport salt-works to the effect that each country should limit sales to its own territory. Of course cheap bromine was then shipped from Germany to the United States and the price thus reduced from 25 to 17½ cents per pound in New York or Philadelphia, or say 16½ cents at the producing localities in West Virginia or Michigan. As bromine itself proved difficult to import, the Germans made it up into potassium and sodium bromides, and these substances also dropped in value, bromideof potassium to 21 cents a pounds. This continues to be the situation in 1892.

The product for the past few years is given in the following table:

Production of bromine from 1883 to 1891.

Years.	Pomeroy district, Ohio.	Tuscarawas valley, Ohio.	West Virginia.	Michigan.	Pennsylvania.	Total.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1883	171,116	23,334	106,650	....	....	301,100
1884	159,881	21,710	99,509	....	....	281,100
1885	110,000	15,000	85,000	40,000	60,000	310,000
1886	111,866	15,000	126,391	125,528	49,549	428,343
1887	59,312	16,425	45,350	....	78,000	199,087
1888	44,070	20,470	81,124	61,609	100,113	307,386
1889	165,973		90,028	45,968	116,922	418,891
1890	101,813		118,184	59,696	108,154	387,847
1891	....	....	....	....	....	343,000

The only importations of bromine in recent years are tabulated below.

Bromine imported into United States.

Year ended—	Quantity.	Value.
	Pounds.	
June 30, 1886	22,099	$6,288
December 31, 1887	66,307	16,216
1891	19,020	2,473

GYPSUM.

By E. W. Parker.

Against a product of 182,995 short tons in 1890, valued at $574,523, the output in 1891 was 208,126 short tons, worth $628,051. In determining the value of the product the usual method of ascertaining the amounts sold crude, ground (for land plaster), and calcined, with the value of each, has been carried out. Segregated in this manner the amount and value of the product by States in 1891 is found to have been as shown in the following table. In order to protect the interests of individual operators the product of California, Ohio, Utah, and Wyoming have been consolidated, there being but one operator in each of those States.

Product of gypsum in the United States in 1891, by States.

States.	Total product.	Total amount sold crude.	Value of crude.	Ground into land plaster.	Value of land plaster.	Calcined.		Value of calcined plaster.	Total value.
						Weight before calcining.	Weight after calcining.		
	Short tons.	*Short tons.*		*Short tons.*		*Short tons.*	*Short tons.*		
California, Ohio, Utah, and Wyoming	17.115	....	....	988	$3,336	16,127	14,085	$90,810	$94,146
Iowa	31,385	....	....	4,822	4,845	26,563	21,049	53,250	58,095
Kansas	40,217	640	$1,280	70	210	39,497	28,468	159,832	161,322
Michigan	79,700	11,000	22,000	15,100	28,550	53,600	44,860	173,175	223,725
New York	30,135	6,730	5,058	23,405	53,513	....	....	....	58,571
South Dakota	3,615	....	....	1,560	4,680	2,055	1,544	4,938	9,618
Virginia	5,959	204	352	5,755	22,222	....	....	....	22,574
Total	208,126	18,574	28,690	51,700	117,356	136,727	110,006	482,005	628,051

Comparing the total results with those for 1889 and 1890, we find that both the amount and value of the product are in excess of those of 1890, but considerably less than in 1889, a year of exceptional activity in the industry. The total product, with its distribution and value for the last three years, were as follows:

Comparative statistics of gypsum production for two years.

States.	Total product.			Total value.		
	1889.	1890.	1891.	1889.	1890.	1891.
	Short tons.	*Short tons.*	*Short tons.*			
Colorado	7,700	4,580	....	$28,940	$22,050	....
Iowa	21,789	20,900	31,385	55,250	47,350	$58,095
Kansas	17,332	20,250	40,217	94,235	72,457	161,322
Michigan	131,767	74,877	79,700	373,740	192,099	223,725
New York	52,608	32,903	30,135	79.476	73,093	58,571
South Dakota	320	2,900	3,615	2,650	7,750	9,618
Virginia	6,838	6,350	5,959	20,336	20,782	22,574
Other states (*a*)	29,420	20,235	17,115	109,491	138,942	94,146
Total	267,769	182,995	208,126	764,118	574,523	628,051

a Includes California, Ohio, Utah, and Wyoming.

California.—The larger portion of the product of California is calcined into plaster of Paris, about 10 per cent. of the output being sold as land plaster. The business is a steady one, the annual production varying but little. The gypsum is produced in Santa Barbara county and shipped to San Francisco for marketing.

Colorado.—The product in 1891 increased slightly over that of 1890. The value, however, decreased somewhat, or from $22,050 to $18,500, due to 900 tons of the 1891 product being sold in crude state at $1 per ton, while all of the product in 1890, with the exception of 50 tons ground into land plaster, was calcined into plaster of Paris.

Iowa.—One firm went out of existence in the early part of 1891, but notwithstanding this the product increased nearly 50 per cent., or from 20,900 tons to 31,385 tons. The value did not increase in proportion, being $47,350 in 1890 and $53,250 in 1891. Prices were reported as demoralized in 1891, and the increased demand was due to the lower prices.

Kansas.—Out of six operators, returns have been received from four. The output of those not reporting has been estimated at about the same figures as were returned for 1890. This shows the product to have been 39,092 short tons, worth $157,322, an increase in tonnage of 18,842, and in value of $84,865. Should the delinquent operators have shown the same rate of increase as the ones reporting, the product would not fall short of 42,000 short tons. The reported product is from Marshall, Barber, and Saline counties. The principal manufactured product is wall plaster of an excellent quality, the gypsum being mixed with clay and especially adapted for this purpose.

Michigan.—Adopting the same method of estimating the unreported operators in Michigan the product in 1891 is ascertained to be 79,700 tons, valued at $223,725, against 74,877 tons, worth $192,099 in 1890. This is an increase of 4,823 tons in amount and $31,626 in value. Among the increased facilities noted during the year was the doubling of its mill capacity by the Western Plaster Works of Alabaster, the improvements being completed in January, 1891. After running six months the mill was burned on July 9. The company is rebuilding and enlarging the plant to a capacity of 200 tons of calcined plaster per day. As noted in the report for 1890, the mill of Mr. Loren Day at Grand Rapids was destroyed by fire May 13, 1891. This property produced no plaster after that date.

New York.—The principal product reported was from Onondaga and Cayuga counties, with smaller amounts from Genesee, Madison, Monroe, and Ontario. It is used entirely as a fertilizer, and owing to a wet season in 1891 the demand fell off and what plaster was sold brought lower prices than in 1890. The decrease in product was 2,868 short tons and, in value, $14,522.

Ohio.—The product is of excellent quality and the greater portion is calcined into plaster of Paris. That which is off color (and which represents about 8 per cent. of the total) is ground into land plaster and sold for $2 per ton. The purer mineral is valued at $3 per ton crude and $5 per ton after calcining. The demand in 1891 is reported as in excess of that of 1890. The output is entirely from Ottawa county. Additional facilities have been added to the grinding and calcining property by the addition of new machinery, so as to double the capacity of the works.

South Dakota.—Product increased 715 short tons over 1890, and value, $1,868. Meade county furnishes the greater part of the product, a small amount coming from Lawrence county. In Meade county four new locations, comprising 80 acres of gypsum land, were opened up by one of the operating companies and additional machinery placed on the ground.

Texas.—The Lone Star Plaster Company, of Quanah, Texas, was organized in May, 1891, with a capital of $100,000, for the purpose of mining gypsum and manufacturing land and wall plaster. Operations were begun in April, 1892, with a mill capacity of 75 tons of plaster per day. The promoters of the enterprise are interested in the Acme Cement Plaster Company, of Gypsum City, Kansas, and claim the product of the Quanah mill, known as "Climax" plaster, to be equal to the "Acme" in quality.

Utah and Wyoming.—Utah did not report any product for 1890, but has a good output for 1891. It is mined in Juab county and the total product was calcined. The product in Wyoming decreased from 1890. A small quantity was sold for land plaster, but most of the product is calcined.

Virginia.—The product decreased slightly, or from 6,350 to 5,959 short tons. The value however increased from $20,782 to $22,222. It comes from Smyth and Washington counties and is used entirely for fertilizing purposes.

Imports.—The following table exhibits the total gypsum, ground or calcined and crude, imported into the United States since 1867.

Gypsum imported into the United States from 1867 to 1891.

Years ended—	Total.	Ground or calcined.		Unground.		Value of manufactured plaster of Paris.
		Quantity.	Value.	Quantity.	Value.	
		Long tons.		*Long tons.*		
June 30, 1867	$125, 281		$29, 895	97, 951	$95, 386	
1868	114, 350		33, 988	87, 694	80, 362	
1869	186, 512		52, 238	137, 039	133, 430	$844
1870	148, 720		46, 872	107, 237	100, 416	1, 432
1871	154, 013		64, 465	100, 400	88, 256	1, 292
1872	168, 873		66, 418	95, 339	99, 902	2, 553
1873	165, 459		35, 628	118, 926	122, 495	7, 336
1874	170, 901		36, 410	123, 717	130, 172	4, 319
1875	171, 096		52, 155	93, 772	115, 664	3, 277
1876	179, 070		47, 588	139, 713	127, 084	4, 398
1877	162, 917		49, 445	97, 656	105, 629	7, 843
1878	140, 587		33, 496	89, 239	100, 102	6, 989
1879	125. 542		18, 339	96, 963	99, 027	8, 176
1880	150, 409		17, 074	120, 327	120, 642	12, 693
1881	171, 724		24, 915	128, 607	128, 107	18, 702
1882	200, 922	5, 737	53, 478	128, 382	127, 067	20, 377
1883	218, 969	4, 291	44, 118	157, 851	152, 982	(*a*) 21, 869
1884	210, 904	4, 996	42, 904	166, 310	168, 000	
1885	173, 752	6, 418	54, 208	117, 161	119, 544	
1886	153, 338	5, 911	37, 642	122, 270	115, 696	
1887	195, 890	4, 814	33, 736	146, 708	162, 154	
Dec. 31, 1888	190, 787	3, 340	20, 764	156, 697	170, 023	
1889	220, 140	5, 466	40, 291	170, 965	179, 849	
1890	229, 859	7, 568	55, 250	171, 289	174, 609	
1891	226, 319	9, 560	97, 316	110, 257	129, 003	

a Not specified since 1883.

MAGNESITE.

This mineral, though not abundant elsewhere in the United States, occurs in large deposits at various points in California, the following being the most notable localities of its occurrence so far as known: Child's valley, Napa county; Mount Diablo range, Alameda county; on Coyote creek, Santa Clara county; Gold Run, Iowa Hill, and Damascus, Placer county; Arroyo Seco, Monterey county; near Visalia, Tulare county, and at several places in Mariposa and Tuolumne counties.

From the reports of the California State Mineralogist the following information has been gathered in regard to the occurrence of several deposits: That in Childs valley occurs in the form of a lode from 5 to 7 feet thick, standing at an angle of about 70 degrees and having regular walls, the most of the deposits found elsewhere occurring in beds from 2 to 6 feet in thickness. This lode consists of the white carbonate of magnesia, the mineral being broken out in slabs several inches thick and from 2 to 6 feet in width. The deposit in the Mount Diablo range is of the hydrous variety, very large, and pulverizes readily; the Placer county deposits are also very extensive, but no attempts have ever been made to utilize either of them, the same remark applying largely to those in Tuolumne, Tulare, and Mariposa counties.

The mineral in the Visalia beds is white, hard, fine grained, and in texture resembles porcelain unglazed, features that characterize the mass of the mineral found in this State. These beds which, vary from 1 to 6 feet in thickness, are interstratified with talcose slate and serpentine. A heavy bed of magnesian rock, principally magnesite, charged with crystals of iron pyrites, accompanies many of the larger gold-bearing quartz veins in Tuolumne and Mariposa counties. This rock is also charged with nickel and chrome talc in green films like the magnesite of Canada.

An artificial carbonate of magnesia is obtained as a by-product in the tanks in which are treated the mother liquors at the works of the Union Pacific Salt Company, Alameda county, this material being largely used in the manufacture of explosives.

Not until recently has much use been made of magnesite either in California or elsewhere on the Pacific coast. Of late, much experimenting has been made with a view to employing it more largely in both the manufactures and arts, and with results that promise for these trials a good measure of success. The most important of these uses thus far has been in the manufacture of paper from wood pulp, in which process the material is employed as a bleaching agent, for which purpose it is found to be both cheaper and more effective than chlorine, heretofore used.

From the Snow Flake magnesia mine in Child's valley, owned by Messrs. H. G. Staab and W. H. Whitton, there was shipped last year to the Willamette Pulp and Paper Company, Oregon, 700 tons of calcined magnesite, being equivalent to 1,400 tons of the rock before the carbonic acid was expelled. The above is the only furnace yet erected on the coast for roasting the rock, as this Oregon company is the only one here that has yet employed this material in the manufacture of paper. Messrs. Stanley and Bartlett, lessees of the Snow Flake property, mined and manufactured last year a total of 1,500 tons of the crude rock, 100 tons of this having been used by the Pacific Rolling Mills for lining furnace bottoms, and by the manufacturers of artificial stone, experimenters in the manufacture of paint, etc. There are employed by the Snow Flake company about 20 men, miners, teamsters, wood-choppers, etc., included. This mine and works are distant 10 miles from Rutherford, a station on the Calistoga railroad, 65 miles from San Francisco, at which latter point the material costs calcined and ground, delivered on the cars, $8 per ton, railroad freight being $2 per ton, hauling from furnace to Rutherford $2.50 per ton.

The prospective increased demand for magnesite on the Pacific coast has determined Messrs. Staab and Whitton to greatly enlarge the capacity of their mill and furnace in the early future, the probability being that they will be able to ship the calcined article to markets as far east as Chicago and perhaps Pittsburg, which markets now obtain the most of their supplies from New York and other Atlantic seaports into which it is imported from European countries. In Pittsburg and other large manufacturing districts dolomitic limestone is employed in making basic steel. For this stone magnesite would be substituted if it could be obtained at prices somewhat lower than now has to be paid for the imported calcined article, on which there is imposed a duty of 20 per cent., the raw coming in free.

FLUORSPAR.

Rosiclaire, Illinois, continues to be the only domestic source of supply. The product in 1891 was 10,044 short tons, valued at $78,330, being in excess of any year's business since the industry was established. The operators report the demand for fluorspar (particularly for fluxing purposes, as its properties in this regard become better understood) to be increasing annually and the trade steadily improving. In addition to its use for metallurgical purposes, it is consumed in the manufacture of glass and of hydrofluoric acid. When intended for glass or acid making the fluorspar is crushed and put through a buhr mill at the mines before selling. For other purposes it is sold in lumps as mined. The reader is referred to the preceding volume, "Mineral Resources of the United States, 1889–'90," for a more extended discussion of the use of fluorspar for metallurgical purposes.

The following table shows the yearly production of fluorspar since 1882:

Production of fluorspar in the United States from 1882 to 1891.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1882	4,000	$20,000	1887	5,000	$20,000
1883	4,000	20,000	1888	6,000	30,000
1884	4,000	20,000	1889	9,500	45,835
1885	5,000	22,500	1890	8,250	55,328
1886	5,000	22,000	1891	10,044	78,330

BORAX.

The following are the companies that during the year ending June 30, 1892, have produced borax in the States of California and Nevada, with number of tons turned out by each:

Companies.	Tons.
San Bernardino Borax Company	540
Columbus Borax Company	240
Consolidated and Trudo Borax Company	360
Pacific Coast Borax Company	5, 000
Nevada Salt and Borax Company	550
Total	6, 690

This is equivalent to 13,380,000 pounds, being a slight increase on the output of the preceding year. Of these companies, all except the Pacific Coast manufacture the borax at works erected on or near the several marshes where the crude material is obtained. The Consolidated and Trudo works are located in Saline valley, Inyo county, California, a locality that has only within the past year or two begun to make an active production. The Pacific Coast Company owns some six or eight different salines. From four of these, all that are being at present worked, the crude material is collected and shipped to the extensive refinery near San Francisco, where it is converted into a merchantable article. With their deposits in Death valley nothing for several years past has been done, as these, by reason of the arid and barren character of the surrounding country and the long wagon transportation required to market, the product can not be operated to advantage.

The factors of production remaining the same the cost of making this sale has undergone no change of late. So too the markets during the year have seen but little fluctuation, prices having shown a close conformity to the figures that for a number of years past have obtained.

Delivered at points on the railroads nearest the salines the companies have been selling the refined article at the rate of 6½ cents per pound by the carload, the prices realized for carload lots in San Francisco having averaged 7½ cents per pound for the refined and 7 cents for the concentrated.

This stability in the market, coupled with fairly remunerative prices, has been due largely to an arrangement entered into by the several companies tending to slightly restrict the product and regulate the manner in which it shall be put upon the market. In former years, owing to local competition and a lack of concerted action in handling their output, these companies, instead of making gains, went behind at a rate that compelled some of them to suspend operations.

Even now the profits realized by them are not inordinately large. It costs an average of 4 cents per pound for them to make the sale, delivered at the marshes. The expense of transportation to countries of general consumption amounts to nearly 3 cents per pound, making the cost of this commodity laid down at points of large distribution, such as New York and Chicago, about 7 cents per pound wholesale—say 8 cents retail.

When the California manufacturers first began making this salt it was selling at the rate of 35 cents per pound in all the leading markets of the world. With the establishment of this industry in this country the price of the foreign article declined so sharply that a number of producers abandoned the field. Immediately following this the price advanced, but not to the old figure, and not enough to bring about a general resumption of the business. The present tariff of 4 cents per pound on refined borax admits of a remunerative price to the California producers, and a large and prosperous industry has been built up in a region of country where no other pursuit has been able to gain an extensive foothold.

The California and Nevada manufacturers of borax are not now exporting much of their product to other countries, being satisfied with having secured the home market. Australia, China, and Japan, including British Columbia and Hawaii, obtain now their supplies almost wholly from England, a thousand centals or so sent to Mexico and Central America constituting foreign shipments from the port of San Francisco.

The bulk of shipments made to the Atlantic side have of late been by sea, 75 per cent. of consignments being to New York, the balance mostly to Chicago.

The consumption of borax in the United States about equals now the production made, what little is imported being mostly in the form of boracic acid. The use of this salt is growing year by year and, as its value as a detergent and an antiseptic, as well as for sanitary purposes, becomes better understood among the masses, must ultimately become very large. However great the demand, the resources of these California and Nevada deposits will be ample to meet it. By reason of their self-recuperative properties they can in fact never be wholly exhausted. The first crop, which consists for the most part of a surface crust, having been removed, another gradually takes its place, this process of reproduction going on so rapidly that a new crop may be harvested every five or six years, none of them so heavy, however, as that first gathered.

GRAPHITE.

By E. W. Parker.

Production was limited in 1891 to the mines at Ticonderoga, New York, and amounted to 1,559,674 pounds of refined graphite, valued at $110,000. No work of any consequence was done upon the properties in Pennsylvania and Michigan, though the owners report the expectation of resuming operations at an early date.

Uses.—The consumption of graphite is steadily increasing. Its use in the manufacture of lead pencils is well known. For this and for the preparation of lubricants the higher grades are necessary. For crucibles, stove polish, foundry facings, etc., the poorer qualities are used. Paint for covering iron and other metal surfaces made from graphite is found to be easily and quickly applied and to possess great durability. It has been adopted by the Pennsylvania Railroad Company for painting the iron work of its new elevated railroad through Jersey City. Graphite has been found to withstand the cutting action of acid slag in the Bessemer converter and a considerable demand for it is said to have recently risen among steel manufacturers.

Graphite mining in Ceylon.—The island of Ceylon, off the southeast coast of British India, furnishes the bulk of the world's supply of graphite. It is particularly adapted to crucible manufacture. Notwithstanding the fact that the methods of mining are the crudest possible large profits are made, and it is said enormous fortunes have been made by native operators. Objection is made to the introduction of machinery and more improved methods on the ground that, as at present operated, the work is profitable, and that the introduction of machinery means new conditions which may not be thoroughly understood and losses consequently entailed. A visitor to these mines gives a description of their methods. The graphite is mined from an open cut and is handed in buckets or thrown in lumps from one man to another until the top is reached. Drills and hammers for blasting represent the extent of machinery employed. Timbering of a kind is used, but not with much knowledge, either as to the adaptability of the wood employed or skill in its manipulation. Ventilation is not thought of and after blasting miners are obliged to suspend work until the cut has been cleared by natural influences of the gases caused by the explosion. No statement is made of the wages paid for labor; but, when the crude methods are considered and the number of men necessary to supply the work of machinery, the rate of compensation must be extremely low to admit of fortunes being made by the owners.

Graphite imported into the United States from 1867 to 1891.

Years ended—	Unmanufactured.		Manufactured.	Total.
	Quantity.	Value.		
	Cwt.			
June 30, 1867	27,113	$54,131	....	$54,131
1868	68,620	149,083	....	149,083
1869	74,846	351,004	....	351,004
1870	80,795	269,291	$833	270,124
1871	51,628	136,200	3,754	139,954
1872	96,381	329,030	....	329,030
1873	157,539	548,613	....	548,613
1874	111,992	382,591	....	382,591
1875	46,492	122,050	....	122,050
1876	50,589	150,709	17,605	168,314
1877	75,361	204,630	18,091	222,721
1878	60,244	154,757	16,909	171,666
1879	65,662	164,013	24,637	188,650
1880	109,908	278,022	22,941	300,963
1881	150,927	381,966	31,674	413,640
1882	150,421	363,835	25,536	389,371
1883	154,893	361,949	21,721	383,670
1884	144,086	286,393	1,863	288,256
1885	110,462	207,228	....	207,228
1886	83,368	164,111	....	164,111
1887	168,841	331,621	....	331,621
Dec. 31, 1888	184,013	353,990	....	353,990
1889	177,381	378,057	....	378,057
1890	255,955	594,746	....	594,746
1891	212,360	555,080	....	555,080

ASBESTOS.

BY E. W. PARKER.

In considering the subject of asbestos care should be taken to distinguish what is properly asbestos and a very similar but distinct mineral, chrysotile. Asbestos is a fibrous species of hornblende, and occurs associated with metamorphic rocks rich in that mineral. Chrysotile, though usually considered in trade as asbestos, is an entirely different mineral and occurs in distinct veins in serpentine formations. Both minerals are fibrous and both are remarkable for their resistance to the action of heat. The fibers of chrysotile are exceedingly tough, and being at the same time flexible and slightly elastic, it is used principally in the manufacture of fireproof fabrics. Asbestos, on the other hand, while possessing fibers of greater length, has not the same strength, and is used in the manufacture of articles where resistance to heat is requisite but the strength of fiber not essential. The principal uses for which it serves are boiler and steam-pipe covering, packing for fireproof safes, and for making cements and paints.

Occurrence.—No deposits of chrysotile have as yet been found in the United States. Asbestos occurs in considerable quantity in California and Wyoming, and in limited amount along the eastern slope of the Appalachian range from New York to Georgia. The commercial product has been limited to California, where 66 tons were mined in 1891, valued at about $3,960. A small amount (about 4 tons) was mined in Wyoming in the prosecution of assessment work, but none of this was marketed. A deposit of asbestos was found near Hamilton, Washington, during the year, and it is understood that it will be developed.

The United States depends for its supply of chrysotile upon the Thetford and Black Lake mines of Canada. The production of this mineral was not begun until 1879, when 300 tons were mined. In 1889 the total shipments reported to the Department of Agriculture by the operators were 5,588 tons, worth $360,144. In 1890 the shipments were estimated at 7,000 tons.

Imports.—The increase in the use of asbestos in the United States during the past twenty years may be observed from the following table of imports, the value of which in 1871 being but $12, and in 1891 $358,461. The increase in the last ten years is particularly noticeable. It must be remarked that this table includes the chrysotile imported from Canada, and which, as previously stated, is usually classed as asbestos.

In addition to the well-known uses for which asbestos has been employed for some time, it has been recently found valuable in the manufacture of masks for persons in foundries, and for the use of firemen and others subjected to the presence of intense heat. It has also come into use for making joint wipers for plumbing, and for holders in grasping hot irons, crucibles, etc.

Asbestos imported from 1869 to 1891.

Years ended—	Unmanufactured.	Manufactured.	Total.
June 30, 1869		$310	$310
1870		7	7
1871		12	12
1872			
1873	$18		18
1874	152		152
1875	4, 706	1, 077	5, 783
1876	5, 485	396	5, 881
1877	1, 671	1, 550	3, 221
1878	3, 536	372	3, 908
1879	3, 204	4, 624	7, 828
1880	9, 736		9, 736
1881	27, 717	69	27, 786
1882	15, 235	504	15, 739
1883	24, 369	243	24, 612
1884	48, 755	1, 185	49, 940
Dec. 31, 1885	73, 026	617	73, 643
1886	134, 193	932	135, 125
1887	140, 264	581	140, 845
1888	168, 584	8, 126	176, 710
1889	254, 239	9, 154	263, 393
1890	252, 557	5, 342	257, 879
1891	353, 589	4, 872	358, 461

SOAPSTONE.

By E. W. Parker.

Lower prices, due to active competition, reduced the value of the product, but the total amount quarried was greater by 2,840 tons than that of 1890. The increased product is due to the development of soapstone quarries in Georgia and North Carolina, four new companies having entered the field in those States with an aggregate product of 4,032 short tons. The total product for the year was 16,514 short tons, worth $243,981, against 13,670 tons, valued at $252,309, in 1890. The above product for 1891 is exclusive of a small amount used as a pigment and which is mentioned under the chapter on mineral paints.

Among the increased facilities for quarrying and manufacturing soapstone made during 1891 may be mentioned: In Georgia, a pulverizing plant with a capacity of 10 tons of powdered soapstone per day. The product from this property in 1891 was sold rough; it will henceforth be ground on the premises, and the owners expect to triple their output during the current year. In New Hampshire one firm reports a doubled capacity, but a slightly decreased product. Three companies began operations in North Carolina with facilities for preparing the stone as desired by consumers. The plants include apparatus for sawing and dressing into slabs, and for crushing, grinding, and bolting into powder. One firm in Pennsylvania reports 20 per cent. increased capacity. A new mill, doubling the former capacity, was constructed at Grafton, Vermont. No interference with operations in any locality due to labor troubles has been reported.

Production in previous years.—In the following table the statistics for 1880 and 1889 are from the reports of the Tenth and Eleventh Censuses; intervening years are for estimates made by the Geological Survey, and those for 1890 and 1891 are compiled from direct returns from operators:

Annual product of soapstone from 1880 to 1891.

Years.	Short tons.	Value.
1880	8,441	$66,665
1881	7,000	75,000
1882	6,000	90,000
1883	8,000	150,000
1884	10,000	200,000
1885	10,000	200,000
1886	12,000	225,000
1887	12,000	225,000
1888	15,000	250,000
1889	12,715	231,708
1890	13,670	252,309
1891	16,514	243,981

Fibrous talc.—The production has increased steadily. Gouverneur, St. Lawrence county, New York, remains the sole source of supply. With the exception of a small amount used in the manufacture of dynamite, the entire product is consumed as a filler in making medium grades of paper. The output in 1891 was 53,054 short tons, valued at $493,068, against 41,354 tons, valued at $389,186 in 1890, an increase of 11,700 tons in quantity and $103,882 in value.

One new mill, doubling previous capacity, was completed in February, 1892, and two more with similar increasing facility were commenced and will be completed in 1892. No labor troubles affecting the industry occurred. Since 1880 the annual production of fibrous talc has been as follows:

Annual production of fibrous talc since 1880.

Years.	Short tons.	Value.
1880	4, 210	$54, 730
1881	a 7, 000	60, 000
1882	a 6, 000	75, 000
1883	a 6, 000	75, 000
1884	a 10, 000	110, 000
1885	a 10, 000	110, 000
1886	a 12, 000	125, 000
1887	a 15, 000	160, 000
1888	a 20, 000	210, 000
1889	23, 746	244, 170
1890	41, 354	389, 196
1891	53, 054	493, 068

a Estimated.

MINERAL PAINTS.

By E. W. Parker.

Under this head are included ochers, umbers, siennas, metallic paints, Venetian and Indian reds, white lead, red lead, litharge and orange mineral. Owing to producers of the first three mentioned not keeping separate accounts, it is necessary to include them in one statement.

Ocher.—Including ocher, umber, and sienna, the product for 1891 was 18,294 short tons, valued at $233,823. This was an increase in amount over 1890 of 739 short tons, but a decrease in value of $3,700. Notwithstanding the lower prices which ruled in 1891, a number of new operations were begun, and some of the older firms increased their facilities. New mines were opened in Lehigh and Berks counties, Pennsylvania, and one firm in the latter county doubled its facilities by the addition of new machinery, and another firm operating in Northampton county, Pennsylvania, and Warren county, New Jersey, increased its capacity about one-third. In El Paso county, Colorado, a new plant, costing $25,000, was erected.

Annual production of ocher since 1884.

Years.	Short tons.	Value.	Years.	Short tons.	Value.
1884	7,000	$84,000	1888	10,000	$120,000
1885	3,950	43,575	1889	15,158	177,472
1886	6,300	91,850	1890	17,555	237,523
1887	8,000	75,000	1891	18,294	233,823

Divided by States the production for the last three years is shown in the following table. Prior to 1889, when the statistics were compiled for the eleventh census, the product for each State was not published.

Production of ocher in 1889, 1890, and 1891, by States.

States.	1889.		1890.		1891.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Alabama	336	$3,500	350	$4,100	524	$5,840
Colorado	50	150	1,000	15,000		
Georgia	2,512	29,720	800	12,800	600	9,000
Maryland	616	12,000				
Massachusetts	80	750	300	2,700	300	2,700
Missouri			2.200	30,000	1,850	27,500
New Jersey					600	7,200
New York			365	4,493		
Pennsylvania	7,922	103,797	4,173	61,458	4,535	56,588
Vermont	1,884	7,800			935	11,095
Virginia	1,658	18,755	1,367	22,972	1,950	29.900
Wisconsin	100	1,000				
Other States (*a*)			7,000	84,000	7,000	84,000
Total	15,158	177,472	17,555	237,523	18,294	233,823

(*a*) Includes all of Maryland, and estimated products of some firms in other States not reporting.

Ocher, etc., imported from 1867 to 1883.

Fiscal years ending June 30—	All ground in oil.		Indian red and Spanish brown.		Mineral, French and Paris green.		Other, dry, not otherwise specified.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1867	11,373	$385	....	$35,374	....	$2,083	1,430,118	$9,923
1868	6,949	333	....	11,165	....	500	3,670,093	32,102
1869	65,344	2,496	2,582,335	31,624	8,369	2,495	5,379,478	39,546
1870	149,240	6,042	3,377,944	41,607	9,618	3,444	3,935,978	32,593
1871	121,080	4,465	2,286,930	40,663	33,488	11,038	2,800,148	24,767
1872	277,617	9,225	2,810,282	38,763	41,422	10,341	5,645,343	56,680
1873	94,245	3,850	135,360	2,506	34,382	8,078	3,940,785	51,318
1874	98,176	4,623	263,389	3,772	102,876	18,153	3,212,988	35,365
1875	280,517	12,352	646,009	9,714	64,910	13,506	3,282,415	37,929
1876	63,916	3,365	1,524,989	19,555	21,222	5,385	3,962,646	47,405
1877	41,718	2,269	2,179,631	24,218	27,687	6,724	3,427,208	32,924
1878	25,674	1,591	2,314,028	23,677	67,655	14,376	3,910,947	33,260
1879	17,649	1,141	2,873,550	26,929	17,598	3,114	3,792,850	42,563
1880	91,293	4,233	3,655,920	32,726	16,154	3,269	4,602,546	52,120
1881	99,431	4,676	3,201,880	30,195	75,465	14,648	3,414,704	46,069
1882	159,281	7,915	3,789,586	34,136	18,293	2,821	5,530,204	68,106
1883 (*a*)	137,978	6,143	1,549,968	13,788	6,972	885	7,022,615	90,593

a Since 1883 classified as "dry" and "ground in oil."

Imports of ocher of all kinds from 1884 to 1891.

Years ended—	Dry.		Ground in oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
June 30, 1884	6,164,359	$63,973	108,966	$4,717	6,273,325	$68,690
1885	4,983,701	51,499	79,666	3,616	5,063,363	55,115
Dec. 31, 1886	4,939,183	53,593	112,784	6,574	5,051,967	60,167
1887	5,957,200	58,162	54,104	7,337	6,011,304	65,499
1888	6,574,608	64,123	43,142	9,690	6,617,750	73,813
1889	5,540,267	52,502	51,063	9,072	5,591,330	61,574
1890	....	....	....	....	6,471,863	71,953
1891	6,246,890	63,040	52,206	5,272	6,299,096	68,312

Imports of umber from 1867 to 1891.

Years ended—	Quantity.	Value.	Years ended—	Quantity.	Value.
	Pounds.			*Pounds.*	
June 30, 1867	2,147,342	$15,946	June 30, 1880	1,877,645	$17,271
1868	345,173	2,750	1881	1,475,835	11,126
1869	570,771	6,159	1882	1,923,648	20,494
1870	708,825	6,313	1883	785,794	8,419
1871	470,392	7,064	1884	2,946,675	20,654
1872	1,409,822	18,203	1885	1,198,060	8,504
1873	845,601	8,414	Dec. 31, 1886	1,262,930	9,187
1874	729,864	6,200	1887	2,385,281	16,536
1875	513,811	5,596	1888	1,423,800	14,684
1876	681,199	7,527	1889	1,555,070	20,887
1877	1,101,422	10,213	1890	1,556,823	19,329
1878	1,038,880	8,302	1891	633,291	6,498
1879	986,105	6,959			

Metallic paint.—California, Delaware, New Jersey, New York, Ohio, Pennsylvania, Tennessee, Vermont, Virginia, and Wisconsin contributed to the product, which amounted to 25,142 short tons, worth $334,455. In order of importance, Pennsylvania ranked first with a total product of 9,175 short tons, valued at $134,138, and New York second with 7,352 tons, worth $99,487, the two States contributing nearly two-thirds the total product. The output was slightly in excess of that of 1890, the increase in quantity being 943 short tons, but the value fell off $6,784. This shows a decrease in the average value per ton from $14.08 to $13.28. Although prices were usually lower, the general demand was reported good. Colorado did not produce any metallic paint, the sales for the year being made from old stock, and Delaware and Virginia appear for the first time as producers. Compared with 1889 and 1890, the product by States was as follows:

Production of metallic paint in 1889, 1890, and 1891, by States.

States.	1889.		1890.		1891.	
	Product.	Value.	Product.	Value.	Product.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Alabama	3,000	$30,000	....	....	....	....
California	....	....	40	$480	22	$880
Colorado	90	2,500	1,300	22,100	....	....
Delaware	....	....	....	....	73	1,097
New Jersey	....	....	10	130	867	13,178
New York	3,658	63,698	5,224	72,952	7,352	99,487
Ohio	540	11,123	637	16,341	800	14,500
Pennsylvania	8,849	128,036	8,955	145,243	9,175	134,138
Tennessee	3,507	24,237	5,386	46,088	4,000	30,000
Virginia	....	....	....	....	110	1,800
Vermont	....	....	500	6,000	400	5,000
Wisconsin	1,832	26,700	2,125	31,035	2,343	34,375
Total	21,026	286,294	24,177	340,369	25,142	334,455

Increased facilities, etc.—The improvements made in the way of adding new machinery, opening new properties, etc., have been reported as follows: In California by the addition of a pulverizer and dust collector, bolting reels, conveyors, etc. In New Jersey one firm increased its capacity for preparing ready mixed paint 200 per cent. and its calcining department 25 per cent. Another firm reports the bursting of its boiler and other accidents to machinery which lessened the output. One firm in New York reports 25 per cent. increase in capacity. In Ohio two companies went out of existence, the other companies reporting increased sales. In Wisconsin one operator reports extended development of property and the introduction of machinery which will decrease expenses 50 per cent. Another company put in new boiler and grinding machinery, but the entire works were destroyed by fire the latter part of September and the affairs of the company put in the hands of an assignee. A third correspondent reports 20 per cent. increase in capacity. In no instance have operators reported loss of time by reason of strikes.

Venetian reds.—The product was about the same as in 1890, being 4,191 short tons, worth $90,000.

Soapstone.—For the first time a report is received of soapstone used as a pigment, 25 tons being ground for that purpose, and worth, dry, $200.

White lead.—The product of white lead in 1891 was, approximately, 156,036,131 pounds, or 78,018 short tons, a slight increase over 1890 when the product was 155,272,115 pounds, or 77,636 tons. As a result of the consolidation of a number of producers, under the management of one company known as the National Lead Company of New York, the market value advanced from about an average of 6 cents per pound in 1890 to nearly 7 cents in 1891, the total increase in value being $1,071,062, or from $9,382,967 to $10,454,029. The National Lead Company, with its numerous branches, produced about 80 per cent. of the total, the other 20 per cent. being distributed among eight independent concerns.

Red lead, litharge, and orange mineral.—The amount of red lead produced in 1891 was 9,214,286 pounds (or 4,607 tons), against 11,821,084 pounds (or 5,911 tons) in 1890, a decrease of 2,606,798 pounds. The value of the product in 1891 was $591,730 against $726,844 in the preceding year. The production of litharge increased from 10,230,090 pounds, valued at $665,631 in 1890, to 11,517,299 pounds, worth $720,925. Of orange mineral there were produced in 1891, 660,000 pounds, worth $43,300, against 730,000 pounds, valued at $48,000 in 1891.

Red lead, white lead, and litharge imported from 1867 to 1891.

Year ended—	Red lead.		White lead.		Litharge.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
June 30, 1867	926,843	$53,087	6,636,508	$430,805	230,382	$8,941
1868	1,201,144	76,773	7,533,225	455,698	250,615	12,225
1869	808,686	46,481	8,948,642	515,783	187,333	7,767
1870	1,042,813	54,626	6,228,285	365,706	97,398	4,442
1871	1,295,616	78,410	8,337,842	483,392	70,889	3,870
1872	1,513,794	85,644	7,153,978	431,477	66,544	3,396
1873	1,583,089	99,891	6,331,373	408,986	40,799	2,379
1874	756,644	56,305	4,771,509	323,926	25,687	1,440
1875	1,048,713	73,131	4,354,131	295,642	15,767	950
1876	749,918	54,884	2,546,766	175,776	47,054	2,562
1877	387,260	28,747	2,644,184	174,844	40,331	2,347
1878	170,608	9,364	1,759,608	113,638	28,190	1,499
1879	143,237	7,237	1,274,196	76,061	38,495	1,667
1880	217,033	10,397	1,906,931	107,104	27,389	1,222
1881	212,423	10,009	1,068,030	60,132	63,058	2,568
1882	288,946	12,207	1,161,889	64,493	54,592	2,191
1883	249,145	10,503	1,044,478	58,588	34,850	1,312
1884	265,693	10,589	902,281	67,918	54,183	1,797
1885	216,449	7,641	705,535	40,437	35,283	1,091
Dec. 31, 1886	597,247	23,038	785,554	57,340	51,409	1,831
1887	371,299	16,056	804,320	58,602	35,908	1,302
1888	529,665	23,684	627,900	49,903	62,211	2,248
1889	522,026	24,400	661,694	56,875	41,230	1,412
1890	450,402	20,718	742,196	57,659	48,283	2,146
1891	651,577	23,807	718,228	40,773	94,586	3,108

BARYTES.

Owing to the irregular manner in which the mining of barytes is carried on in Missouri it is exceedingly difficult to obtain a correct statement of the product by correspondence, the only available means of collecting the statistics. In the first place, the greater part of the mining is performed by farmers at seasons of the year when they and their employés and teams would be otherwise idle. In some instances the product is shipped to St. Louis or other points by the miners; at other times it is taken to local merchants and exchanged for merchandise, and by the merchants shipped to the manufacturer. Some persons both mine and purchase, and the conditions are such that frequent duplications are apt to result. It has been endeavored by correspondence with miners, dealers, and manufacturers to secure a fairly reliable statement of the output, eliminating such returns as are doubtless duplicates. This shows the product of the State to have been 12,000 tons in 1891, worth $60,000, the value being taken at the price paid per ton for the crude barytes by the manufacturers.

The product in Virginia increased from 11,528 tons in 1890, to 17,013 tons in 1891. The value, crude, of the product in 1891, was $52,765. North Carolina and South Carolina produced together 2,056 tons, worth $5,688 at the mines. It has been the custom in preceding volumes to give the value of the crude barytes and in order to maintain uniformity in the reports this is maintained. The barytes of commerce, however, is that which has been cleaned and floated and represents a much greater value than that of the crude. The value of floated barytes sold in the United States (exclusive of that made from foreign sources) was not short of $325,000.

The use of barytes as a pigment began about forty years ago. Its principal use to-day is in a mixture of white lead. There can be little doubt that its use is growing and still further increase in production may be expected.

Production of crude barytes from 1882 to 1891.

Years.	Quantity.	Value.
	Short tons.	
1882	22,400	$80,000
1883	30,240	108,000
1884	28,000	100,000
1885	16,800	75,000
1886	11,200	50,000
1887	16,800	75,000
1888	22,400	110,000
1889	21,460	106,313
1890	21,911	86,505
1891	31,069	118,363

Imports of barium sulphate from 1867 to 1891.

Years ended—	Manufactured.		Unmanufactured.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*	
June 30, 1867	14,968,181	$141,273		
1868	2,755,547	26,739		
1869	1,117,335	8,565		
1870	1,684,916	12,917		
1871	1,385,004	9,769		
1872	5,804,098	43,521		
1873	6,939,425	53,759		
1874	4,788,966	42,235		
1875	2,117,854	17,995		
1876	2,655,349	25,325		
1877	2,388,373	19,273		
1878	1,366,857	10,340		
1879	453,333	3,496		
1880	4,924,423	37,374		
1881	1,518,322	11,471		
1882	562,300	3,856		
1883	411,666	2,489		
Dec. 31, 1884	3,884,516	24,671	5,800,816	$8,044
1885	4,095,287	20,606	7,841,715	13,567
1886	3,476,691	18,338	6,588,872	8,862
1887	4,057,831	19,769	10,190,848	13,205
1888	3,821,842	17,135	6,504,975	9,037
1889	3,601,506	22,458	13,571,206	7,660
1890				
1891	2,149	22,041	2,900	8,816

MINERAL WATERS.

By A. C. Peale.

For the year 1891 our list of commercial mineral springs numbers 288, which is an increase of 15 since 1890. Of these, however, only 227 report, leaving a delinquent list of 61 springs.

As in the report for the previous year, the figures for these delinquent springs are taken at one-half the production they last reported. The springs that do report had increased sales.

The total product for 1891, including the estimate as above for the delinquent springs, is 18,392,732 gallons, at a valuation of $2,996,259. This is an increase of 5,385,314 gallons and $416,509 over the figures for 1890.

In the north Atlantic states the total number of springs on the list is 74, instead of 69, as in 1890. This increase is due to the fact that 1 new spring is added and that 4 springs, which for several years had made no report and were taken from the list, have now been placed upon it again. There has also been an increase in production; 681,678 gallons more were sold in 1891 than in 1890, with an increase of $416,234 in the value of the product.

The south Atlantic states also show an increased number of springs, the number for 1891 being 56, an increase of 5 from 1890. Two of these, the Takoma Park springs of Maryland and the Magnolia springs of Florida, are entirely new to the list. The other three were on the list in 1888, but have not reported since. There is an increase of 148,814 gallons for the section, with an increase in value of $67,683.

The total number of springs for the north central states is 87 for 1891, an increase of 2 from 1890. As a matter of fact there is an increase of 3, while 1 had been taken from the old list. However, the increase in the number of gallons is 2,960,143, with a decrease of $255,590 in the value of the production. The increase is due mainly to the increased number of gallons sold from the Michigan springs.

The net increase in the springs of the south central states is 1. One spring each is added for Tennessee and Mississippi and 1 taken from Texas. The increase in production is 24,444 gallons, with an increased value of $24,596.

In the western division, Montana, for the first time on the list, adds 1 spring, making the total 34 instead of 32 as for 1890. There is an increase of 254,136 gallons and an increase of $160,986 in value.

PRODUCTION.

Natural mineral waters sold from 1883 to 1891, inclusive.

	Springs reporting.	Gallons sold.	Value.
1883.			
North Atlantic states	38	2,470,670	$282,270
South Atlantic states	27	312,090	64,973
Northern central states	37	1,435,809	323,600
Southern central states	21	1,441,042	139,973
Western states and territories	6	169,812	52,787
	129	5,829,423	863,603
Estimated	60	1,700,000	256,000
Total	189	7,529,423	1,119,603
1884.			
North Atlantic states	38	3,345,760	328,125
South Atlantic states	27	464,718	103,191
Northern central states	37	2,070,533	420,515
Southern central states	21	1,526,817	147,112
Western states and territories	6	307,500	85,200
	129	7,715,328	1,084,143
Estimated	60	2,500,000	375,000
Total	189	10,215.328	1,459,143
1885.			
North Atlantic states	51	2,527,310	192,605
South Atlantic states	32	908,692	237,153
Northern central states	45	2,925,288	446,211
Southern central states	31	540,436	74,100
Western states and territories	10	509,675	86,776
	169	7,411,401	1,036,845
Estimated	55	1,737,000	276,000
Total	224	9,148,401	1,312,845
1886.			
North Atlantic states	49	2,715,050	177,969
South Atlantic states	38	720,397	123,517
Northern central states	40	2,048,914	401,861
Southern central states	31	822,016	58,222
Western states and territories	14	781,540	137,796
	172	7,087,917	899,365
Estimated	53	1,862,400	384,705
Total	225	8,950,317	1,284,070
1887.			
North Atlantic states	40	2,571,004	213,210
South Atlantic states	34	614,041	147,149
Northern central states	38	1,480,820	208,217
Southern central states	29	741,080	87,946
Western states and territories	12	1,236,324	288,737
	153	6,643.269	945,259
Estimated	62	1,616,340	316,204
Total	215	8,259,609	1,261,463
1888.			
North Atlantic states	42	2,856,799	247,108
South Atlantic states	32	1,689,387	493,489
Northern central states	38	2,002,373	325,839
Southern central states	19	426,410	71,215
Western states and territories	15	1,853,679	421,651
	146	8,828,648	1,559,302
Estimated	52	750,000	120,000
Total	198	9,578,648	1,679,302

Natural mineral waters sold from 1883 to 1891, inclusive—Continued.

	Springs reporting.	Gallons sold.	Value.
1889.			
North Atlantic states	60	4,106,464	$471,575
South Atlantic states	47	646,239	198,032
Northern central states	86	6,137,776	604,238
Southern central states	33	500,000	43,356
Western states and territories	32	1,389,992	431,257
Total	258	12,780,471	1,748,458
1890.			
North Atlantic states	55	5,043,074	1,175,512
South Atlantic states	39	647,625	245,760
Northern central states	71	5,050,413	737,672
Southern central states	30	604,571	81,426
Western states and territories	25	869,504	253,578
	220	12,215,187	2,493,948
Estimated	52	1,692,231	106,802
Total	272	13,907,418	2,600,750
1891.			
North Atlantic states	62	5,724,752	1,591,746
South Atlantic states	41	796,439	313,443
Northern central states	68	8,010,556	482,082
Southern central states	29	629,015	106,022
Western states and territories	27	1,123,640	414,564
	227	16,284,402	2,907,857
Estimated	61	2,108,330	88,402
Total	288	18,392,732	2,996,259

Production of mineral waters for 1891, by States and Territories.

States and territories.	Number of springs reporting.	Product.	Value of product.
		Gallons.	
Alabama	3	14,000	$17,010
Arkansas	5	128,905	31,490
California	12	334,533	135,959
Colorado	8	481,038	133,222
Connecticut	4	25,300	15,960
Florida	2	25,000	9,250
Georgia	3	81,500	27,300
Illinois	5	127,500	13,725
Indiana	10	689,900	37,450
Iowa	2	24,000	2,750
Kansas	7	1,402,544	18,201
Kentucky	5	90,200	10,230
Maine	6	510,518	78,112
Maryland	3	25,600	2,590
Massachusetts	9	841,062	115,591
Michigan	8	2,228,575	149,773
Missouri	6	51,000	6,010
Mississippi	3	31,500	5,410
New Hampshire	3	960,000	502,000
New Mexico	3	32,650	9,700
New York	23	2,779,472	796,047
North Carolina	5	67,146	45,851
Ohio	8	99,920	18,374
Pennsylvania	11	485,250	73,376
Rhode Island	2	79,000	2,335
Tennessee	3	93,000	18,750
Texas	10	271,410	23,132
Vermont	4	44,150	8,325
Virginia	21	534,293	215,392
Washington	2	125,000	63,500
West Virginia	6	31,600	6,800
Wisconsin	20	2,882,117	184,133
Other states (*a*)	5	686,719	130,109
Total	227	18,392,732	2,996,259

a Idaho, Montana, Nebraska, South Carolina, South Dakota.

Alabama.—The three springs reporting sales for 1891 give a slight increase over the figures for 1890. These springs are: Bailey Springs, Bailey Springs, Lauderdale county; Healing Springs, Healing Springs, Washington county; Matchless Mineral Water, Greenville, Butler county.

Arkansas.—The list for 1891 remains the same as for the previous year. The following are the springs reporting, and the figures are increased from those of 1890: Arkansas Lithia Springs, Hope, Hempstead county; Fairchild's Potash Sulphur Springs, Hot Springs, Garland county; Mountain Valley Springs, Mountain Valley, Garland county; Dovepark Springs, Dovepark, Hot Spring county; Eureka Springs, Eureka Springs, Carroll county.

California.—There is no change in the list so far as the number and names of the springs are concerned. The following of the total of 14 report sales for 1891: Azule Seltzer Springs, San Jose, Santa Clara county; Bartlett Springs, Bartlett Springs, Lake county; Castalian Mineral Water, Inyo county; Coronado Natural Mineral Water, Coronado, San Diego county; El Toro Springs, Nevata, Marin county; Geyser Soda and Litton Seltzer Springs, Litton Springs, Sonoma county; Napa Soda Springs, Napa Soda Springs, Napa county; Ojai Hot Springs, Ventura, Ventura county; Pacific Congress Springs, Saratoga, Santa Clara county; Paraiso Springs, Monterey county; Tuscan Springs, Red Bluff, Tehama county; Witter Springs, Upper Lake, Lake county.

Colorado.—Eight of Colorado's commercial springs report as follows: Boulder Springs, Boulder Springs, Boulder county; Cañon City Vichy and Iron Duke Springs, Cañon City, Fremont county; Clark Magnetic Mineral Spring, Pueblo, Pueblo county; Colorado Carlsbad Mineral Water, Denver, Arapahoe county; Idaho Mineral Springs, Central City, Gilpin county; Manitou, Navajo, and Shoshone Springs, Manitou, El Paso county; Seltzer Springs, Boulder, Boulder county; Ute and Little Chief Iron Springs, Manitou, El Paso county.

Connecticut.—Four springs report for 1891, two more than were on the list for 1890. The springs reporting are: Aspinock Springs, Putnam Heights, Windham county; Highland Rock Spring, Manchester, Hartford county; Highland Tonica Spring, Manchester, Hartford county; Stafford Mineral Spring, Stafford Springs, Tolland county.

Florida.—The two springs in Florida reporting sales are: Cantonent Spring, Pensacola, Escambia county; Magnolia Springs, Magnolia Springs, Clay county.

Georgia.—Only three of the four springs on the list report for 1891. They are: Bowden Lithia Springs, Lithia Springs, Douglas county; Hughes Springs, Rome, Floyd county; Ponce de Leon Spring, Atlanta, Fulton county.

Idaho.—This state is still represented on the list by the Idanha Springs, of Soda Springs, in Bingham county.

Illinois.—Five of the nine springs on the list report sales. They are the following: Black Hawk Springs, Rock Island, Rock Island county; Diamond Mineral Springs, Grantfork, Madison county; Peoria Magnetic Artesian Spring, Peoria, Peoria county; Perry Springs, Perry Springs, Pike county; Sanicula Springs, Ottawa, La Salle county.

Indiana.—All of Indiana's springs report sales. They are: Abbott Magnetic and Mineral Water, East Wayne, Allen county; Ash Iron Springs, Muddy Fork, Clark county; Elliot's Mineral Spring, Shoals, Martin county; French Lick Springs, French Lick, Orange county; Indiana Mineral Springs, Indiana Mineral Springs, Warren county; Kickapoo Magnetic Springs, Kickapoo, Warren county; King's Mineral Spring, Muddy Fork, Clark county; Lodi Artesian Well, Silverwood, Fountain county; Magnetic Mineral Springs, Terre Haute, Vigo county; West Baden Springs, West Baden, Orange county.

Iowa.—One spring is taken from the list, leaving the total number five, of which only two report as follows: Black Hawk Springs, Eldon, Davis county; Ottumwa Mineral Springs, Ottumwa, Wapello county.

Kansas.—No change is made in the total number of springs, which remains at eight, of which seven report. They are: Blazing's Artesian Mineral Springs, Manhattan, Riley county; Geuda Mineral Spring, Geuda Springs, Cowley county; Great Spirit Springs, Cawker City, Mitchell county; Iola Mineral Well, Iola, Allen county; Providence Mineral Wells, Providence, Butler county; Topeka Mineral Wells, Topeka, Shawnee county; Wichita Mineral Springs, Wichita, Sedgwick county.

Kentucky.—All of the springs on the list for this state report. They are: Anita Springs, La Grange, Oldham county; Bedford Springs, Bedford, Trimble county; Blue Lick Springs, Blue Lick Springs, Nicholas county; Crab Orchard Springs, Crab Orchard, Lincoln county; St. Patrick's Well, Louisville, Jefferson County.

Maine.—Four springs send no report for 1891. The following report sales: Barker Mill Spring, Auburn, Androscoggin county; Crystal springs, Auburn, Androscoggin county; Keystone Spring, East Poland, Androscoggin county; Poland Spring, South Poland, Androscoggin county; Underwood Springs, Falmouth Foreside, Cumberland county; Wilson Springs, North Raymond, Cumberland county.

Maryland.—One new spring is added to the list, viz, the Tacoma Park Springs, making a total of four for the state. Of the others only the two following report: Chatoolanee Mineral Spring, Chatoolanee, Baltimore county; Flintstone Mineral Springs, Flintstone, Allegany county.

Massachusetts.—All of the springs on the list report for 1891. They are: Allandale Springs, West Roxbury, Suffolk county; Belmont Hill Spring, Everett, Middlesex county; Belmont Natural Spring, Belmont, Middlesex county; Commonwealth Mineral Spring, Waltham, Middlesex county; Echo Grove Springs, Lynn, Essex county; Everett Crystal

Spring, Everett, Middlesex county; Sheep Rock Spring, Lowell, Middlesex county; Simpson Spring, South Easton, Bristol county; Undine Spring, Brighton, Suffolk county.

Michigan.—Two springs are added to the list which were not on the list for 1890. They are: The Moorman Well, Ypsilanti, Washtenaw county, and Mount Clemens Sprudel Water, Mount Clemens, Macomb county. One spring is delinquent, and in addition to the two new springs the following report: Americanus Well, Lansing, Ingham county; Eastman Springs, Benton Harbor, Berrien county; Magnetic Mineral Springs, Spring Lake, Ottawa county; Mount Clemens Original Mineral Springs, Mount Clemens, Macomb county; Salutaris Springs, Saint Clair Springs, Saint Clair county; Zauber Wasser Spring, Hudson, Lenawee county.

Minnesota.—One spring, the Inglewood Springs, Minneapolis, Hennepin county, still constitutes the representation of this state upon the list.

Missouri.—One more spring is delinquent for 1891 than for 1890. Of the ten springs on the list six report as follows: B. B. Spring, Bowling Green, Pike county; Blue Lick Spring, Sedalia, Saline county; Eldorado Springs, Cedar county; Paris Springs, Paris Springs, Lawrence county; Randolph Springs, Randolph Springs, Randolph county; Reiger Springs, Lineville, Mercer county.

Mississippi.—Godbold Mineral Well, Summit, Pike county, is added to the list. In addition to this the following report: Brown's Wells, Brown's Wells, Copiah county; Castalian Springs, Durant, Holmes county.

Montana.—For the first time Montana is represented on our list. The only commercial spring so far as known is Pipestone Springs, Jefferson county.

Nebraska.—The Victoria Mineral Spring, of New Helena, Custer county, is still the only spring on the list for Nebraska.

New Hampshire.—There is no change in the list for New Hampshire. The following springs report: Conway Springs, Conway, Carroll county; Londonderry Lithia Springs, Londonderry, Rockingham county; Ponemah Spring, Amherst Station, Hillsboro county.

New Jersey.—No report has been received from the one spring of New Jersey.

New Mexico.—Three of the four springs credited to the territory report sales. They are: Aztec Springs, Santa Fe, Santa Fe county; Ojo Caliente Springs, Ojo Caliente, Taos county; Soda Springs, Coyote Canon, Bernalillo county.

New York.—Twenty-three of the twenty-nine springs on the list report for 1891. Of these, four were not on the list for the preceding year. They are: Kadawisda Spring, Star Spring, Victor Spring, and Verona Springs. All the springs reporting are: Artesian Lithia Springs, Ballston Spa, Saratoga county; Avon Spring, Avon, Cayuga county; Cayuga Water, Cayuga, Cayuga county; Deep Rock Springs, Oswego,

Oswego county; Kadawisda Spring, Clinton, Oneida county; Massena Springs, Massena, St. Lawrence county; Miller's Geneva Mineral Spring, Geneva, Ontario county; Oak Orchard Acid Springs, Alabama, Genesee county.

Star Springs, Verona Springs, Verona Springs, Oneida county; Victor Springs, Darien, Genesee county; White Sulphur Springs, Sharon Springs, Schoharie county; White Sulphur Springs, Richfield Springs, Otsego county.

Saratoga Springs, Saratoga, county.—Champion Springs, Empire Springs, Excelsior Springs, Hathorn Springs, High Rock Springs, Imperial Springs, Royal or New Putnam Spring, Saratoga Carlsbad Spring, Saratoga Vichy Springs, Saratoga Kissengen Spring.

North Carolina.—Only five of the springs for the state report instead of six as in the previous year. They are: Ashley's Bromine and Arsenic Spring, Ashe county; Barium Springs, Barium, Iredell county; Lemon Springs, Lemon Springs, Moore county; Lincoln Lithia Springs, Lincolnton, Lincoln county; Thompson's Bromine Arsenic Spring, Crumpler, Ashe county.

Ohio.—There is no change from the statistics of 1890. The following springs report for 1891: Adams County Mineral Spring, Mineral Springs, Adams county; Crystal Mineral Spring, Urban, Champaign county; Electro-Magnetic Springs, Fountain Park, Champaign county; Devonian Mineral Spring, Lorain, Lorain county; Magnetic and Saline Spring, Marysville, Union county; Rex Mineral Water, New Richmond, Clermont county; Ripley Bromo-Lithia Spring, Ripley, Brown county; Sulphur Lick Spring, Frankfort, Ross county.

Oregon.—No reports have been received for Oregon's two springs.

Pennsylvania.—All of the commercial springs of Pennsylvania, so far as they are known, have reported. They are: Bedford Springs, Bedford, Bedford county; Black Barren Mineral Spring, Pleasant Grove, Lancaster county; Corry Artesian Mineral Water, Corry, Erie county; Cresson Springs, Cresson, Cambria county; Eureka Mineral Springs, Saegertown, Crawford county; Parker Magnetic Mineral Spring, Gardeau, McKean county; Pavilion Springs, Reading, Berks county; Pulaski Mineral Spring, Pulaski, Lawrence county; Ross-Common Springs, Ross-Common, Monroe county; Sizerville Magnetic Mineral Spring, Sizerville, Cameron county; Susquehanna Springs and Kingland Spring, Rush, Susquehanna county.

Rhode Island.—Both of the springs on our list report. They are: Holly Springs, Woonsocket, Providence county; Ochee Mineral and Medical Springs, Johnston, Providence county.

South Carolina.—The only spring reporting for the state was not upon the list for 1890. It is Garrett Springs, Spartanburg, Spartanburg county.

South Dakota.—South Dakota is still represented only by the Dakota Hot Springs of Hot Springs, Fall River county.

Tennessee.—One new spring is added to the list, viz: Hurricane Springs reports for the first time. The springs reporting are: Hurricane Springs, Tullahoma, Franklin county; Idaho Springs, St. Bethlehem, Montgomery county; Tate Spring, Tate Spring, Grainger county.

Texas.—One spring is dropped from the list for 1891 and of the thirteen remaining the following ten report: Capp's Well, Longview, Gregg county; Elkhart Mineral Well, Elkhart, Anderson county; Hynson's Iron Mountain Spring, Marshall, Harrison county; Mineral Wells, Mineral Wells, Palo Pinto county; Montvale Springs, Marshall, Harrison county; Overall Mineral Well, Franklin, Robertson county; Slack's Well, Walder Depot, Gonzales county; Texas Sour Springs, Luling, Caldwell county; Tioga Mineral Well, Grayson county; Wooten Wells, Wooten Wells, Robertson county.

Vermont.—There is no change in the list for Vermont. The following are the springs that report: Alburgh Springs, Alburgh Springs, Grand Isle county; Brunswick White Sulphur Spring, Brunswick, Essex county; Clarendon Springs, Clarendon, Rutland county; Missisquoi Springs, Sheldon, Franklin county.

Virginia.—Two springs not on the list for 1890 report. They are: Chase City and Healing Springs. The following twenty-one of the twenty-five springs report: Blue Ridge Springs, Blue Ridge Springs, Botetourt county; Buffalo Lithia Springs, Buffalo Lithia Springs, Mecklenburg county; Chase City Chlorine Spring, Chase City, Mecklenburg county; Cove Lithia Springs, Wytheville, Wythe county; Elk Lithia Springs, Elkton, Rockingham county; Farmville Lithia Springs, Farmville, Cumberland county; Healing Springs, Healing Springs, Bath county; Hunter's Pulaski Alum Springs, Walkers Creek, Pulaski county; Massanetta Springs, Harrisonburg, Rockingham county; Otterburn Lithia and Magnetic Spring, Amelia, Amelia county; Osceola Springs, Harrisonburg, Rockingham county; Pæonian Spring, Clarks Gap, Loudoun county; Roanoke Red Sulphur Spring, Catawba, Roanoke county; Rockbridge Alum Springs, Goshen, Rockbridge county; Rockingham Springs, McGaheysville, Rockingham county; Seven Springs, Abingdon, Washington county; Stribling Springs, Stribling Springs, Augusta county; Shenandoah Alum Springs, Mount Jackson, Shenandoah county; Virginia Arsenic, Bromine, and Lithia Spring, Christiansburg, Montgomery county; Wallawhatoola Alum Springs, Richmond, Bath county; Wolf Trap Lithia Springs, Wolf Trap Station, Halifax county.

Washington.—There is no change in the list for the state of Washington. The springs reporting are: Medical Lake Springs, Medical Lake, Spokane county; Yakima Soda Springs, North Yakima, Yakima county.

West Virginia.—The list for 1891 shows no change from that of 1890 for West Virginia. The springs reporting are: Capon Springs, Capon Springs, Hampshire county; Irondale Springs, Independence, Preston county; Red Sulphur Springs, Monroe county; Salt Sulphur Springs, Salt Sulphur Springs, Monroe county; Triplet Springs, Grant district, Pleasants county; White Sulphur Springs, White Sulphur Springs, Greenbrier county.

Wisconsin.—Twenty of the twenty-three springs credited to Wisconsin report sales in 1891. They are: Allouez Magnesia Spring, Green Bay, Brown county: Bethania Mineral Spring, Osceola Mills, Polk county; Darlington Mineral Water, Darlington, Lafayette county; Fort Crawford Spring Prairie du Chien, Crawford county; Lebeus Wasser Spring, Green Bay, Brown county; Nee-Ska-Ra Springs, Wauwatosa, Milwaukee county; Palmyra Springs, Palmyra, Jefferson county; Rainbow Mineral Springs, Wautoma, Waushara county; Salvator Mineral Spring, Green Bay, Brown county; Sheboygan Springs, Sheboygan, Sheboygan county; Silver Sand Spring, Milwaukee, Milwaukee county; Vita Mineral Spring, Beaver Dam, Dodge county.

Waukesha Springs, Waukesha county.—Almanaris Springs, Arcadian Springs, Bethesda Springs, Henk Mineral Spring, Horeb Mineral Spring, Mineral Rock Spring, Hygeia Mineral Spring, White Rock Mineral Spring.

Summary of reports of mineral springs for 1891 by States and Territories.

States and Territories.	Springs reporting.	Springs not reporting.	Total use commercially.	States and Territories.	Springs reporting.	Springs not reporting.	Total use commercially.
NORTH ATLANTIC STATES.				NORTH CENTRAL STATES.			
Maine	6	4	10	Ohio	8	2	10
New Hampshire	3	0	3	Indiana	10	0	10
Vermont	4	0	4	Illinois	5	4	9
Massachusetts	9	0	9	Michigan	8	1	9
Rhode Island	2	0	2	Wisconsin	20	3	23
Connecticut	4	1	5	Minnesota	0	1	1
New York	23	6	29	Iowa	2	3	5
New Jersey	0	1	1	Missouri	6	4	10
Pennsylvania	11	0	11	North Dakota	0	0	0
				South Dakota	1	0	1
SOUTH ATLANTIC STATES.				Nebraska	1	0	1
				Kansas	7	1	8
Delaware	0	0	0				
Maryland	3	2	5	WESTERN STATES AND TERRITORIES.			
District of Columbia	0	0	0				
Virginia	21	4	25				
West Virginia	6	0	6	Alaska	0	0	0
North Carolina	5	6	11	Wyoming	0	0	0
South Carolina	1	2	3	Montana	1	0	1
Georgia	3	1	4	Colorado	8	1	9
Florida	2	0	2	New Mexico	3	1	4
				Arizona	0	0	0
SOUTH CENTRAL STATES.				Utah	0	0	0
				Nevada	0	0	0
Kentucky	5	0	5	Idaho	1	0	1
Tennessee	3	3	6	Washington	2	1	3
Alabama	3	2	5	Oregon	0	2	2
Mississippi	3	0	3	California	12	2	14
Louisiana	0	0	0				
Texas	10	3	13	Total	227	61	288
Indian Territory	0	0	0				
Arkansas	5	0	5				
Oklahoma	0	0	0				

IMPORTS AND EXPORTS.

Imports.—Prior to 1884 natural mineral waters were not distinguished from artificial mineral waters, but since 1883 the distinction has been made, but the latter have not been classified according to the receptacles in which they were imported. The following tables give the importation of mineral waters, showing an increase in the importation of artificial waters, and a decrease in natural waters:

Mineral waters imported and entered for consumption in the United States, 1867 to 1883, inclusive.

Fiscal years ending June 30—	In bottles of 1 quart or less.		In bottles in excess of 1 quart.		Not in bottles.		All, not artificial.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Bottles.		*Quarts.*		*Gallons.*		*Gallons.*		
1867	370, 610	$24, 913	3, 792	$360	....	$137	....	....	$25, 410
1868	241, 702	18, 438	22, 819	2, 052	554	104	....	....	20, 594
1869	344, 691	25, 635	9, 739	802	1, 042	245	....	....	26, 682
1870	433, 212	30, 680	18, 025	1, 743	2, 063	508	....	....	32, 931
1871	470, 947	34, 604	2, 320	174	1, 336	141	....	....	34, 919
1872	892, 913	67, 951	....	....	639	116	....	....	68, 067
1873	35, 508	2, 326	....	....	355	75	394, 423	$98, 151	100, 552
1874	7, 238	691	....	....	95	16	199, 035	79, 789	80, 496
1875	4, 174	471	....	....	5	2	395, 956	101, 640	102, 113
1876	25, 758	1, 899	....	....	....	....	447, 646	134, 889	136, 788
1877	12, 965	1, 328	....	....	....	22	520, 751	167, 458	168, 808
1878	8, 229	815	....	....	....	....	883, 674	350, 912	351, 727
1879	28, 440	2, 352	....	....	3	4	798, 107	282, 153	284, 509
1880	207, 554	19, 731	....	....	....	....	927, 759	285, 798	305, 529
1881	150, 326	11, 850	....	....	55	26	1, 225, 462	383, 616	395, 492
1882	152, 277	17, 010	....	....	....	....	1. 542, 905	410, 105	427, 115
1883	88, 497	7, 054	....	....	....	....	1, 714, 085	441, 439	448, 493

Imports for years 1884 to 1891.

Years ended—	Artificial mineral waters.		Natural mineral waters.	
	Gallons.	Value.	Gallons.	Value.
June 30, 1884	29, 366	$4, 591	1, 505, 298	$362, 651
1885	7, 972	2, 157	1, 660, 072	397, 875
Dec. 31, 1886	62, 464	16, 815	1, 618, 960	354, 242
1887	13, 885	4, 851	1, 915, 511	385, 906
1888	12, 752	4, 411	1, 716, 461	341, 695
1889	36, 494	8, 771	1, 558, 968	368, 661
1890	22, 328	7, 133	2, 322, 008	433, 281
1891	26, 700	8, 700	2, 019, 833	392, 894

Exports.—The exports of natural mineral waters from the United States from 1875 to 1884 varied in value from a minimum of $80 in 1876 to a maximum of $1,529 in 1879. Since 1884 there have been no exports of natural mineral waters reported.

The exports of artificial mineral waters are trifling.

INDEX.

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